GEOTECHNICAL INVESTIGATION REPORT
SOUTHEAST VALLEY REGIONAL DRAINAGE SYSTEM
DESIGN OF SANTAN CHANNEL - PHASE II
ADOT CONTRACT NO. 97-16
TRACS NO. H431401D
MARICOPA COUNTY, ARIZONA

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

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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

January 8, 1998

AEE Job No. 6-117-000356
Report No. 2

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

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January 8, 1998
AEE Job No. 6-117-000356
Report No. 2

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

Attention: **Jerome J. Zovne, Ph.D., P.E.**
Water Resources Section Manager

Gentlemen:

RE: **GEOTECHNICAL INVESTIGATION REPORT**
SOUTHEAST VALLEY REGIONAL DRAINAGE SYSTEM
DESIGN OF SANTAN CHANNEL - PHASE II
ADOT CONTRACT NO. 97-16
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Submitted herein is our Geotechnical Investigation Report for Phase II of the Santan Channel Project. The report provides the results of our field investigation and laboratory analyses, and presents recommended criteria for the design of Connector Channel A-2 and Outfall Channel A-3. This report incorporates review comments provided by the Arizona Department of Transportation (ADOT) Material Group, of our draft report No. 2, dated November 7, 1997.

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:

Lawrence A. Hansen, Ph.D., P.E.
Senior Vice President

And:

James D. Wilson, E.I.T.

c: Addressee (8)
mcb/J98-1/1-8-98

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APPENDIX

1.0 INTRODUCTION

This report is submitted pursuant to a geotechnical investigation made by AGRA Earth & Environmental, Inc. (AEE) of the Phase II portion of the Santan Drainage Channel project, located in the vicinity of Pecos Road and 56th Street in Chandler, Arizona. The purpose of the investigation was to examine the geotechnical profile beneath the proposed channel alignment in order to provide recommendations for design of Connector Channel A-2 and Outfall Channel A-3.

2.0 PROJECT DESCRIPTION

Details of the project were provided by Jerome J. Zovne, Ph.D., P.E., of HDR Engineering, Inc. (HDR). The Santan Channel Project will be a 10-kilometer (km) long stormwater collection and discharge channel system that will be part of the Southeast Valley Regional Drainage System. The system will consist of a series of concrete-lined channels, multi-barreled reinforced concrete box culverts, and pipe culverts which collect and deliver water to and from a celled drainage basin (Basin B). The project will consist of four design elements divided into three construction phases. The elements included in Phase II, which are addressed herein, include the following:

- Connector Channel A-2 will be a concrete-lined trapezoidal channel with a length of about 1.2 km. Its purpose will be to transport water from the pump station near Basin B (located just west of Kyrene Road and north of Pecos Road) to the Gila Drain Floodway via Outfall Channel A-3, located west of the I-10 Freeway.

- Outfall Channel A-3 is a 2 km (approximately) channel consisting of a multi-barreled reinforced concrete box culvert extending from 56th Street west on a line just north of Pecos Road to the west side of I-10. A concrete-lined trapezoidal channel will be constructed to the west side of the box culvert outlet located at the Gila Drain Floodway and parallel to I-10, extending southward to just north of Maricopa Road to a second multi-barreled reinforced concrete box culvert that discharges into the Gila Drain Floodway.

3.0 INVESTIGATION

3.1 FIELD INVESTIGATION

Nineteen test borings (Nos. 1 through 18 and 1A) were drilled on approximate 300 meter (m) centers along the Channel A-2 and A-3 alignments to depths of about 4.5 m below existing site grades. Boring No. 1A was drilled originally by AEE, to a depth of 10.8 m for the Salt River Project (SRP) at the northwest corner of Pecos Road and 56th Street (AEE Job No. 7-117-000268).

The borings were advanced using subcontracted Mobile B-61 and Failing F-10 drill rigs equipped with 203 millimeter (mm) O.D. hollow-stem auger. Standard penetration testing and open-end drive sampling were performed at selected intervals within the borings. Bulk samples of drill cuttings were also collected as needed. Included in Appendix A are logs of the borings and site plans showing the boring locations. The field investigation was supervised by Dennis C. Pickens, Engineering Technician of this firm.

Test Boring No. 15 was drilled within the proposed channel alignment in the vicinity of a known petroleum spill. Sampling was performed at approximately 1.5 m intervals in conformance with standard environmental sampling procedures. The samples were delivered to Columbia Analytical Services, Inc. (CAS) for testing of hydrocarbons. Supervision of the drilling and sample preparation was performed by Elizabeth Judd, E.I.T., of this firm.

3.2 LABORATORY ANALYSIS

Moisture content, grain-size analysis, Atterberg limits, expansion, pH, chloride content and soluble sulfate tests were performed on selected samples. The moisture contents of selected soil samples are shown on the boring logs, presented in Appendix A. The remaining test results are presented in Appendix B. Samples collected within the upper 4.7 m within Boring No. 15 were submitted to CAS for laboratory analysis of total petroleum hydrocarbons (Test Method 418.1AZ). The results of the tests are presented in Appendix C.

4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 SITE CONDITIONS

The site is relatively flat, grading downward slightly to the southwest. Active farmland is present to the north of Pecos Road, between the Gila Drain and I-10 Freeway, and to the west of I-10. The Gila River Indian Community (GRIC) is located to the south of Pecos Road.

4.2 GEOTECHNICAL PROFILE

The geotechnical profile underlying the project site to the depths investigated can be generalized as somewhat lenticular deposits of fine-grained silty and sandy clay interbedded with coarser grained silty to clayey sand and gravelly sand.

The finer grained soils are generally moderately firm to hard in consistency, exhibit low to medium plasticity and contain zones that are weakly to strongly cemented with calcium carbonate. The

coarser grained soils typically are medium dense to very dense, nonplastic to medium in plasticity, and uncemented to weakly cemented with calcium carbonate.

4.3 GROUNDWATER CONDITIONS

Groundwater was not encountered to the depth of investigation in any of the borings performed for Phase II of this project. The soil moisture conditions were described as slightly moist to moist and moisture contents varied from 2 to 15 percent. The depth to groundwater in the general project site vicinity, based on maps presented by Hammet and Herther (1995)*, varies from about 33 to 42 m below the existing ground surface.

5.0 DISCUSSION & RECOMMENDATIONS

The project will consist of both box culverts and open concrete-lined trapezoidal channels. Presented in the following sections are recommendations regarding foundation support of the box culverts and criteria for the design of sloped embankment channels.

5.1 EARTH PRESSURES AGAINST BOX CULVERTS

The earth pressures imposed on the top, bottom and sides of buried, rigid, reinforced concrete box culverts are dependent upon support conditions, the placement and density of backfill, and the surcharge due to roadways or embankments above the box culverts. Design methods presented by Quigley and Duncan (1978) are recommended for calculating earth pressures and have been utilized in formulating the recommendations presented below.

The recommended earth pressures are based on the following assumptions:

- The backfill material surrounding the culvert structure is as dense as the in-place natural soils at the site. With this assumption, the problem is treated as a projection embankment condition, and therefore there is no trench effect or bottom effect on the structure.
- The depth below the culvert to an incompressible stratum is greater than twice the width of the culvert. The test borings in the general area indicated that the depth to bedrock, or strongly cemented zones of appreciable thickness, is greatly in excess of twice the culvert width.
- The unit weight of compacted backfill is 20.6 kilonewtons per cubic meter (kN/m^3).

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*References are listed at the end of this report.

The recommended pressure diagrams for the design of the box culvert sections are presented in Figure 1. Values for the crown pressure factor (N) and the edge pressure factor (m) can be interpolated from Figures 2 and 3, respectively, for the box culvert configuration which will be utilized. Alternatively, if it is desired to perform a less rigorous analysis, the simplified earth pressure diagram presented in Figure 4 may be used for design.

It is not anticipated that groundwater will need to be considered in the design of the box culverts.

5.2 WINGWALLS

Wingwalls for box culvert inlets and outlets likely will be conventional cantilever-type walls that will be separated structurally from the box culvert. 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 120 kilopascals (kPa) not be exceeded for footings bearing on native soils or properly compacted structure fill meeting the requirements of Section 203 of the Arizona Department of Transportation (ADOT) Standard Specifications (ADOT, 1996). Given the existing soil conditions, it is estimated that the total settlement of wingwall foundations will not exceed 19 millimeters (mm) for the above recommended soil bearing pressure. However, significant moisture fluctuations in the supporting clayey soils (where present) could result in additional vertical movements.

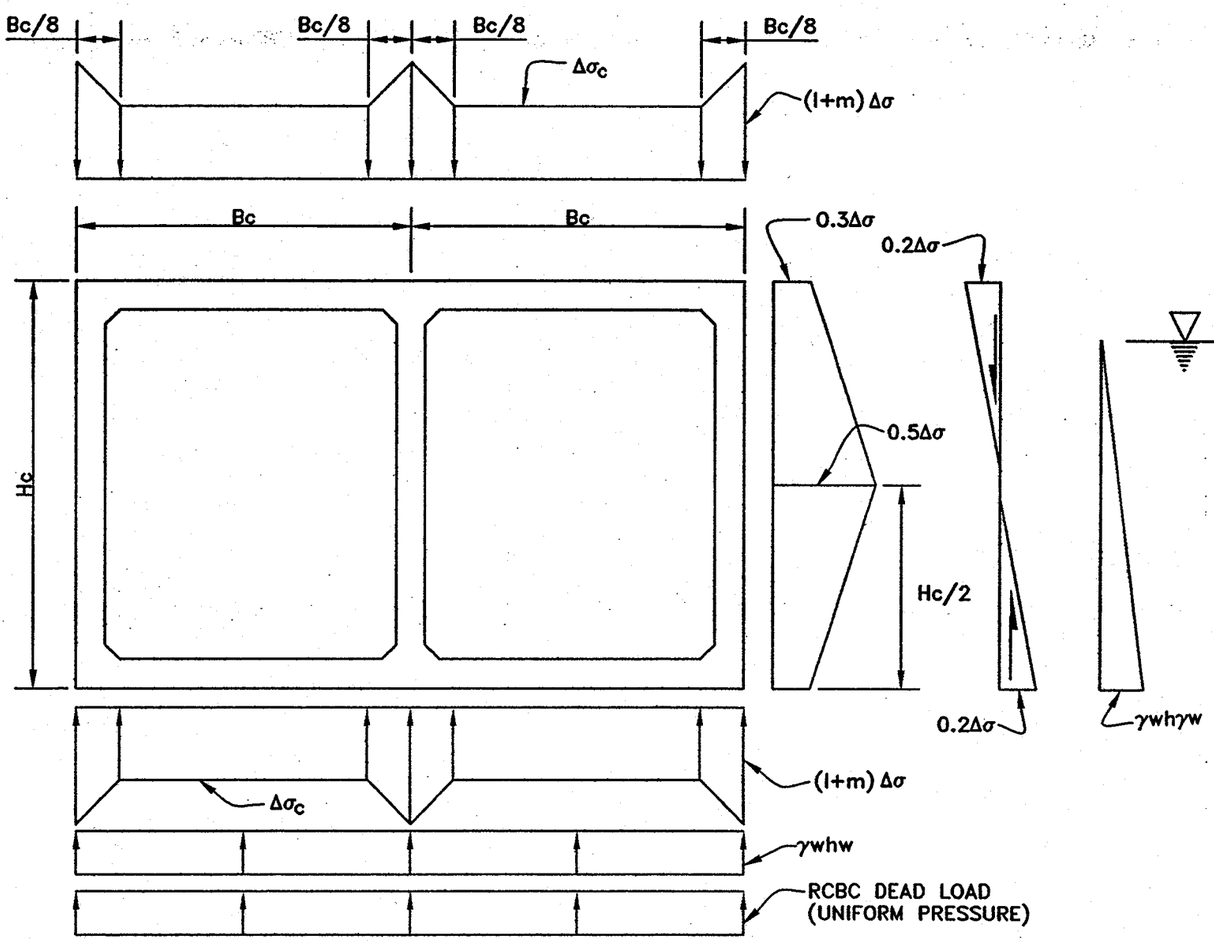
Free-draining granular backfill should be utilized behind wingwalls. This material should meet the requirements for Class 4 aggregate base material (ADOT, 1996). This material should be compacted to at least 95 percent of maximum dry density in accordance with Arizona Test Methods 225, 226 and 227.

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 7.9 kPa per meter 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 5.5 kPa per meter of depth. The recommended fluid pressures are based on the walls having horizontal backfill. If sloping backfills are used, modified pressures can be provided upon request.

5.3 CHANNEL & BOX CULVERT EXCAVATIONS

5.3.1 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 may be necessary in



$\Delta\sigma_c = \underline{N}H\gamma$
N = CROWN PRESSURE FACTOR
H = BACKFILL/OVERBURDEN DEPTH ABOVE RCBC CROWN
γ = UNIT WEIGHT OF BACKFILL
m = EDGE PRESSURE FACTOR
γw = UNIT WEIGHT OF WATER
hw = HEIGHT OF GROUND WATER TABLE ABOVE RCBC BASE

NOTE: PRESSURES SHOWN VALID ONLY IF DEPTH TO BEDROCK IS GREATER THAN OR EQUAL TO TWICE Bc.

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DRAWN	SLB
DATE	12/97
SCALE	NTS

FIGURE 1
QUIGLEY & DUNCAN, (1978)
EARTH & WATER PRESSURE DIAGRAMS
FOR RECTANGULAR REINFORCED
CONCRETE BOX CULVERT (RCBC)

CROWN PRESSURE FACTOR FOR HEIGHTS OF SURCHARGE (H) LESS THAN TEN TUNNEL WIDTHS, NATIVE SOIL

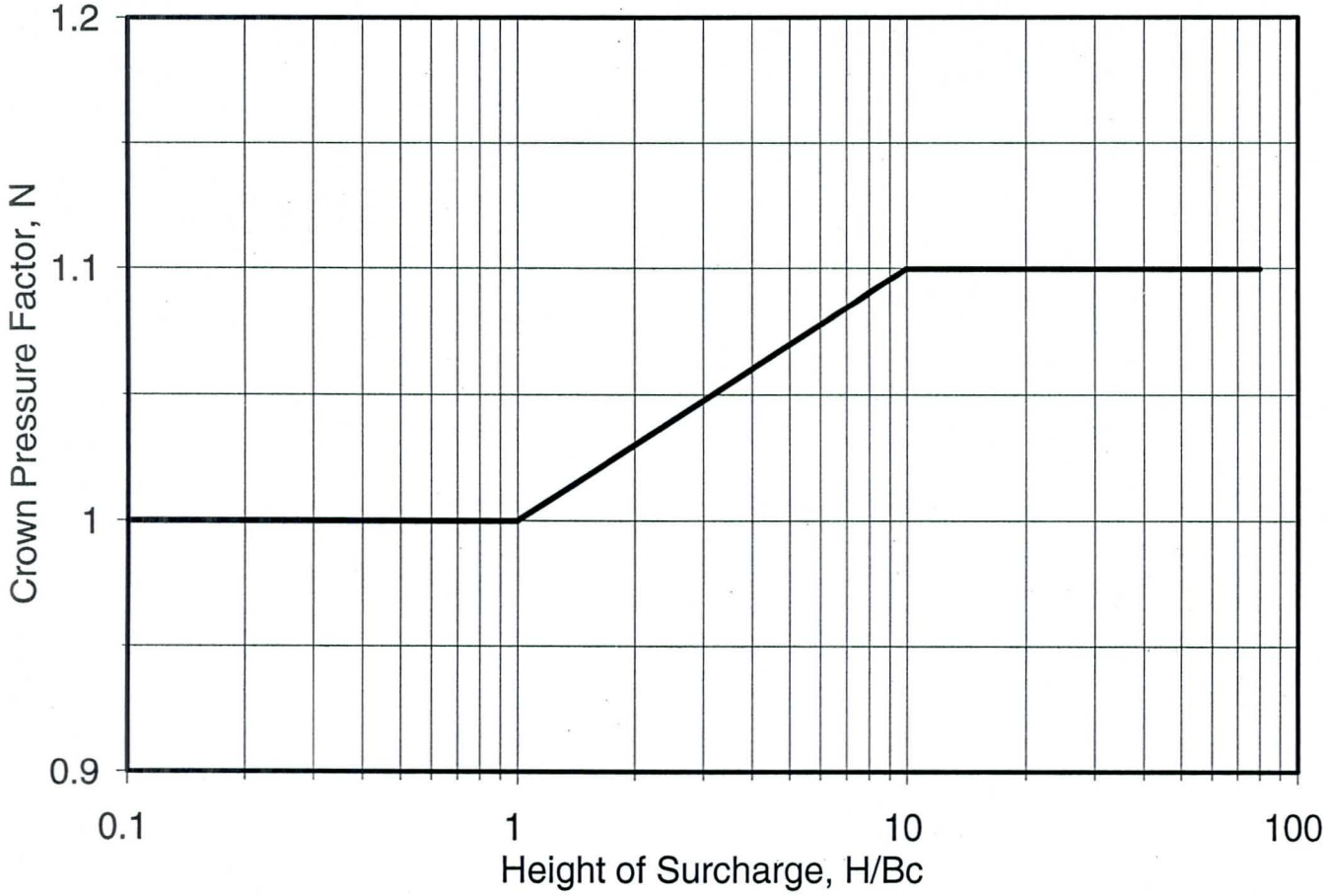


FIGURE 2

EDGE PRESSURE FACTOR FOR RECTANGULAR TUNNELS,
EMBANKMENT CONDITION & DEEP SOIL FOUNDATIONS

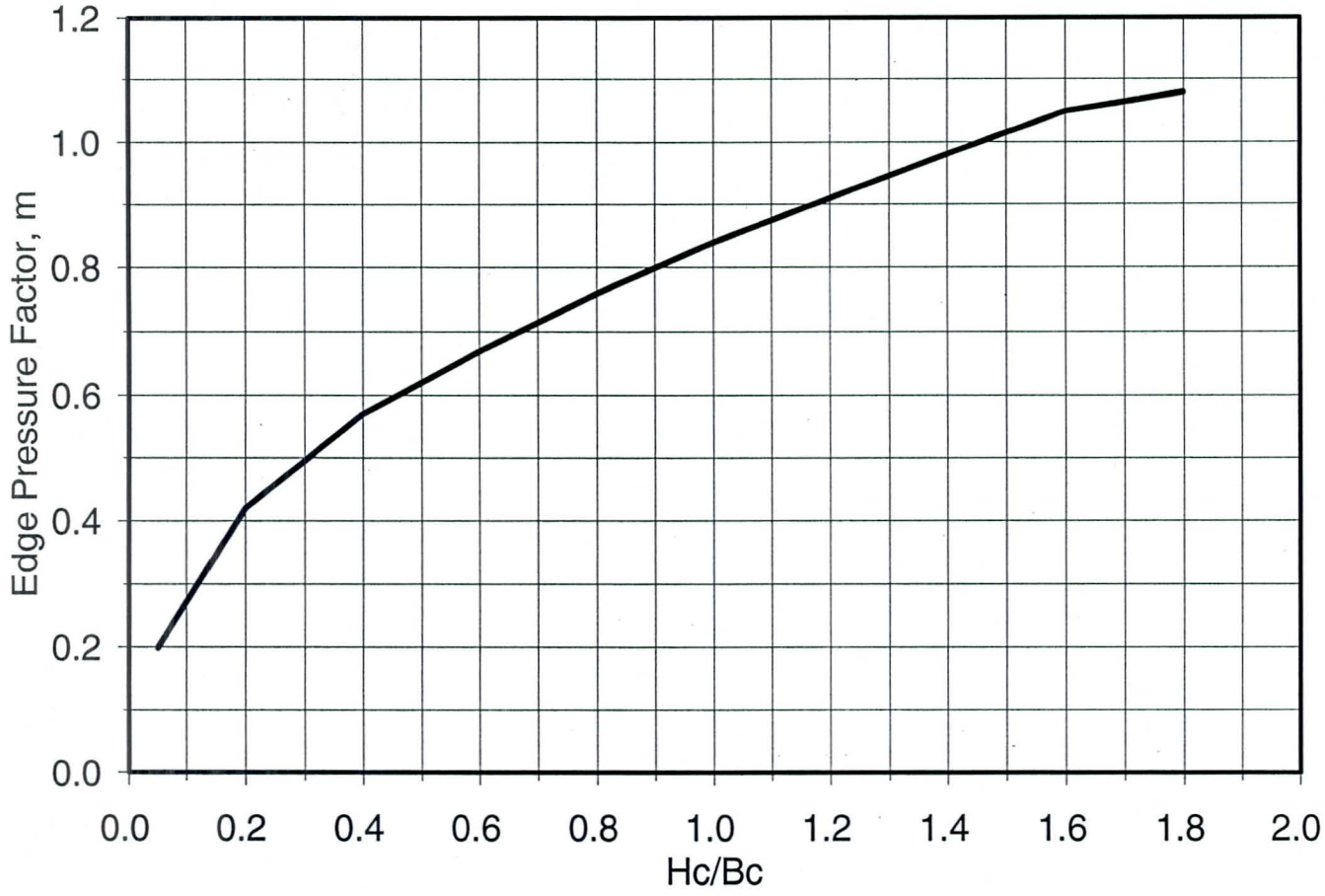
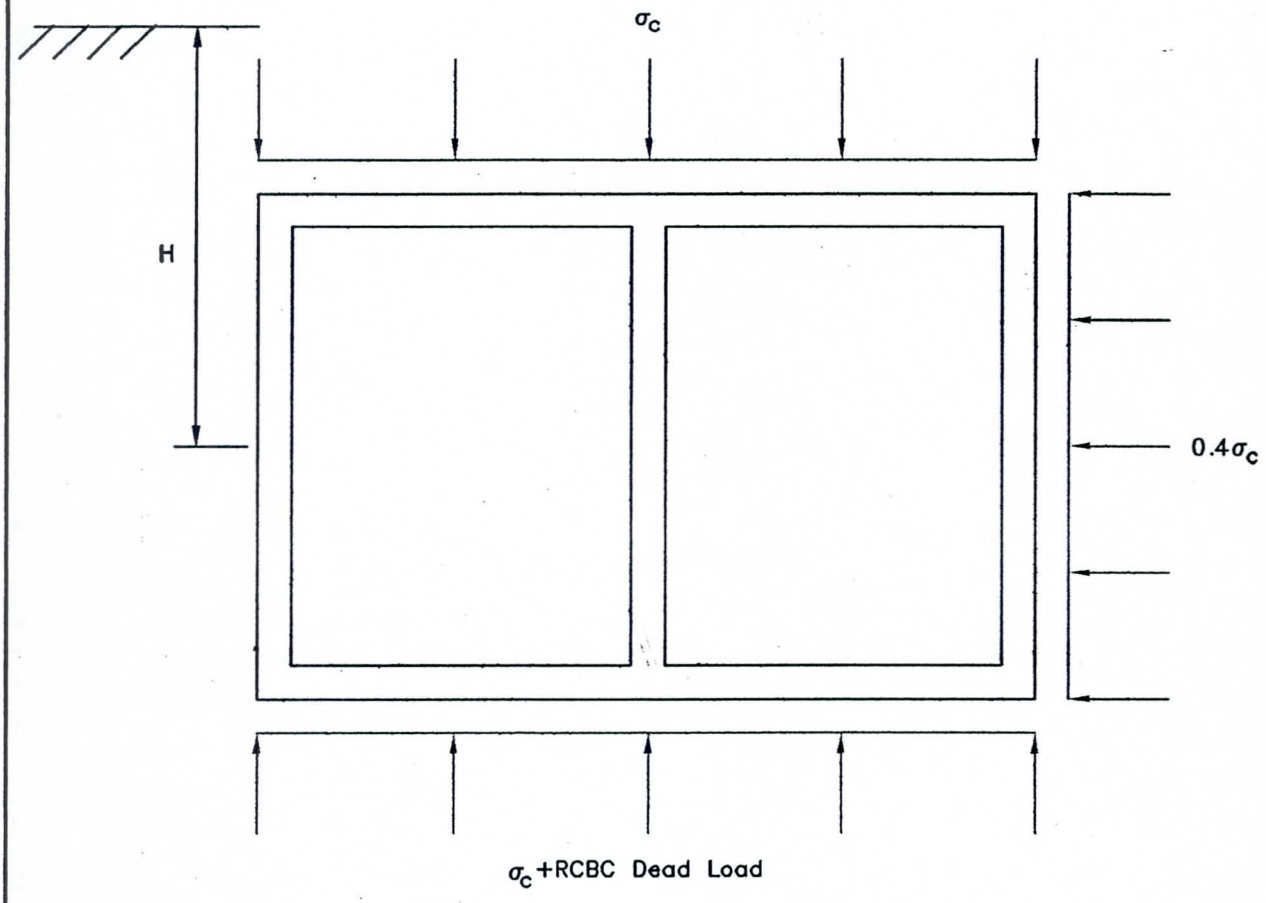


FIGURE 3



γ=Unit weight of backfill

H=Overburden depth above RCBC crown

$\sigma c = 1.1\gamma H$

AGRA Earth & Environmental ENGINEERING GLOBAL SOLUTIONS 3232 West Virginia Avenue, Phoenix, Arizona 85009-1502 Tel: (602)272-6848 Fax: (602)272-7239	JOB NO. 6-117-000356 DESIGN JDW DRAWN SLB DATE 12/97 SCALE NTS	FIGURE 4 Simplified Earth Pressure Diagram For Concrete Box Culverts

G:\Geotech\Highways-Streets\Reports\FIG_4.dwg Mon Dec 29 11:16:27 1997

areas where moderately to strongly lime cemented soils are encountered. In general, the more-cemented zones typically are less than about 1.0 m in thickness.

5.3.2 Excavation Slopes

In general, it is recommended that temporary excavations, which do not exceed about 4.0 m in depth, be made no steeper than 1.0V:0.75H (vertical to horizontal). Should steeper slopes be required due to proximity to existing structures or for purposes of economy, additional stability analyses should be performed. Flatter excavation slopes may be required in isolated areas if loose man-made fills or uncemented granular soils are encountered.

The perimeter of all temporary excavations should be protected against surface water runoff with berms or other measures at the top of the slope. Moderate to severe raveling and erosion of the slopes could occur if impacted by runoff.

Permanent cut slopes should be constructed no steeper than 1.0V:1.5H, provided that the slope is covered with a concrete or shotcrete lining.

5.3.3 Earthwork Factors

Relative to use of the materials to be excavated from the Phase II channel alignment, an overall shrink factor of 10 percent is estimated. This factor may vary depending on many factors, including wind loss and recompactive effort applied at the new destination of the material.

5.4 CORROSIVITY OF SITE SOILS

Total soluble-sulfate values for 3 samples tested range from 28 to 720 ppm. The tests indicate a negligible to moderate potential for sulfate attack of concrete. According to Section 4.2 of the Building Code Requirements for Reinforced Concrete (ACI 318-89), the use of Type II Portland cement is recommended for sulfate contents up to 1500 ppm.

The pH value for all three samples tested was 8.7 ohm-cm, and chloride test values vary from 140 ppm to 660 ppm.

REFERENCES

Arizona Department of Transportation (ADOT), 1996, Standard Specifications for Road and Bridge Construction, Highways Division, Phoenix, AZ.

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.

Quigley, D.W. and Duncan, J.M., 1978, Earth Pressures on Conduits and Retaining Walls, University of California, Berkeley, Report No. UCB/GT/78-06.

APPENDIX A

FIELD INVESTIGATION

TEST DRILLING EQUIPMENT & PROCEDURES

Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 16.8 cm (6 5/8") O.D., 8.3 cm (3 1/4") I.D. hollow stem auger or 11.3 cm (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 9.5 to 11.4 kN-m torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 71 to 90 kN (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 6.1 cm (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 11 kN-m (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 16 kN-m (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 22.8 cm (9") O.D. by 15.2 cm (6") I.D. or 16.8 cm (6 5/8") O.D. by 10.2 cm (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 0.3 m (1') increments, as noted on the boring logs. Standard penetration tests or 6.1 cm (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 12.7 cm (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 9.66 kN-m (85,500 inches-pounds) of torque with a pulldown capacity of 156 kN (35,000 pounds). Drilling is performed with either 10.2 cm (4"), or larger, diameter Tricone roller bits or 10.2 cm (4") to 15.2 cm (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 meters per minute. Standard penetration, 6.15 cm (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, 5.1 cm (2") O.D., 3.5 cm (1 3/8") I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 7.6 cm (3") O.D. samplers lined with 6.15 cm (2.42") I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 76.2 cm (30") free fall drop hammer required to advance the samplers in 15.2 cm (6") increments. However, in stratified soils, driving resistance is sometimes recorded in a few centimeters (2" or 3") 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 15.2 cm (6") 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.

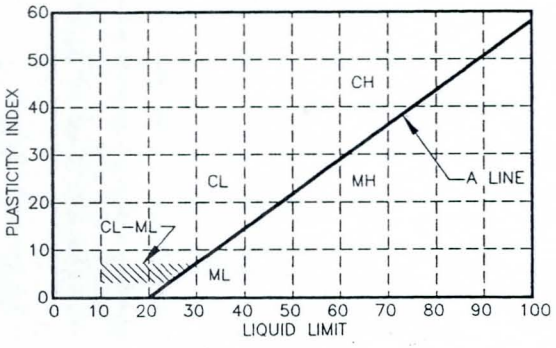
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

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 & H TCH 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 0.3 meter (foot) is obtained by the ASTM D1586 procedure using 5.1 centimeter (2-inch) O.D., 3.5 centimeter (1 3/8-inch) 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

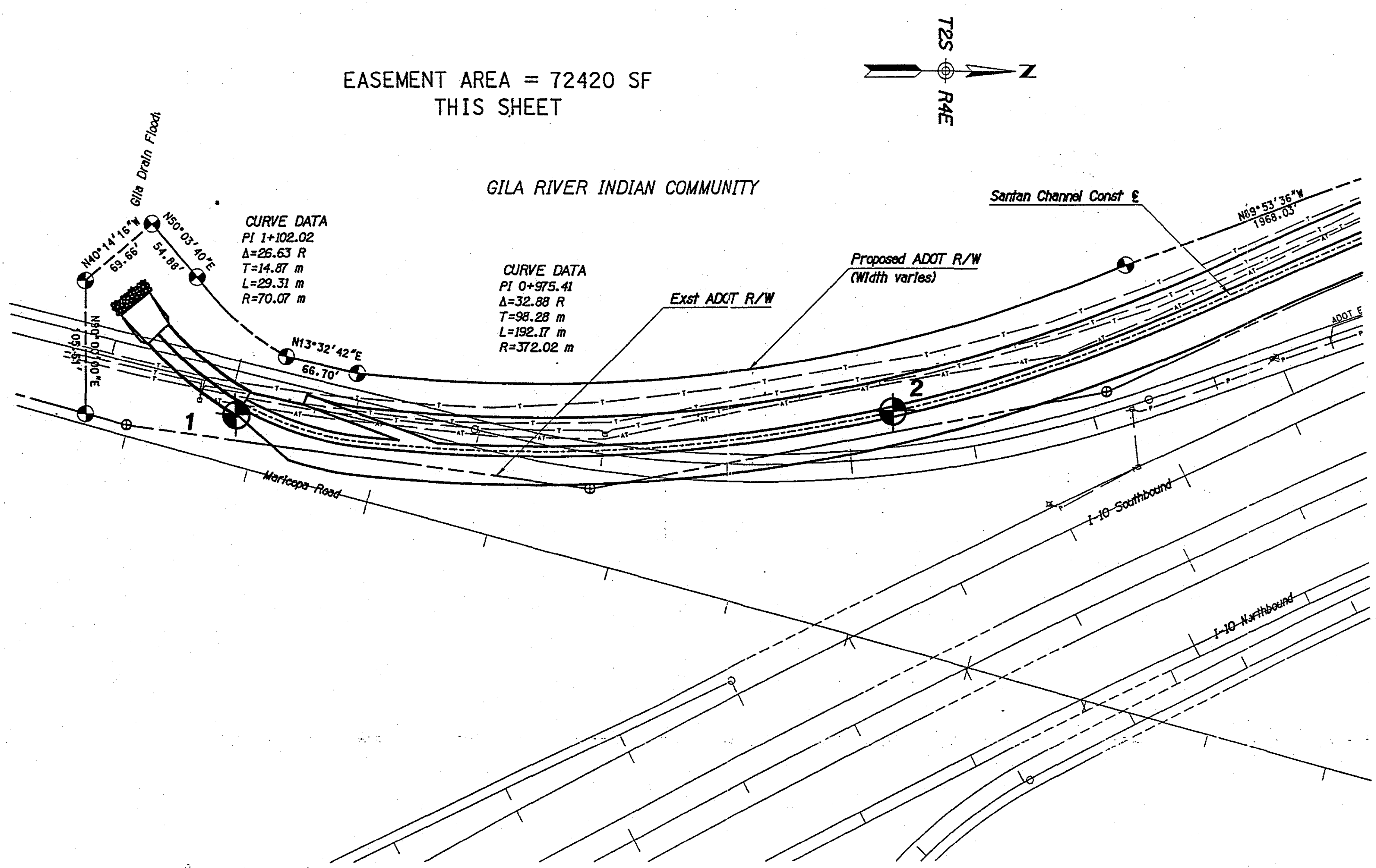
2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several centimeters with fist.
3-4	Soft	Easily penetrated several centimeters with thumb.
5-8	Medium stiff	Can be penetrated several centimeters 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

METRIC FORMAT PAPER



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS						
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				CHECKED	JJZ 5/97	TRACS NO.
				HDR Engineering, Inc.		
				ROUTE	SECTION	SANTAN CHANNEL R/W REQUIREMENTS

SHEET 1 OF 9

Metric

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oooooSYSTIMEooooo
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TRACS NO. H4314 01 D

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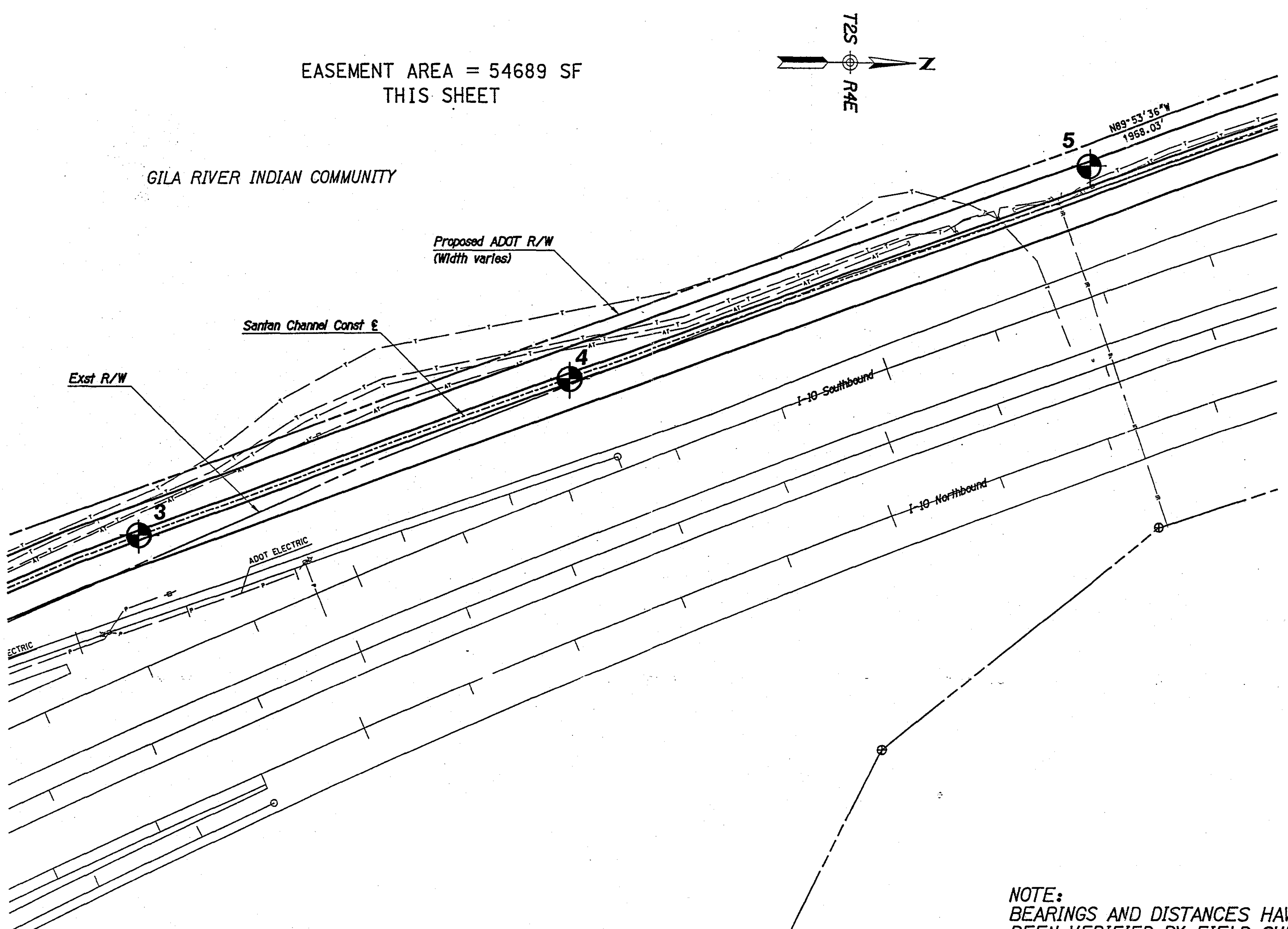

NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS			
C.O.	DATE	BY	DESCRIPTION

DRAWING NO.	
HARD COPY	
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CHECKED	JJZ 5/97
HDR Engineering, Inc.	
ROUTE	SECTION: SANTAN CHANNEL R/W REQUIREMENTS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
RIGHT OF WAY PLANS SECTION

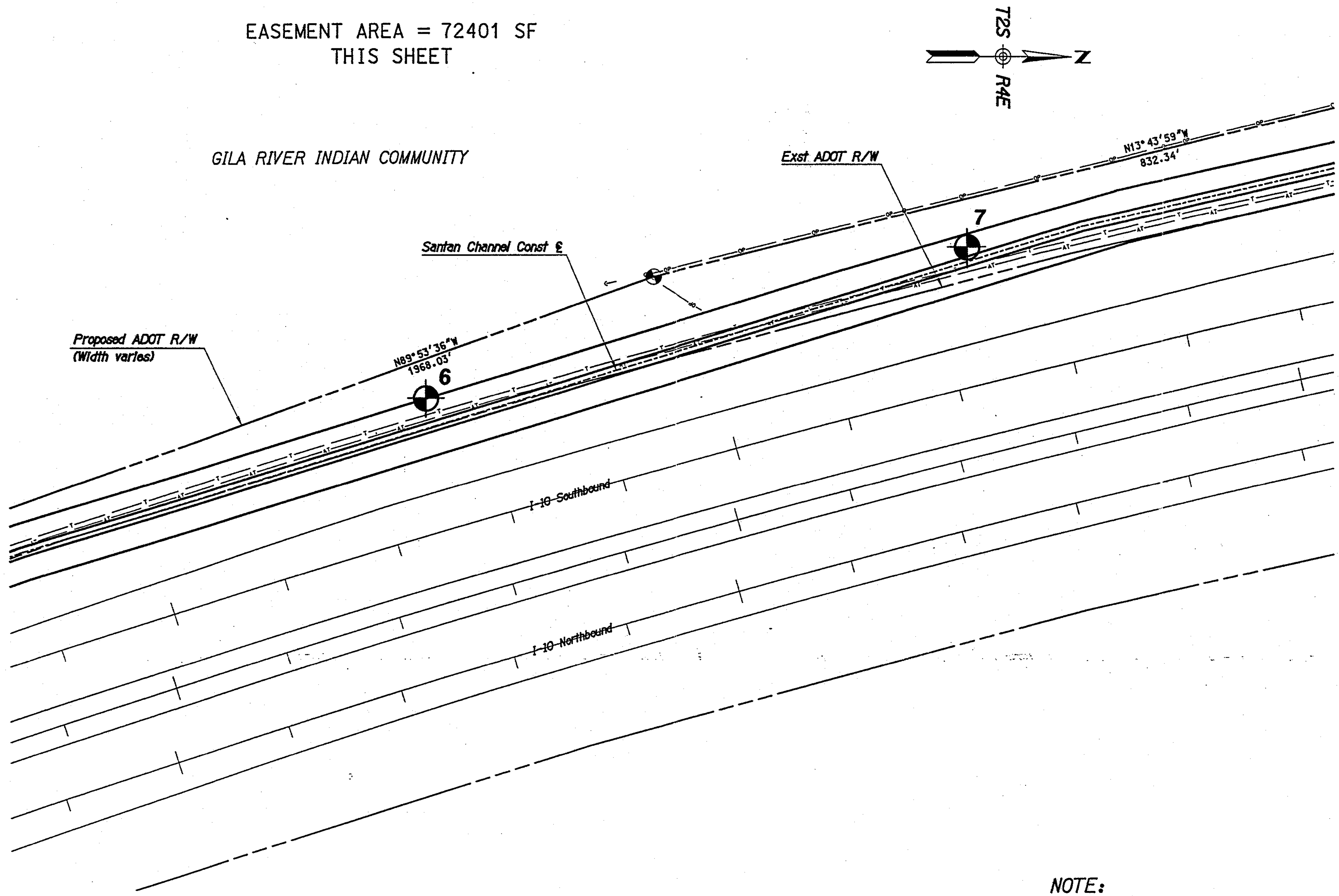
HIGHWAY: SANTAN CHANNEL
PROJECT NO.
TRACS NO.

SHEET 2 OF 9

TRACS NO. H4314 01 D

Metric

EASEMENT AREA = 72401 SF
THIS SHEET



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS			
C.O.	DATE	BY	DESCRIPTION

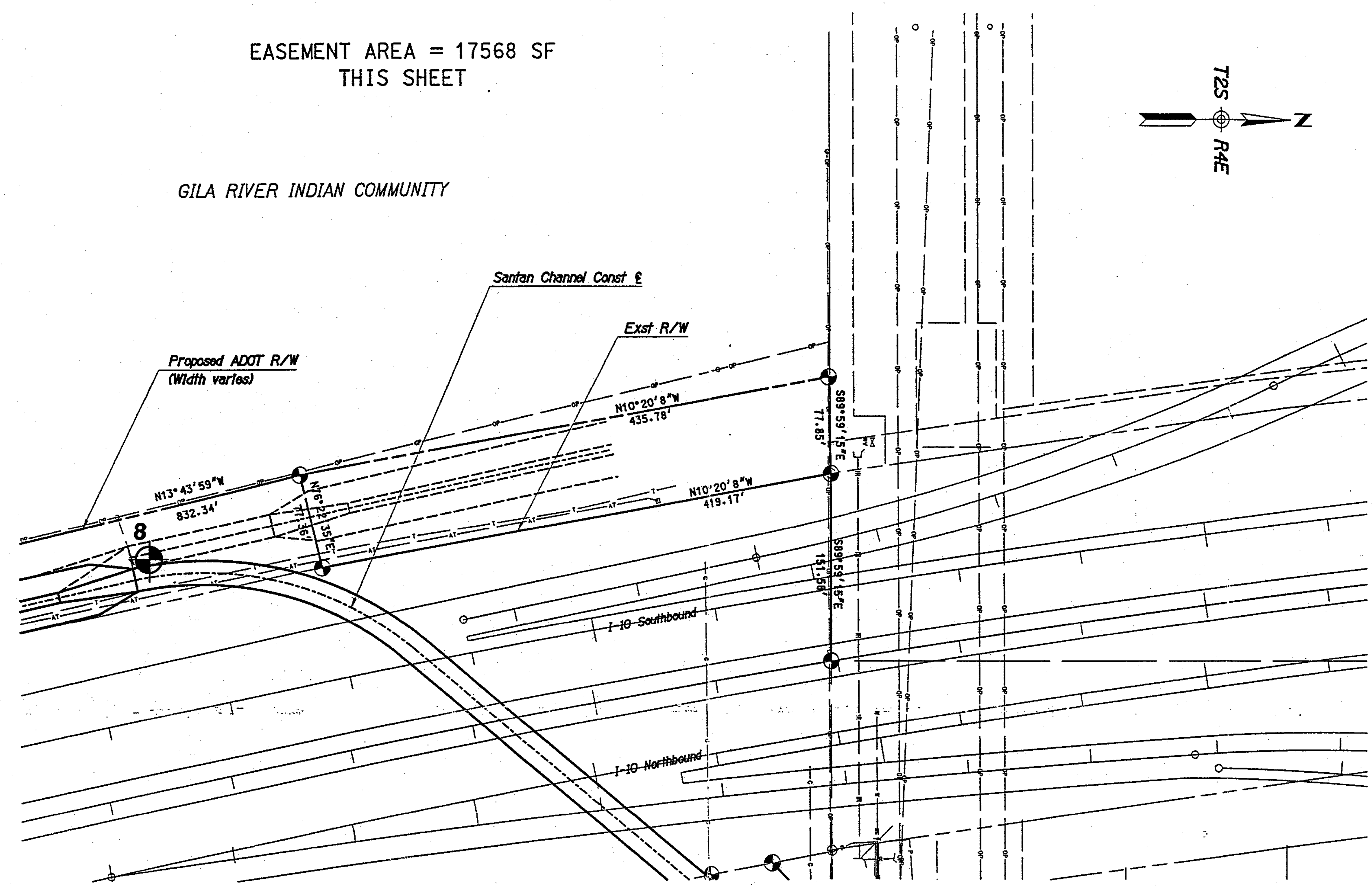
DRAWING NO.		ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION RIGHT OF WAY PLANS SECTION
HARD COPY		HIGHWAY SANTAN CHANNEL
DRAWN	KAJ 5/97	PROJECT NO.
CHECKED	JJZ 5/97	TRACS NO.
HDR Engineering, Inc.		
ROUTE	SECTION	SANTAN CHANNEL R/W REQUIREMENTS

SHEET 3 OF 9

TRACS NO. H4314 01 D

Metric

EASEMENT AREA = 17568 SF
THIS SHEET



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS			
C.O.	DATE	BY	DESCRIPTION

DRAWING NO.
HARD COPY
DRAWN KAJ 5/97
CHECKED JJZ 5/97
HDR Engineering, Inc.

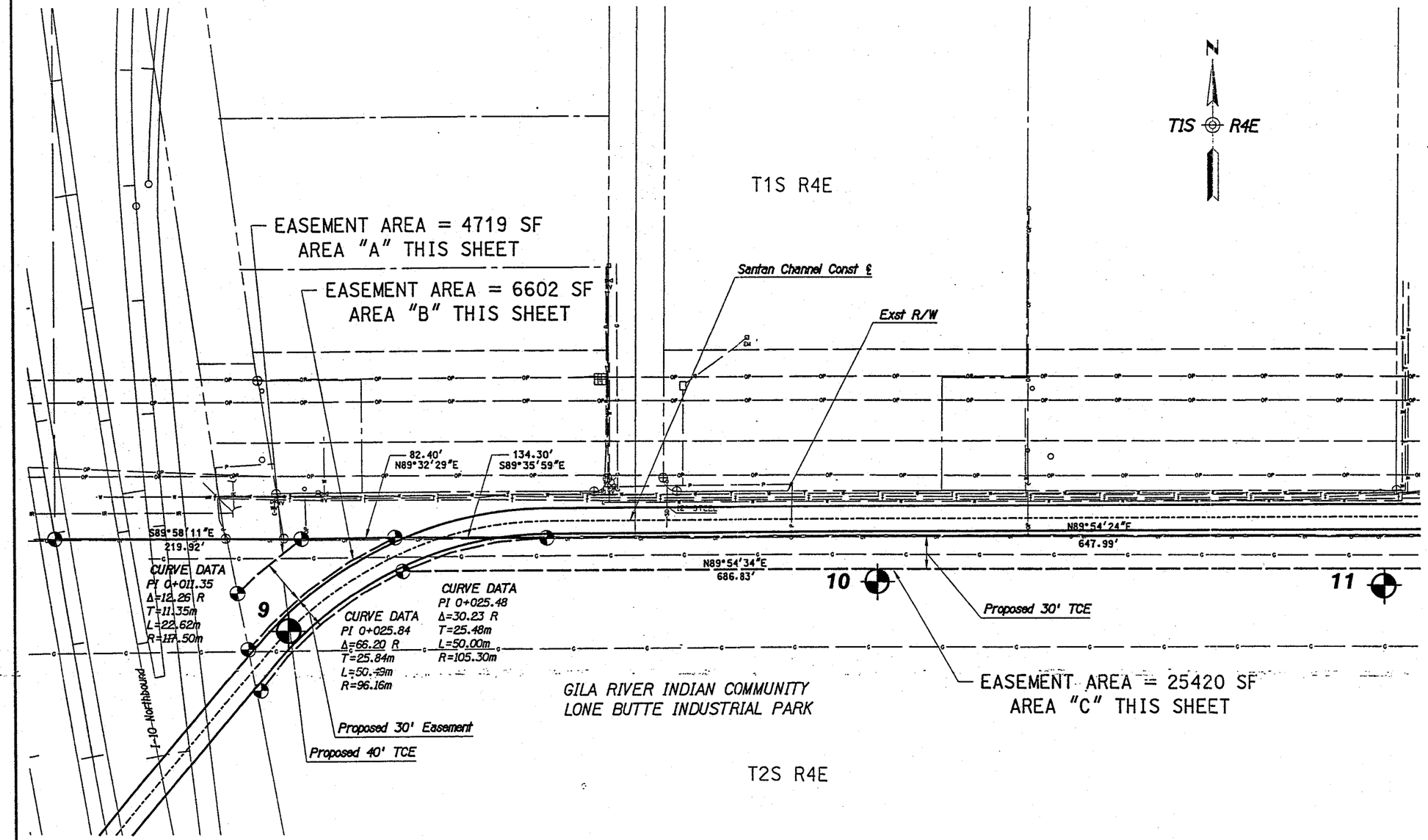
ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
RIGHT OF WAY PLANS SECTION

HIGHWAY SANTAN CHANNEL
PROJECT NO.
TRACS NO.
ROUTE
SECTION SANTAN CHANNEL R/W REQUIREMENTS

SHEET 4 OF 9

TRACS NO. H4314 01 D

Metric



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS				DRAWING NO.		ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION RIGHT OF WAY PLANS SECTION	
C.O.	DATE	BY	DESCRIPTION	HARD COPY			
				DRAWN	KAJ 5/97	HIGHWAY SANTAN CHANNEL	
				CHECKED	JJZ 5/97	PROJECT NO.	
				HDR Engineering, Inc.		TRACS NO.	
				ROUTE	SECTION SANTAN CHANNEL R/W REQUIREMENTS		SHEET 5 OF 9

ooooooDGN=SPECIFICATIONoooooo
ooooooSYSTIMEoooooo
VIEW NAME:

TRACS NO. H4314 01 D

EASEMENT AREA = 32046 SF
THIS SHEET

N

T1S R4E

T1S R4E

Santan Channel Const ℄

Exst R/W

N89°54'24"E
647.99'

N89°54'34"E
686.83'

12

13

Proposed 30' TCE

GILA RIVER INDIAN COMMUNITY
LONE BUTTE INDUSTRIAL PARK

T2S R4E

NOTE:
BEARINGS AND DISTANCES HAVE NOT
BEEN VERIFIED BY FIELD SURVEY.

REVISIONS			
C.O.	DATE	BY	DESCRIPTION

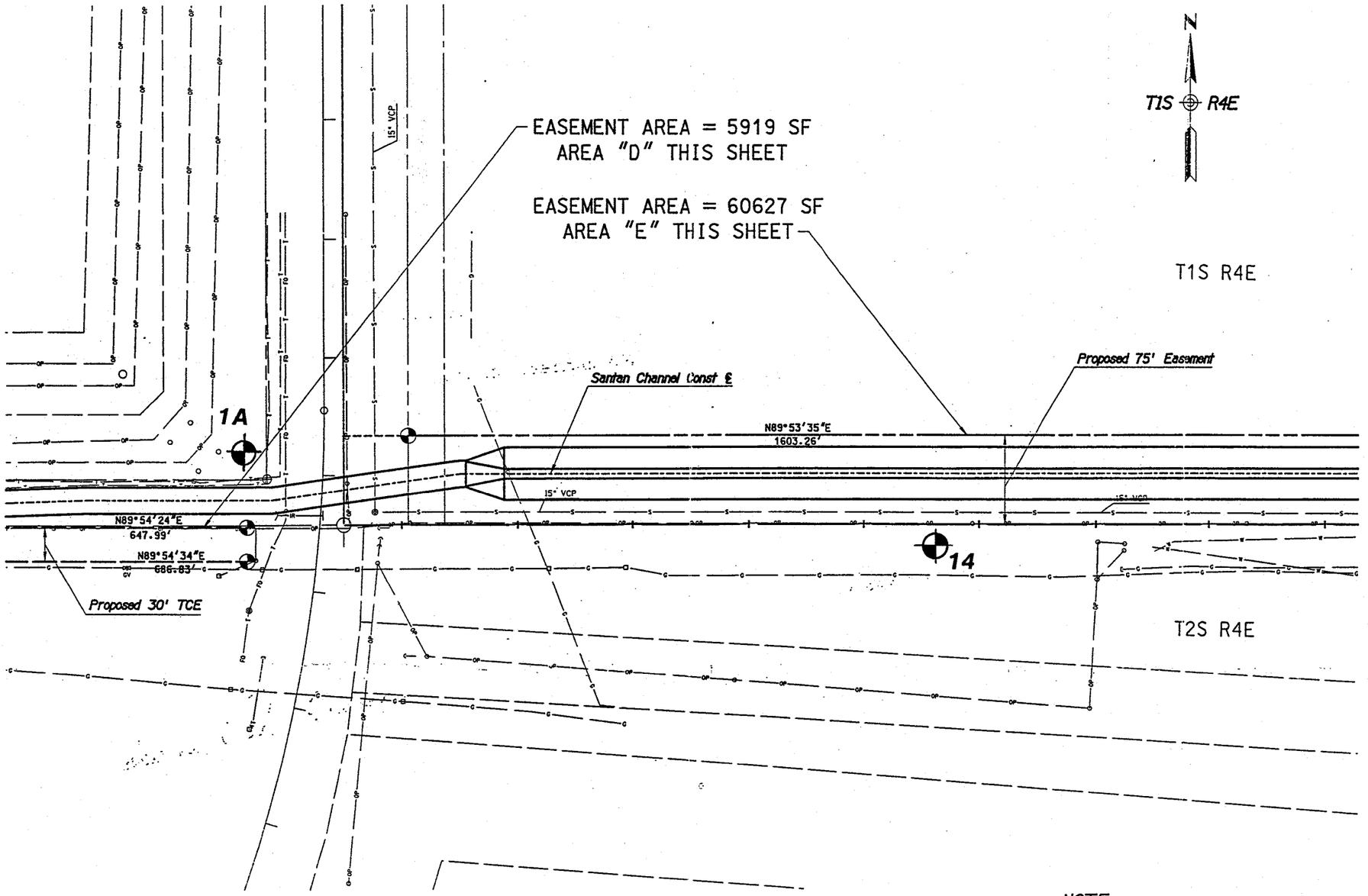
DRAWING NO.	
HARD COPY	
DRAWN	KAJ 5/97
CHECKED	JJZ 5/97
HDR Engineering, Inc.	
ROUTE	SECTION: SANTAN CHANNEL R/W REQUIREMENTS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
RIGHT OF WAY PLANS SECTION
HIGHWAY: SANTAN CHANNEL
PROJECT NO.
TRACS NO.

SHEET 6 OF 9

ooooo DGN= SPECIFICATION ooooo
ooooo SYSTIME ooooo
VIEW NAME:

TRACS NO. H4314 01 D



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS				DRAWING NO.	
C.O.	DATE	BY	DESCRIPTION	HARD COPY	
				DRAWN	KAJ 5/97
				CHECKED	JJZ 5/97
				HDR Engineering, Inc.	
				ROUTE	SECTION

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
RIGHT OF WAY PLANS SECTION
HIGHWAY: SANTAN CHANNEL
PROJECT NO.
TRACS NO.
SANTAN CHANNEL R/W REQUIREMENTS
SHEET 7 OF 9

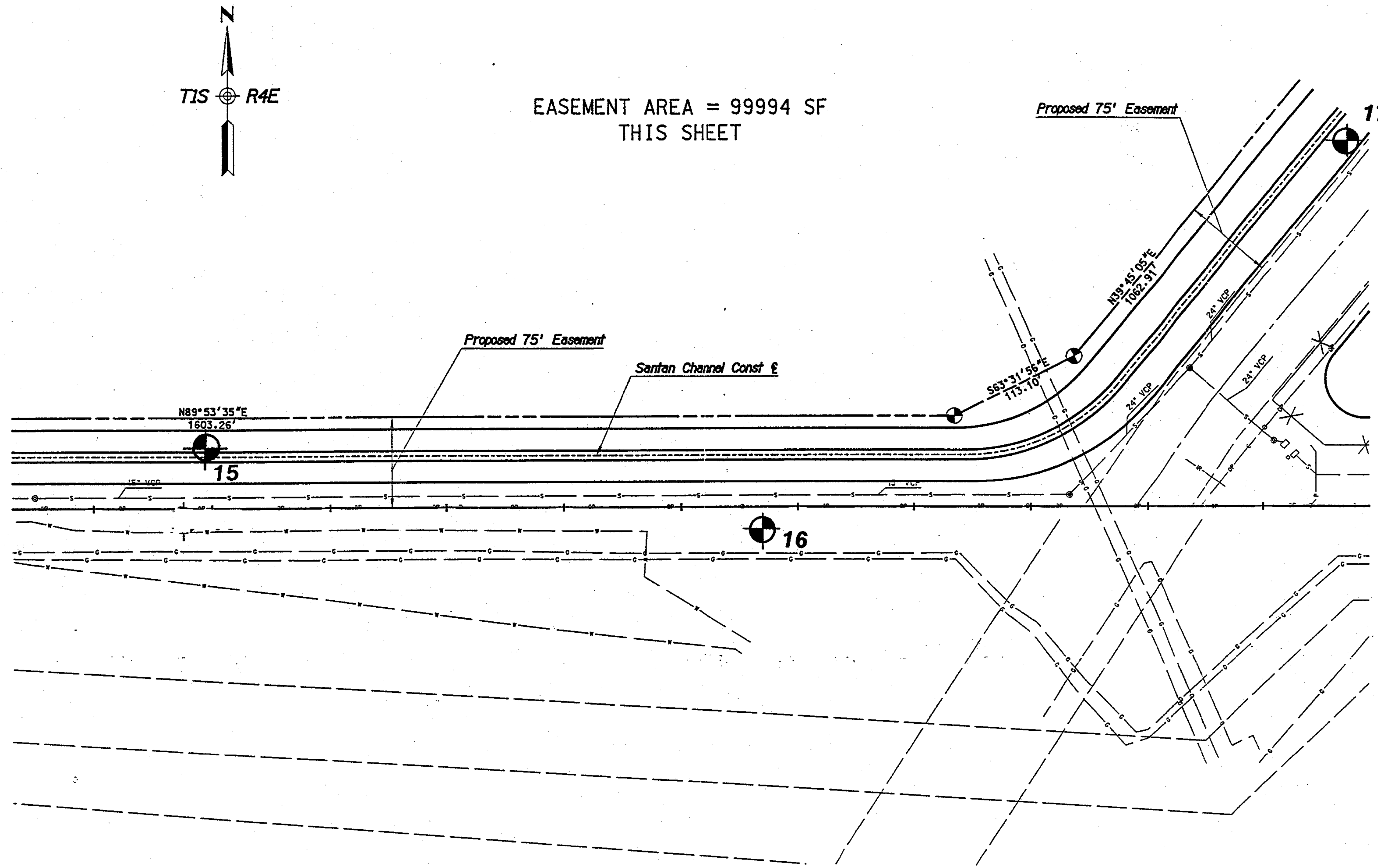
ooooDGNoSPECIFICATIONoooooo
ooooSYSTIMEoooooo
VIEW NAME:

TRACS NO. H4314 01 D

Metric

METRIC FORMAT PAPER

METRIC FORMAT PAPER



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS			
C.O.	DATE	BY	DESCRIPTION

DRAWING NO.
HARD COPY
DRAWN KAJ 5/97
CHECKED JJZ 5/97
HDR Engineering, Inc.
ROUTE

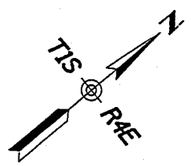
ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
RIGHT OF WAY PLANS SECTION
HIGHWAY SANTAN CHANNEL
PROJECT NO.
TRACS NO.
SECTION SANTAN CHANNEL R/W REQUIREMENTS
SHEET 8 OF 9

Metric

ooooo DGN o SPECIFICATION ooooo
ooooo SYSTIME ooooo
VIEW NAME:
TRACS NO. H4314 01 D

METRIC FORMAT PAPER

EASEMENT AREA = 58540 SF
THIS SHEET



NOTE:
BEARINGS AND DISTANCES HAVE NOT BEEN VERIFIED BY FIELD SURVEY.

REVISIONS			
C.O.	DATE	BY	DESCRIPTION

DRAWING NO.	
HARD COPY	
DRAWN	KAJ 5/97
CHECKED	JJZ 5/97
HDR Engineering, Inc.	
ROUTE	SECTION SANTAN CHANNEL R/W REQUIREMENTS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
RIGHT OF WAY PLANS SECTION

HIGHWAY SANTAN CHANNEL
PROJECT NO.
TRACS NO.

SHEET 9 OF 9

ooooo DGN=SPECIFICATIONooooo VIEW NAME:
ooooo SYSTIME ooooo

TRACS NO. H4314 01 D

METRIC FORMAT PAPER

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 1

JOB NO. 6-117-000356 DATE 10-22-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A S	6-7- 12				slightly moist firm to hard	**CLAYEY SAND**, predominantly fine grained, subrounded, low to medium plasticity, light brown
1										
							7			note: well graded gravel from 1.83m to 3.66m
2				S S	12-16- 26			SC		
3				U	100/ 203mm					
4								CL	moist hard	**SILTY CLAY**, trace of predominantly fine grained gravel, medium plasticity, brown
				S	50/0mm					Stopped Auger at 4.42m Stopped Sampler at 4.42m
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/08/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 1A

JOB NO. 6-117-000356 DATE 9-12-97

LOCATION
RIG TYPE CME-75
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		S	16-16-16				slightly moist firm to hard	**SILTY TO CLAYEY SAND**, predominantly fine grained sand, low to medium plasticity, brown note: weakly to moderately lime cemented below 0.46m, moderately to strongly lime cemented below 1.52m (in lenses), clay content increase below 3.96m
1		U	24	100	4			
2		S	13-50/152mm			SC		
3		U	83	104	11			
4								
5		U	60				slightly moist firm to hard	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, brown note: sand content increases below 7.62m
6		U	41	110	13			
7						SC		
8		U	23					
9		U	50/127mm			SM	slightly moist hard	**SILTY SAND**, some to considerable gravel, predominantly medium grained, weakly to moderately lime cemented, nonplastic, light brown
10						SC		
11		U	50/152mm				slightly moist hard	**CLAYEY SAND**, predominantly medium grained, strongly lime cemented, low to medium plasticity, light brown
12								Stopped Auger at 10.67m Sampler refused at 10.82m note: this boring originally drilled by AEE for SRP at northwest corner of 56th St. and Pecos Rd., (indicated as Boring No. 1, AEE Job No. 7-117-000268)
13								
14								
15								

6-117-000356.GWH 01/08/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 2

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	5-7-5				moist	**SANDY CLAY**, predominantly fine grained sand, trace of lime, medium plasticity, brown
1								CL	moderately firm to hard	note: weakly to moderately lime cemented lenses below 1.52m
2				S	7-27-34					**CLAYEY SAND**, some fine grained gravel, subrounded, predominantly fine grained, low plasticity, brown
				A					moist	
3				S	13-29-32		2	SC	hard	
4										
5				S	8-20 50/ 152mm					Stopped Auger at 4.42m Stopped Sampler at 4.88m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 3

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Sample	Sample Type	Blow Counts	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		S	5-13-19	CL	slightly moist to moist very firm to hard	**SANDY CLAY**, predominantly fine grained, weakly to moderately lime cemented, medium plasticity, brown note: strongly lime cemented at 1.52m note: grading to clayey sand at 2.44m
1		U	66			
2		S	50-50/51mm			
		A				
3		S	36-35-20	SC	moist hard	**CLAYEY SAND**, trace of fine grained gravel, subrounded to subangular, predominantly fine to medium grained sand, weakly lime cemented, low to medium plasticity, light brown
4				GC	moist hard	**CLAYEY GRAVEL**, some sand, well graded, subrounded, weakly to moderately lime cemented, medium plasticity, light brown
5		S	15-50/51mm			
6						Stopped Auger at 4.42m Sampler refused at 4.62m
7						
8						
9						
10						
11						
12						
13						
14						
15						

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 4

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A					slightly moist to moist	**CLAYEY SAND**, predominantly fine grained, low to medium plasticity, brown
				S	1-12-21					
1				S	17-36-50			SC	very firm to hard	note: some moderately lime cemented lenses from 0.61m to 0.91m
				S	35-50/102mm					
2										note: moderately to strongly lime cemented lenses from 1.22m to 1.83m
3				S	28-50/51mm		8	GC	moist hard	**CLAYEY GRAVEL**, some to considerable sand, predominantly fine grained gravel, subrounded to rounded, some lime, low plasticity, light brown
4										note: some lime cemented lenses
				S	50/102mm					Stopped Auger at 4.42m Sampler refused at 4.52m
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 5

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	4-13-17			SC	slightly moist to moist firm	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, brown
1				S	14-18-22			CL		
2				S	16-50/127mm			SC	moist very firm to hard	**SANDY CLAY**, predominantly fine grained, weakly lime cemented, medium plasticity, brown note: moderately lime cemented at 1.52m
3				S	9-30-29			GM		
4				U	80		12		moist hard	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, light brown note: trace of well graded gravel gravel from 1.52m to 4.27m
5										
6									moist hard	**SILTY GRAVEL**, trace of clay, predominantly fine grained, trace of lime, nonplastic to low plasticity, brown
7										Stopped Auger at 4.42m Stopped Sampler at 4.72m
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 6

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A				SM	slightly moist to moist	**SILTY SAND**, predominantly fine to medium grained, nonplastic, light brown
				S	2-11-15					
1				S	11-28-31				firm	
				S	24-24		10	SC	slightly moist to moist	**CLAYEY SAND**, predominantly fine to medium grained, weakly lime cemented, medium plasticity, brown
2				A	50/102mm					
3				U	55				hard	
								CL	moist	**SILTY CLAY**, trace of fine grained sand, weakly lime cemented, medium plasticity, light brown to white
4									hard	
								SM		note: some moderately lime cemented lenses
				S	5-50-50/0mm					
5									moist	**SILTY SAND**, predominantly fine to medium grained, moderately lime cemented, low plasticity, brown
6									hard	
7										Stopped Auger at 4.42m Stopped Sampler at 4.72m
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 7

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	3-14-17			SM	slightly moist to moist very firm	**SILTY SAND**, fine to medium grained, weakly lime cemented, nonplastic, brown
1				U	38					
2				S	16-25-16				slightly moist to moist very firm to hard	**CLAYEY SAND**, trace of clay, fine to medium grained, weakly lime cemented, low plasticity, light brown
3				S	14-14-25			SC		note: trace of coarse grained gravel at 3.05m
4										note: strongly lime cemented lense at 3.96m
5				S	14-21-34					note: no clay from 4.27m to 4.58m
6										Stopped Auger at 4.42m Stopped Sampler at 4.88m
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 8

JOB NO. 6-117-000356 DATE 10-29-97

LOCATION
RIG TYPE Mobile B61
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	1-4-7			SM	slightly moist to moist moderately firm	**SILTY SAND**, fine to medium grained, nonplastic, light brown
1				S	13-17-20					
				U	48					
2				A				SC	slightly moist very firm to hard	**CLAYEY SAND**, predominantly fine to medium grained, weakly to moderately lime cemented, low to medium plasticity, light brown
3				S	21-50/127mm					
4										
				S	18-48					
5					50/76mm					Stopped Auger at 4.42m Sampler refused at 4.80m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 9

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A S	3-8-8			SM	slightly moist firm	**SILTY SAND**, predominantly fine grained, nonplastic, light brown
1				S	4-8-12					
2				S	3-10-13		7		slightly moist firm to hard	**SANDY SILT**, predominantly fine grained sand, weakly lime cemented, low plasticity, light brown
				A				ML		
3				S	25-21-30					
4				U	88					
5										Stopped Auger at 4.42m Stopped Sampler at 4.72m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 10

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-7-18				moist firm	**CLAYEY SAND**, predominantly fine grained, low to medium plasticity, light brown
1								SC		
				U	28					note: weakly lime cemented at 1.52m
2										
3				S	22-30-25				moist hard	**SILTY SAND**, trace of fine grained gravel, predominantly fine grained sand, weakly to moderately lime cemented, nonplastic, light brown
4								SM		
				S	8-10-50/0mm		7			
5										Stopped Auger at 4.42m Stopped Sampler at 4.72m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 11

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	1-3-9			SM	slightly moist	**SILTY SAND**, predominantly fine grained, nonplastic, light brown
1				S	9-20-50/76mm				moderately firm	
2								SC	slightly moist	**CLAYEY SAND**, predominantly fine grained, weakly to moderately lime cemented, low plasticity, light brown
3				U	34				hard	note: some well graded gravel at 2.44m
4				A				GC	slightly moist	**CLAYEY GRAVEL**, considerable sand, well graded, rounded to subrounded, weakly lime cemented, low to medium plasticity, light brown
5				S	6-6-50/76mm		13		very firm to hard	
6										Stopped Auger at 4.42m Sampler refused at 4.80m
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 12

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	2-3-8			SM	slightly moist	**SILTY SAND**, predominantly fine grained, nonplastic, light brown
1									moderately firm	
				U	87			SC		**SANDY CLAY**, predominantly fine grained sand, weakly lime cemented, low to medium plasticity, light brown to tan
2									moist	
3				S	20-22-25		10		very firm	note: some moderately lime cemented lenses
								SM		
4									moist	**SILTY SAND**, some gravel, trace to some clay, well graded, subrounded, weakly lime cemented, low to medium plasticity, brown
				S	19-17 50/ 127mm				hard	
5										Stopped Auger at 4.42m Sampler refused at 4.85m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 13

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A				ML	slightly moist	**SANDY SILT**, well graded sand, low plasticity, light brown
				S	3-4-9		12			
1									moderately firm	
				U	70					
2									slightly moist to moist	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, brown to tan
								SC		
3				S	19-34-35		9		hard	note: some moderately lime cemented lenses
4										
				S	16-21-35					
5										Stopped Auger at 4.42m Stopped Sampler at 4.88m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356.GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample
U - 51mm I.D. California Tube Sample.
NR - No Recovery

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 14

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A				SM	slightly moist	**SILTY SAND**, predominantly medium grained, nonplastic, brown
				S	16-12-13				firm	
1										
				S	16-19-20				slightly moist to moist	**SANDY CLAY**, some gravel, well graded sand, weakly lime cemented, medium plasticity, brown
2				A						
								CL	very firm to hard	
3				U	45		8			
4										
				S	23-25-30					
5										Stopped Auger at 4.42m Stopped Sampler at 4.88m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 15

JOB NO. 6-117-000356 DATE 12-18-97

LOCATION See Site Plan
RIG TYPE Mobile B-61
BORING TYPE 8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				U	84			CL	slightly moist hard	**SILTY CLAY**, weakly lime cemented, low to medium plasticity, brown to light brown
1										
2				S	36-50/ 127mm			GC	slightly moist hard	**CLAYEY SAND & GRAVEL**, poorly graded sand, predominantly fine grained gravel, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown note: thin layers of moderate to strong lime cementation
3				S	30-50/ 127mm					
4										
5				S	20-28-49			SP GC	moist dense	**SAND**, some silt, predominantly medium to fine grained, subrounded to subangular, nonplastic, brown
6									slightly moist very firm	**CLAYEY SAND & GRAVEL**, poorly graded sand, predominantly fine grained gravel, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
7										
8										Stopped Auger at 4.57m Stopped Sampler at 5.03m
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/08/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 16

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	10-18-14				moist very firm to hard	**CLAYEY SAND**, trace of fine grained gravel, predominantly fine to medium grained, low to medium plasticity, light brown to tan
1										
2				S	8-18-14		8	SC		
3				S	16-24-30					
4				A						
				U	41					Stopped Auger at 4.42m Stopped Sampler at 4.73m
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample
U - 51mm I.D. California Tube Sample.
NR - No Recovery

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 17

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	12-15-13				moist medium dense	Man-made FILL **SANDY SILT**, predominantly fine to medium grained sand, low plasticity, brown
1								ML		
2				S	3-6-9		15			
3				U	52				moist hard	**SANDY CLAY TO CLAYEY SAND**, predominantly fine grained, weakly lime cemented, medium plasticity, light brown
4								SC		
5				S	25-29-42					Stopped Auger at 4.42m Stopped Sampler at 4.88m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

PROJECT Design of Santan Channel - Phase II

LOG OF TEST BORING NO. 18

JOB NO. 6-117-000356 DATE 10-21-97

LOCATION
RIG TYPE Failing F-10
BORING TYPE 203mm Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Meters	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	14-12-9			SM	slightly moist to moist	**SILTY SAND**, predominantly fine to medium grained, nonplastic, brown
1									medium dense	
				U	28		13			
2				A				CL	moist	**SANDY CLAY**, considerable well graded gravel, rounded to subrounded, predominantly fine to medium grained sand, low to medium plasticity, brown
									firm	
3				S	16-12-11				moist	**SAND**, trace of coarse grained gravel, predominantly medium grained, nonplastic, brown
4				A				SP	medium dense to very dense	
				S	8-50/51mm					
5										Stopped Auger at 4.42m Sampler refused at 4.88m
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

6-117-000356 GWH 01/05/98

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill Cuttings
S - 51mm O.D. 35mm I.D. Tube Sample.
U - 51mm I.D. California Tube Sample.
NR - No Recovery

APPENDIX B

LABORATORY TESTING

LABORATORY TESTING PROCEDURES

Consolidation Tests Soiltest or Clockhouse apparatus of the "floating-ring" type are employed for the one-dimensional consolidation tests. They are designed to receive 1 inch high 2.5 inch O.D. brass liner rings with soil specimens as secured in the field. Procedures for the tests generally are those outlined in ASTM D2435. Loads are applied in several increments to the upper surface of the test specimen and the resulting deformations are recorded at selected time intervals for each increment. For soils which are essentially saturated, each increment of load is maintained until the deformation versus log of time curve indicates completion of primary consolidation. For partially saturated soils, each increment of load is maintained until the rate of deformation is equal or less than 3/10,000 inch per hour. Applied loads are such that each new increment is equal to the total previously applied loading. Porous stones are placed in contact with the top and bottom of the specimens to permit free addition or expulsion of water. For partially saturated soils, the tests are normally performed at in situ moisture conditions until consolidation is complete under stresses approximately equal to those which will be imposed by the combined overburden and foundation loads. The samples are then submerged to show the effect of moisture increase and the tests continued under higher loadings. Generally, the tests are continued to about twice the anticipated curve due to overburden and structural loads with a rebound curve then being established by releasing loads.

Expansion Tests The same type of consolidometer apparatus described above is used in expansion testing. Undisturbed samples contained in brass liner rings are placed in the consolidometers, subjected to appropriate surcharge loads and submerged. The loads are maintained until the expansion versus log of time curve indicates the completion of "primary swell".

Direct Shear Tests Direct shear tests are run using a Clockhouse or Soiltest apparatus of varying strain-control. The machine is designed to receive one of the 1 inch high 2.42 inch diameter specimens obtained by tube sampling. Generally, each sample is sheared under a normal load equivalent to the effective overburden pressure at the point of sampling. In some instances, samples are sheared at several normal loads to obtain the cohesion and angle of internal friction. When necessary, samples are saturated and/or consolidated before shearing in order to approximate the anticipated controlling field loading conditions.

njf/M1-97/6-18-97

AGRA Earth & Environmental, Inc.

PROJECT: DESIGN OF SANTAN CHANNEL
LOCATION: SOUTH VALLEY DRAINAGE

JOB NO: 6-117-000356
WORK ORDER NO: 4
DATE SAMPLED: 10-30-97

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	6.3mm	9.5mm	12.5m	19mm	25mm	37.5m	50mm	75mm	100mm	150mm	Lab #
PERCENT PASSING BY WEIGHT																							
#13 @ 0-1.52m	ML	33	8	62	74	82	84	87	91	94	95	100	100	100	100	100	100	100	100	100	100	100	88
#14 @ 2.90-3.20m	CL	44	27	51	53	56	58	60	65	70	72	81	85	91	95	98	100	100	100	100	100	100	96
#16 @ 1.37-1.83m	SC	31	10	26	40	66	76	81	88	91	92	98	98	98	98	100	100	100	100	100	100	100	100
#1 @ 0-1.52m	SC	27	12	46	60	73	78	83	89	91	92	94	94	96	97	98	99	100	100	100	100	100	105
#9 @ 1.37-1.82m	ML	31	7	70	83	90	92	94	98	99	99	100	100	100	100	100	100	100	100	100	100	100	113
#12 @ 2.90-3.35m	SM	48	16	48	52	57	59	61	66	70	72	80	84	92	96	100	100	100	100	100	100	100	127
#17 @ 1.37-1.83m	ML	41	13	52	67	80	85	89	94	97	98	100	100	100	100	100	100	100	100	100	100	100	130

AGRA Earth & Environmental, Inc.

PROJECT: DESIGN OF SANTAN CHANNEL
LOCATION: SOUTH VALLEY DRAINAGE

JOB NO: 6-117-000356
WORK ORDER NO: 5
DATE SAMPLED: 10-30-97

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

SIEVE SIZES

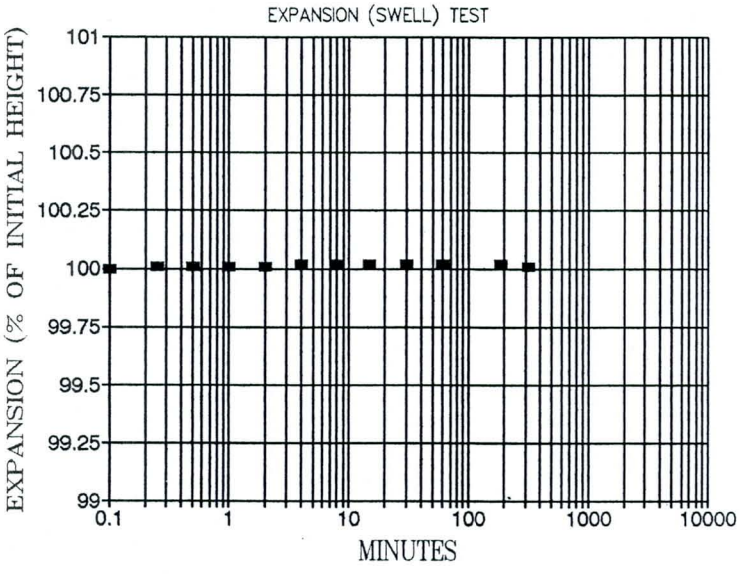
				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	6.3mm	9.5mm	12.5m	19mm	25mm	37.5m	50mm	75mm	100mm	150mm	Lab #
PERCENT PASSING BY WEIGHT																							
#5 @ 4.42-4.72m	GM	34	10	48	51	53	54	55	57	59	59	64	71	77	80	85	89	100	100	100	100	100	143
#6 @ 1.37-1.78m	SC	40	18	47	54	60	63	65	70	74	75	100	100	100	100	100	100	100	100	100	100	100	147
#2 @ 2.90-3.35m	SC	30	8	45	48	51	53	56	63	71	75	100	100	100	100	100	100	100	100	100	100	100	160
#4 @ 1.52-3.05m	GC	32	11	26	35	41	42	44	47	51	53	60	65	76	85	94	99	100	100	100	100	100	173

AGRA Earth & Environmental

PROJECT:	DESIGN OF SANTAN CHANNEL	**JOB NO:**	6-117-000356
LOCATION:	SOUTH VALLEY DRAINAGE	**WORK ORDER NO:**	5
MATERIAL:		**LAB NO:**	143
SAMPLE SOURCE:	#5 @ 4.42-4.72m	**DATE SAMPLED:**	10-03-97
SAMPLE PREP:	REMOLD		
TARGET:	92.9 PCF @ 18.9% MOISTURE		
LOAD:	1 PSI		

ONE DIMENSIONAL SWELL OR SETTLEMENT OF SOILS (ASTM D-4546)

INITIAL DRY DENSITY	99.9 pcf
FINAL DRY DENSITY	99.9 pcf
INITIAL MOISTURE CONTENT	15.2%
FINAL MOISTURE CONTENT	21.0%
MOIST. PICK-UP (% DRY WT.)	5.8%
MOIST. PICK-UP (% IN. VOL.)	9.3%
SWELL (% INITAL HT.)	0.02%

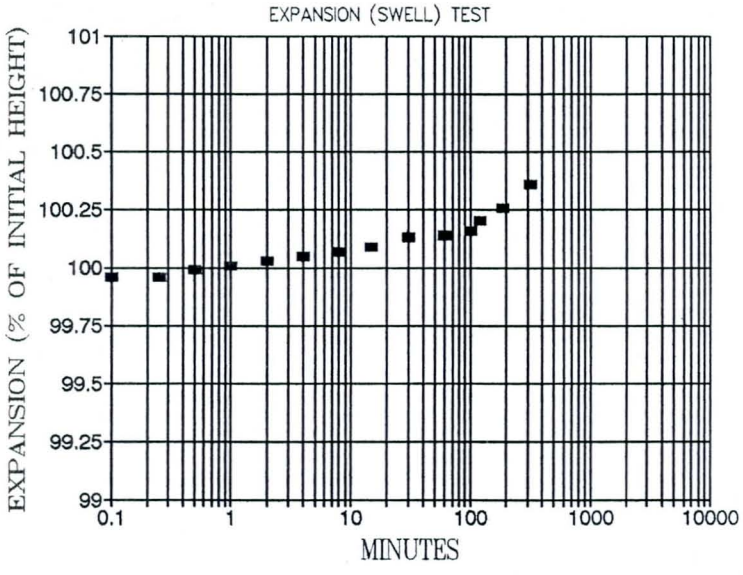


AGRA Earth & Environmental

PROJECT:	DESIGN OF SANTAN CHANNEL	**JOB NO:**	6-117-000356
LOCATION:	SOUTH VALLEY DRAINAGE	**WORK ORDER NO:**	4
MATERIAL:		**LAB NO:**	115
SAMPLE SOURCE:	#9 @ 14.5-15.5m	**DATE SAMPLED:**	10-30-97
SAMPLE PREP:	REMOLD		
TARGET:	92.9 PCF @ 18.9% MOISTURE		
LOAD:	1 PSI		

ONE DIMENSIONAL SWELL OR SETTLEMENT OF SOILS (ASTM D-4546)

INITIAL DRY DENSITY	92.4 pcf
FINAL DRY DENSITY	92.1 pcf
INITIAL MOISTURE CONTENT	16.3%
FINAL MOISTURE CONTENT	28.6%
MOIST. PICK-UP (% DRY WT.)	12.3%
MOIST. PICK-UP (% IN. VOL.)	18.2%
SWELL (% INITAL HT.)	0.36%

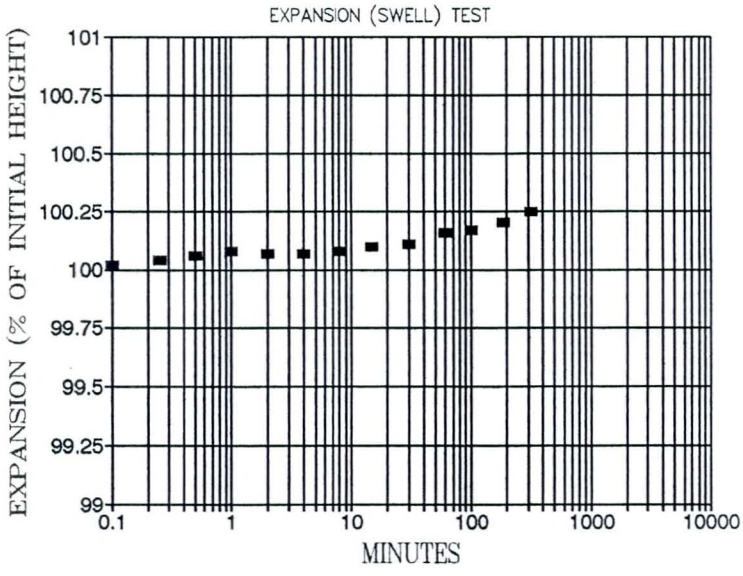


AGRA Earth & Environmental

PROJECT:	DESIGN OF SANTAN CHANNEL	**JOB NO:**	6-117-000356
LOCATION:	SOUTH VALLEY DRAINAGE	**WORK ORDER NO:**	4
MATERIAL:		**LAB NO:**	131
SAMPLE SOURCE:	#17 @ 9.5-10.5m	**DATE SAMPLED:**	10-30-97
SAMPLE PREP:	REMOLD		
TARGET:	92.9 PCF @ 18.9% MOISTURE		
LOAD:	1 PSI		

ONE DIMENSIONAL SWELL OR SETTLEMENT OF SOILS (ASTM D-4546)

INITIAL DRY DENSITY	102.7 pcf
FINAL DRY DENSITY	102.4 pcf
INITIAL MOISTURE CONTENT	20.3%
FINAL MOISTURE CONTENT	23.4%
MOIST. PICK-UP (% DRY WT.)	3.0%
MOIST. PICK-UP (% IN. VOL.)	5.0%
SWELL (% INITAL HT.)	0.25%



IAS Laboratories

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

November 19, 1997

Submitted by: Cliff Metz/PO#5497

Report to: Agra Earth & Environmental

Report No: 6604567

Job# 6-117-000356

SOIL ANALYSES

Sender ID	Lab No	pH	Chloride	S04-S
#16@3.05-4.57	627	8.7	660 ppm	720 ppm
#1@0.0-1.52	628	8.7	360 ppm	85 ppm
#9@1.52-3.05	629	8.7	140 ppm	28 ppm

APPENDIX C

CAS LABORATORY TESTING

December 26, 1997

Keith Dahlen
AGRA Earth & Environmental
3232 W. Virginia Avenue
Phoenix, AZ 85009-1502

Re: Santan Channel / Project #6-117-000356

Dear Keith:

Enclosed are the results of the samples submitted to our laboratory on December 18, 1997. For your reference, these analyses have been assigned our service request number X9702661.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed. Columbia Analytical Services, Inc. is certified for environmental analyses by the Arizona Department of Health Services (Certificate #AZ0497).

Please call if you have any questions. My extension is 12.

Respectfully submitted,

Columbia Analytical Services, Inc.

Tracy L Dutton

Tracy L. Dutton
Project Chemist

TLD/lm

3902 East University Drive, Suite D2 ▪ Phoenix, AZ 85034 ▪ (602) 437-2001 ▪ 800-695-7222 ▪ Fax (602) 437-5308

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	AGRA Earth & Environmental	**Service Request:**	X9702661
Project:	Santan Channel/#6-117-000356	**Date Collected:**	12/18/97
Sample Matrix:	soil	**Date Received:**	12/18/97

Total Recoverable Petroleum Hydrocarbons

Prep Method:	METHOD	Units:	mg/Kg (ppm)
Analysis Method:	418.1 AZ	Basis:	Wet
Test Notes:			

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
0.5'-1'	X9702661-001	20	1	12/19/97	12/19/97	20	
5'-5.5'	X9702661-002	20	1	12/19/97	12/19/97	ND	
10'-10.5'	X9702661-003	20	1	12/19/97	12/19/97	ND	
15'-15.5'	X9702661-004	20	1	12/19/97	12/19/97	120	
Method Blank	X971219-MB	20	1	12/19/97	12/19/97	ND	

Approved By: JTD Date: 12-29-97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: AGRA Earth & Environmental
Project: Santan Channel/#6-117-000356
Sample Matrix: soil

Service Request: X9702661
Date Collected: 12/18/97
Date Received: 12/18/97
Date Extracted: 12/19/97
Date Analyzed: 12/19/97

Duplicate Summary
Total Recoverable Petroleum Hydrocarbons

Sample Name: 0.5'-1'
Lab Code: X9702661-001DUP
Test Notes:

Units: mg/Kg (ppm)
Basis: Wet

Analyte	Prep Method	Analysis Method	MRL	Sample Result	Duplicate Sample Result	Relative Percent Difference	Result Notes
TPH	METHOD	418.1 AZ	20	20	21	5	

Approved By: JJD Date: 12-29-97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	AGRA Earth & Environmental	**Service Request:**	X9702661
Project:	Santan Channel/#6-117-000356	**Date Collected:**	NA
LCS Matrix:	soil	**Date Received:**	NA
		Date Extracted:	12/19/97
		Date Analyzed:	12/19/97

Laboratory Control Sample Summary
Total Recoverable Petroleum Hydrocarbons

Sample Name:	Lab Control Sample	Units:	mg/Kg (ppm)
Lab Code:	X971219-LCS	Basis:	Wet
Test Notes:			

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
TPH	METHOD	418.1 AZ	495	591	119	60-133	

Approved By: JJD Date: 12-29-97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	AGRA Earth & Environmental	**Service Request:**	X9702661
Project:	Santan Channel/#6-117-000356	**Date Collected:**	12/18/97
Sample Matrix:	soil	**Date Received:**	12/18/97
		Date Extracted:	12/19/97
		Date Analyzed:	12/19/97

Matrix Spike Summary
Total Recoverable Petroleum Hydrocarbons

Sample Name:	0.5'-1'	Units:	mg/Kg (ppm)
Lab Code:	X9702661-001MS	Basis:	Wet
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
TPH	METHOD	418.1 AZ	20	497	20	546	106	60-133	

Approved By: JJD Date: 12-29-97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	AGRA Earth & Environmental	**Service Request:**	X9702661
Project:	Santan Channel/#6-117-000356	**Date Collected:**	12/18/97
Sample Matrix:	soil	**Date Received:**	12/18/97

Total Solids

Prep Method:	METHOD	Units:	mg/Kg (ppm)
Analysis Method:	160.3 Modified	Basis:	Wet
Test Notes:			

Sample Name	Lab Code	Date Analyzed	Result	Result Notes
0.5'-1'	X9702661-001	12/19/97	91	
5'-5.5'	X9702661-002	12/19/97	92	
10'-10.5'	X9702661-003	12/19/97	78	
15'-15.5'	X9702661-004	12/19/97	85	
Method Blank	X971219-MB	12/19/97	NA	

Approved By: JJD Date: 12-29-97

AGRA
Earth & Environmental

TO LABORATORY: Columbia Analytical
ADDRESS: 3902 E. University
Suite D-2
Phoenix AZ 85034
PHONE: 437-2001
CONTACT PERSON: Ms. Tracy Dutton

Chain of Custody

DATE 12-18-97 PAGE 1 OF 1

PROJECT NAME: SANTAN Channel
SITE LOCATION: 56th St + Pecos Rd
JOB NO. 6-117.000356

SAMPLERS (SIGNATURE) (PHONE NO.)

ANALYSES REQUESTED

SAMPLE I.D.	DATE	TIME	MATRIX	LAB I.D.	HALOGENATED 601/8010 VOLATILES	AROMATIC 602/8020 VOLATIES	TPH 418-1	CHLORINATED PESTICIDES & PCB'S 608/8080	CHLORINATED HERBICIDES 8150	TOTAL LEAD (PB)	TOTAL CHROMIUM (CR)	SDWA PRIMARY INORGANICS	SDWA SECONDARY INORGANICS	PRIORITY POLLUTANT METALS (TCLP)	BULK ASBESTOS (PLM)	NUMBER OF CONTAINERS
0.5-1'	12-18	8:25		2661-01			X									
5-5.5'	12-18	8:57		02			X									
10-10.5'	12-18	9:10		03			X									
15-15.5'	12-18	9:15		04			X									

PROJECT INFORMATION	SAMPLE RECEIPT	
PROJECT MANAGER	TOTAL NO. OF CONTAINERS	4
Keith Dahlen	CHAIN OF CUSTODY SEALS	
SHIPPING I.D. NO.	REC'D GOOD CONDITION/COLD	
VIA:	CONFORMS TO RECORD	
P.O. 30657	LAB NO. X9702661	

SPECIAL INSTRUCTIONS/COMMENTS:

	1.	2.	3.
RELINQUISHED BY	[signature] 12-18-97		
(SIGNATURE) (TIME)	Bob Judd 1645		
(PRINTED NAME) (DATE)	AEE		
(COMPANY)			
RECEIVED BY	Leslie May		RECEIVED BY (LABORATORY)
(SIGNATURE) (TIME)	Leslie May 1643		
(PRINTED NAME) (DATE)	CAS 12-18-97		
(COMPANY)			

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