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**Geotechnical Engineering Report
Northern/Orangewood Storm Drain Project
Phase II
Glendale Avenue
99th Avenue to 83rd Avenue
Glendale, Arizona
R.A.M. Project No. G01522
Report No. 2**



RICKER • ATKINSON • McBEE & ASSOCIATES, INC.
Geotechnical Engineering • Construction Materials Testing

**Geotechnical Engineering Report
Northern/Orangewood Storm Drain Project
Phase II
Glendale Avenue
99th Avenue to 83rd Avenue
Glendale, Arizona
R.A.M. Project No. G01522
Report No. 2**

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RICKER • ATKINSON • McBEE & ASSOCIATES, INC.

Geotechnical Engineering • Construction Materials Testing

Wood, Patel & Associates
1550 E. Missouri, Suite 203
Phoenix, Arizona 85014

January 20, 1998

Attention: Ashok Patel, P.E.

Subject: Geotechnical Engineering Report
Northern/Orangewood Storm Drain Project
Phase II
99th Avenue to 83rd Avenue
Glendale, Arizona

R.A.M. Project No. G01522
Report No. 2

Attached to this letter is the Geotechnical Engineering Report for the proposed Northern/Orangewood Storm Drain Project to be located in Glendale, Arizona.

The proposed project will include two miles of storm drain along Glendale Avenue from 99th Avenue to 83rd Avenue. The results of our field exploration; laboratory testing; and engineering analysis, evaluation and recommendations are presented in the report.

The following is a brief summary of selected recommendations.

A. Site Soils:

- Use as fill in pavement areas.

B. Replacement Pavement:

- If existing pavements are to be replaced in kind, then the minimum section should be 8 inches of asphalt concrete on 9 inches of base material.
- If based on City of Glendale design procedure, a pavement section of 4 inches of asphalt concrete on 12 inches of base material is required.

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

Respectfully submitted,

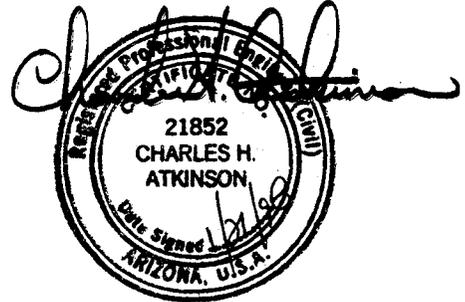
RICKER, ATKINSON, MCBEE & ASSOCIATES, INC.



By: Kenneth L. Ricker, P.E.

/nk

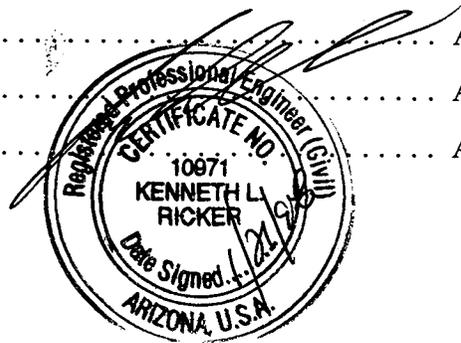
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Reviewed by: Charles H. Atkinson, P.E.

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REPORT

INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Northern/Orangewood Storm Drain Project - Phase II in Glendale, Arizona. The scope of our services included performing a field exploration program, laboratory analysis and geotechnical engineering evaluation, analysis and recommendations. The geotechnical recommendations presented herein consist of pavement design, site development, material suitability and requirements and site preparation and grading procedures. We would be pleased to discuss with you any additional recommendations you may require. In addition, we are available to review project specifications and plans for conformance with our recommendations at no charge to you.

This firm should be notified for additional evaluation and recommendations should the facility design parameters (location, type, size, structural loads), site use or conditions encountered during construction differ from those presented herein.

PROPOSED CONSTRUCTION

The Northern/Orangewood Storm Drain Project - Phase II will include a storm drain along Glendale Avenue from 99th Avenue to 83rd Avenue. The storm drain will be a 72- to 108-inch diameter pipe and will be buried 12 to 15 feet below existing street grade near the centerline of Glendale Avenue. Replacement pavement will be required along Glendale Avenue.

SITE CONDITIONS

The Glendale Avenue storm drain will be located along a four-lane paved road with some medians and center turn lanes. The road extends through farmland with some residential areas on the south side.

FIELD EXPLORATIONS

Subsurface conditions were explored by drilling twenty-one test borings to depths of 10 to 21 feet as shown on the Site Plans in Appendix A. The test borings were drilled with a CME 55 drill rig using 7-inch diameter, hollow-stem augers. The drilling equipment and crew were provided by D

& S Drilling, Inc. The test boring locations were determined in the field by a technician from our firm who also directed the drill crew. During the field explorations, representative disturbed and undisturbed samples were obtained, the test borings logged and soils field classified by our technician. The relatively undisturbed samples were obtained by driving a 3-inch diameter, ring-lined, open-end sampler into the soil with a 140-pound hammer dropping 30 inches. In addition, standard penetration tests were performed at selected depths. The results of the field explorations are presented in Appendix A.

LABORATORY ANALYSIS

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

<u>Type of Test</u>	<u>Type of Sample</u>	<u>Number of Samples Tested</u>
Sieve Analysis and Atterberg Limits (ASTM C136, D1140, D4318)	Representative	42
Standard Proctor (ASTM D698)	Representative	3
R-Value (ASTM D2844)	Representative	4
Moisture Content/Dry Density*	Undisturbed (Ring)	14
Moisture Content	Split-Spoon	26

* R-Value test performed by Maxim Technologies, Inc.

**Reported on the test boring logs

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

SUBSURFACE CONDITIONS

The subsurface conditions encountered at the test boring locations were variable. The results of each test boring are presented in Appendix A in the Test Boring Logs. In Test Borings 1, 2, 4, 5, 10, 11, 12 and 16 through 21 the surface soils to depths of 5 to 12 feet were stiff sandy clays of medium to high plasticity. The underlying soils in these test borings and the soil for the full depth of

exploration in Test Borings 3, 6, 7, 8, 9, 13, 14 and 15 were medium dense to very dense granular soils with some layers of sandy clay. The granular soils were composed of clayey sand and gravel, silty to clayey sand with some gravel, clayey sand with a trace to some gravel, clayey gravelly sand, gravelly sand and sandy gravel with some clay. The surface soils were overlain by 5 to 10 inches of asphalt concrete on 4 to 15 inches of base material. Refusal to auger penetration occurred in Test Borings 2, 4 and 10 at depths of 10.0 to 14.5 feet.

The soil moisture was described as nearly dry to slightly damp. At the time of field explorations for the project no groundwater was encountered in our test borings. Groundwater at the sites is relatively deep and will not influence construction.

PAVEMENT DESIGN RECOMMENDATIONS

Replacement Pavements:

The City of Glendale design criteria was used in developing a pavement section for replacement pavements. Two options are available for the pavement replacement areas.

1. Replace in kind: Based on the existing sections, minimum thickness should be 8.0 inches of asphalt concrete on 9.0 inches of base material along Glendale Avenue.
2. Design section: Based on the City of Glendale procedures for section and half-section streets, the thickness should be 4.0 inches of asphalt concrete on 12.0 inches of base material for all pavements.

It is recommended that the City of Glendale select the best option based on the current roadway conditions, projected traffic and planned future improvements.

For 4.0-inch-thick asphalt pavements the asphalt concrete mix used shall be MAG 19mm (Arterial). The upper 4 inches of base material shall be MAG Aggregate Base and the remainder may be MAG Select. All pavement sections should be constructed in accordance with MAG Specifications as

modified by the City of Glendale.

The above sections are minimal and should function well with periodic maintenance (seal coats, overlays or patching) where proper drainage is provided and maintained. Should moisture penetrate the subgrade soils or ponding occur on or adjacent to the pavement section, increased maintenance and a significant reduction in pavement life could occur. Therefore, good surface drainage on and adjacent to the pavement is essential for achieving the desired pavement life.

Surface Drainage:

Most soils will undergo some degree of volume change as the result of wetting. The degree of volume change will depend on the type of soil, swell potential, natural soils structure or degree of compaction (if a fill). These volume changes could result in movements in overlying facilities and non-structure elements including sidewalks, planters, retaining walls, floor slabs, etc. Therefore, good site and surface drainage away from these elements is required. In addition, water should not be allowed to pond within 10 feet of the facilities or other elements which are sensitive to movements. The exterior footing excavation backfill must be well compacted to minimize the possibility of moisture infiltration through this zone.

Excavatability:

The excavatability of site materials is difficult to evaluate based only on the exploration equipment used during this design report. Therefore, we recommend that the contractor evaluate the excavatability of site materials by performing test excavations with the size and type of equipment the contractor plans on using at the site. For design purposes the following paragraph presents our best analysis as to the excavatability of site soils.

The near surface soils can probably be removed with conventional excavating equipment. Excavations penetrating the granular deposits containing large amounts of gravel will be slower and more difficult to accomplish. OSHA requires all excavations over five feet in depth, in which personnel are to enter, be either braced or sloped in accordance with OSHA regulations.

Earthwork Factors:

Earthwork losses due to ground height losses and shrinkage were estimated based on past experiences in the area and limited test data. The materials encountered at the site were of low to medium density. The estimated ground height losses due to subgrade compaction are as follows for previously ungraded areas:

*Ground Height Loss at Given Percent Compaction

<u>95%</u>	<u>100%</u>
0.5" to 1.0"	0.8" to 1.3"

* Based on maximum dry density obtained by ASTM D698 dry densities obtained from samples, and achieving an 8-inch deep compacted zone without stripping natural surface zones. These values do not include recompaction of zone disturbed by demolition or previous site usage.

The estimated shrinkage losses from cut to fill zones are as follows for naturally occurring soils. Where existing fills are reconditioned considerable shrinkage to some gain in material is expected:

*Estimated Percent Shrinkage at Given Percent Compaction

<u>Depth of Excavation</u>	<u>95%</u>	<u>100%</u>	<u>105%</u>
0 to 10 feet	15%± 2%	20% ± 2%	25% ± 2%
10 to 20 feet	10%± 2%	15% ± 2%	20% ± 2%

*Based on maximum dry density obtained by ASTM D698 and dry densities obtained from samples for natural undisturbed soils from the near surface zone and local experience.

Our experience with earthwork losses has generally indicated that subgrades and fill zones compacted to a minimum value of 95% of maximum dry density (ASTM D698) result in losses comparable to 100% compaction (similarly for 90% minimum use 95% and for 100% minimum use 105%). These estimates do not include compaction to greater depths than assumed, losses due to wind or wastage, over-excavation, etc. These values do not include recompaction of zones disturbed

by demolition or previous site usage.

Workability:

Wetting site soils such that moisture contents are at or above optimum could result in some soil pumping under dynamic loadings such as heavy construction equipment driving over the area. In building areas, some pumping is not detrimental to foundation or floor slabs provided the specified percent compaction is achieved. However, in flexible pavement areas where pumping has occurred, and in building areas where severe pumping has damaged subgrade conditions, the area should be allowed to dry until soils are workable without pumping, or the wetted areas removed and replaced with drier site soils.

Construction Excavation:

At the time of our field exploration and to the depth explored, no groundwater was observed in the test borings.

1. In excavations, unbraced temporary slopes in the surface sandy clay soils should stand at slopes of 3/4H:1V. Locally, it may be necessary to flatten slopes to 1.5H:1V if very clean, loose sand lenses of significant thickness are encountered. Excavations into the granular soils may be constructed at a slope of 1H:1V. As an alternative, localized bracing or shoring may be required in areas of caving and lenses.
2. Surface areas behind the crest of excavations should be graded so that surface waters do not pond within 10 feet of the crest, or drain into the excavation.
3. Heavy material stockpiles should not be placed within 10 feet of the crest. Similarly, heavy construction equipment should not pass or be parked within 10 feet of the crest.
4. The crest of slopes should be monitored daily for evidence of movement or potential problems.

The design of any bracing systems should be reviewed by a qualified geotechnical engineer. Also, observations should be made by the geotechnical engineer during excavating to evaluate site conditions and determine if modifications are necessary in excavation procedures. If unbraced slopes are utilized, some surface raveling, erosion, and spalling should be expected unless measures are taken to stabilize exposed cut surfaces.

MATERIALS SUITABILITY AND REQUIREMENTS

Site Soils:

The near surface clay soils exhibit medium to high plasticity. These soils may be used as fill in pavement area or as storm drain backfill. These soils must be mechanically compacted to required densities.

Imported Soils:

Fill and backfill required around the facilities or in exterior slab areas or for use as retaining wall backfills should be imported soils meeting the following requirements:

Maximum Particle Size	6 inches
Maximum Swell Potential	1.5%*

*Based on a sample which is remolded to 95% of the ASTM D698 maximum dry density at a moisture content of 2 percent below optimum, placed under a surcharge load of 100 psf and wetted.

Base Material:

Base material used below concrete slab and pavement areas should conform to the requirements of Maricopa Association of Governments (MAG) Specifications for Aggregate Base (Section 702). Existing asphalt concrete pavement which is milled may be used as base and select materials provided the material meets the requirements of MAG Section 702.

Asphalt Concrete Pavement:

Asphalt concrete pavement materials should conform to the requirements of MAG Specifications as modified by the City of Glendale (Superpave Mixes may be required).

Pipe Bedding:

Material used as pipe bedding should be granular soils which meet the requirements of MAG Specifications as modified by the City of Glendale.

SITE PREPARATION AND GRADING PROCEDURES

Pavement Areas:

Recommendations presented in the previous sections of this report are based upon the following site preparation and grading procedures. Therefore, all earthwork should be accomplished with observation and testing by a qualified technician under the direction of a registered geotechnical/materials engineer. The following apply to pavement areas disturbed by installation of the storm drain.

1. Clear and grub the site by removing and disposing of all pavement section, debris, rubble and remnants of former developments.
2. Moisture condition and place all fill and backfill materials required to achieve specified grades. Fill materials should be moisture conditioned, placed and compacted in horizontal lifts of thicknesses compatible with the compaction equipment being used.
3. Compact subgrade, fill, backfill, subbase fill or base material to the following minimum percent compaction of the ASTM D698 maximum dry density for each lift.

Material

Minimum Percent Compaction

Soil:

Below pavements----- 95

Base Material:

Below pavements----- 100

4. The moisture content of soil and base materials at the time of compaction should be:

<u>Type</u>	<u>Area of Use</u>	<u>Moisture Content</u>
On-site Soil	Pavement	2% below optimum or lower
Imported Soil	Pavement	2% below optimum or lower
Base Material	Pavement	Optimum plus or minus 3%

5. Any soils which are disturbed or overexcavated by the contractor outside the limits of the plans or specifications should be replaced with materials compacted as specified above.

APPENDIX A
FIELD EXPLORATIONS



FUTURE CHANNEL

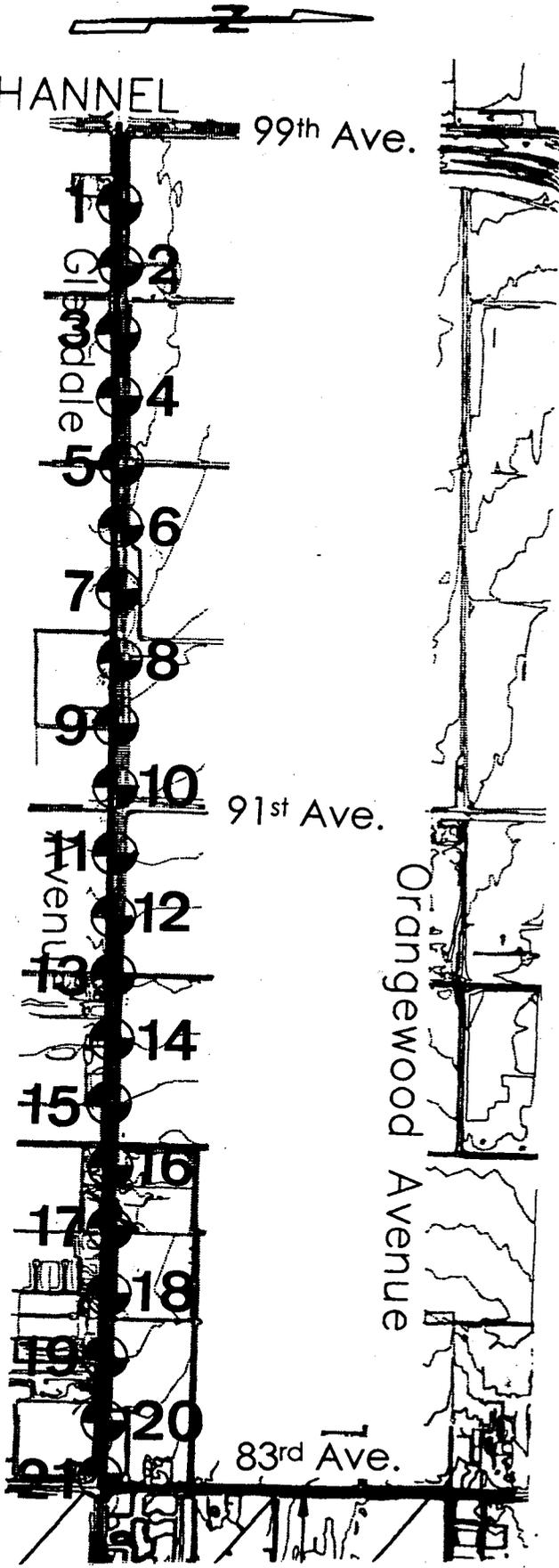
99th Ave.

91st Ave.

83rd Ave.

Gardale

Orangewood Avenue



Test Boring Location

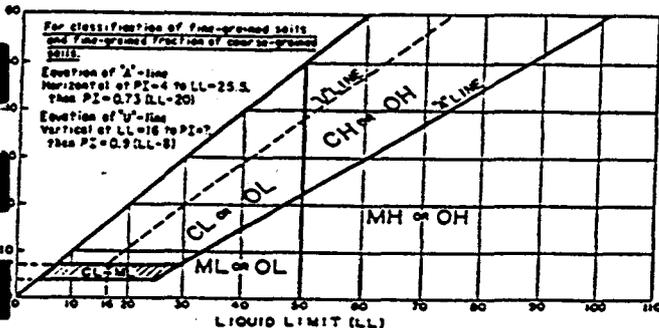
SITE PLAN

LEGEND

CLASSIFICATION OF SOILS

ASTM Designation: D2487-83
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests			Soil Classification		
			Group Symbol	Name	
COARSE-GRAINED SOILS More than 50% retained on No. 200 Sieve	Gravels More than 50% coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines	$Cu > 4$ and $1 < Cc < 3$	GW	Well graded gravel
			$Cu < 4$ and/or $1 > Cc > 3$	GP	Poorly graded gravel
	Gravels with Fines More than 12% fines		Fines classify as ML or MH	GM	Silty gravel
			Fines classify as CL or CH	GC	Clayey gravel
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	$Cu > 6$ and $1 < Cc < 3$	SW	Well-graded sand
			$Cu < 6$ and/or $1 > Cc > 3$	SP	Poorly graded sand
Sands with Fines More than 12% fines		Fines classify as ML or MH	SM	Silty sand	
		Fines classify as CL or CH	SC	Clayey sand	
FINE-GRAINED SOILS 50% or more passes the No. 200 Sieve	Silts and Clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line	CL	Lean clay
			$PI < 4$ or plots below "A" line	ML	Silt
	Organic		Liquid Limit - oven dried Liquid limit - not dried < 0.75	OL	Organic clay Organic silt
			PI plots on or above "A" line	CH	Fat clay
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots below "A" line	MH	Elastic silt
			Organic	Liquid limit - oven dried Liquid limit - not dried < 0.75	OH
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor				PT



TEST BORING LOG DEFINITIONS

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

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

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

U.S. STANDARD SERIES SIEVE			GRAIN SIZES		CLEAR SQUARE SIEVE OPENINGS		
200	40	10	4	3/4"	3"	12"	
SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
MOISTURE CONDITION (INCREASING MOISTURE →)							
DRY	SLIGHTLY DAMP		DAMP (Plastic Limit)	MOIST	VERY MOIST	WELL (SATURATED) (Liquid Limit)	
CONSISTENCY CORRELATION				RELATIVE DENSITY CORRELATION			
CLAYS & SILTS		BLOWS/FOOT*		SANDS & GRAVELS		BLOWS/FOOT*	
VERY SOFT	0-2		VERY LOOSE	0-4			
SOFT	2-4		LOOSE	4-10			
FIRM	4-8		MEDIUM DENSE	10-30			
STIFF	8-16		DENSE	30-50			
VERY STIFF	16-32		VERY DENSE	OVER 50			
HARD	OVER 32						
*Number of blows of 140 lb. hammer falling 30" to drive a 2" O.D. (1-3/8" I.D.) split-spoon sampler (ASTM D1586).							

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 5+75
 Elevation: 1065.5 Datum: City of Glendale

TEST BORING: 2
 Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 8" Base Material.
						CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
		6	N		10	SC/ SM	Silty to Clayey Sand, Some Gravel; brown, slightly damp, medium dense, low plasticity fines.
10		28	R	NR		SC/ GC	Clayey Sand and Gravel; brown, slightly damp, dense, medium plasticity fines.
15							Refusal at 14 feet. No Groundwater Observed. NR = No Recovery.
20							
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.10+75

TEST BORING: 3

Elevation: 1066

Datum: City of Glendale

Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 8" Base Material.
10		31	R	NR		SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
15		16	N		3	SC/ SM	Silty to Clayey Sand, Some Gravel; brown, slightly damp, medium dense, low plasticity fines.
20		50/2"	R	NR			Stopped drilling at 15 feet. No Groundwater Observed. NR = No Recovery.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 15+75
 Elevation: 1067 Datum: City of Glendale

TEST BORING: 4
 Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 10" Base Material.
						CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
	10		N		9	SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
10		18	R	NR			
15							Refusal at 14.5 feet. No Groundwater Observed. NR = No Recovery.
20							
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 21+00
 Elevation: 1068 Datum: City of Glendale

TEST BORING: 5
 Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 8" Base Material.
						CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
10	27		R	NR		SC	Clayey Gravelly Sand; brown, slightly damp, medium dense to dense, medium plasticity fines.
15	32		N		5	SC/ GC	Clayey Sand and Gravel; brown, slightly damp, dense, medium plasticity fines.
20	50/2"		R	NR			Stopped drilling at 15 feet. No Groundwater Observed. NR = No Recovery.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.26+00 TEST BORING: 6
 Elevation: 1069.5 Datum: City of Glendale Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							5" Asphalt Concrete on 12" Base Material.
10		16	N		8	SC/ GC	Clayey Sand and Gravel; brown, slightly damp, dense, medium plasticity fines.
15		12	R	NR		SC	Clayey Gravelly Sand; brown, slightly damp, medium dense to dense, medium plasticity fines.
20		50/2"	N	NR			Stopped drilling at 15 feet. No Groundwater Observed. NR = No Recovery.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.31+00
 Elevation: 1074 Datum: City of Glendale

TEST BORING: 7
 Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							6" Asphalt Concrete on 8" Base Material.
						SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
	14		R	NR			
10						SP/SM	Gravelly Sand, Some Silt; brown, nearly dry, medium dense to dense, no to low plasticity fines.
	33		N		3		
15							
20		50/2"	R	NR			Stopped drilling at 17 feet. No Groundwater Observed. NR = No Recovery.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.36+00

TEST BORING: 8

Elevation: 1075

Datum: City of Glendale

Date: 12-23-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							7" Asphalt Concrete on 15" Base Material.
10		24	N		6	SC	Clayey Gravelly Sand; brown, slightly damp, medium dense to dense, medium plasticity fines.
15		50/6"	R	109	6		
20		50/3"	N		7		Stopped drilling at 17 feet. No Groundwater Observed.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.41+00
 Elevation: 1077 Datum: City of Glendale

TEST BORING: 9
 Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
0							8" Asphalt Concrete on 12" Base Material.
5						SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
5	20		R	NR			
10						SP/ SM	Gravelly Sand, Some Silt; brown, nearly dry, medium dense to dense, no to low plasticity fines.
10	16		N		2		
15							
15	50/4"		R	NR			
20							Stopped drilling at 17 feet. No Groundwater Observed. NR = No Recovery.
20							
25							
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.46+00
 Elevation: 1078

TEST BORING: 10
 Datum: City of Glendale
 Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 10" Base Material.
10		16	N		6	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15							Refusal at 10 feet. No Groundwater Observed.
20							
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.51+00
 Elevation: 1078 Datum: City of Glendale

TEST BORING: 11
 Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 12" Base Material.
						CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
	50/8"	R	123	9			
10						GP/ GC	Sandy Gravel, Some Clay; brown, slightly damp, dense to very dense, medium plasticity fines.
	50/4"	N	NR				
15							Stopped drilling at 15 feet. No Groundwater Observed. NR = No Recovery.
	50/2"	R	NR				
20							
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta.56+00
 Elevation: 1081 Datum: City of Glendale

TEST BORING: 12
 Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							9" Asphalt Concrete on 10" Base Material.
10		22	N		12	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15		50/2"	R	NR		SC/ GC	Clayey Sand and Gravel; brown, slightly damp, dense, medium plasticity fines.
20		50/2"	N		7		Stopped drilling at 15.5 feet. No Groundwater Observed. NR = No Recovery.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 61+00
 Elevation: 1084

TEST BORING: 13
 Datum: City of Glendale Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5		50/3"	R	NR		SC	8" Asphalt Concrete on 10" Base Material. Clayey Gravelly Sand; brown, slightly damp, medium dense to dense, medium plasticity fines.
10		8	N		20	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15		50/6"	R	121	6		
20							Stopped drilling at 17 feet. No Groundwater Observed. NR = No Recovery.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 66+00
 Elevation: 1086 Datum: City of Glendale

TEST BORING: 14
 Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
0							10" Asphalt Concrete on 10" Base Material.
5		50/2"	N	NR		SC	Clayey Gravelly Sand; brown, slightly damp, medium dense to dense, medium plasticity fines.
10		25	R	105	16		
15		21	N		3		
20		22	R	104	21		
25							Stopped drilling at 21 feet. No Groundwater Observed. NR = No Recovery.
This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.							

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 71+00 TEST BORING: 15
 Elevation: 1088.5 Datum: City of Glendale Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							7" Asphalt Concrete on 10" Base Material.
10		50/2"	R	NR		SC	Clayey Gravelly Sand; brown, slightly damp, medium dense to dense, medium plasticity fines.
15		44	N		9		
20		50/2"	R	NR		GP/ GC	Sandy Gravel, Some Clay; brown, slightly damp, dense to very dense, medium plasticity fines.
25		50/2"	N		5		Stopped drilling at 20.5 feet. No Groundwater Observed. NR = No Recovery.

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 76+00 TEST BORING: 16
 Elevation: 1090 Datum: City of Glendale Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							7" Asphalt Concrete on 10" Base Material.
						CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
	35	N		7	7	SC/ SM	Silty to Clayey Sand, Some Gravel; brown, slightly damp, medium dense, low plasticity fines.
10							7" Asphalt Concrete on 10" Base Material.
	23	R		106	14	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15							Some Moderate Cementation
	26	N			16		
20							
	26	R		146	13		
25							Stopped drilling at 21 feet. No Groundwater Observed.
							This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 81+00
 Elevation: 1091

TEST BORING: 17
 Date: 12-24-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							7" Asphalt Concrete on 10" Base Material.
10	27		R	109	13	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15	18		N		12	SC/ SM	Silty to Clayey Sand, Some Gravel; brown, slightly damp, medium dense, low plasticity fines.
20	33		R	115	5		
25							Stopped drilling at 17 feet. No Groundwater Observed.
							This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 86+00
 Elevation: 1092

TEST BORING: 18
 Date: 12-26-97

Datum: City of Glendale

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
0							7" Asphalt Concrete on 10" Base Material.
5		31	N		4	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
10		24	R	101	16	SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
15		25	N		6		
20							Stopped drilling at 16.5 feet. No Groundwater Observed.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 91+00
 Elevation: 1093 Datum: City of Glendale

TEST BORING: 19
 Date: 12-26-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8" Asphalt Concrete on 10" Base Material.
10		17	R	104	17	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15		17	N		9	SP/ SM	Gravelly Sand, Some Silt; brown, nearly dry, medium dense to dense, no to low plasticity fines.
20		Not Recorded	R	122	5		Stopped drilling at 16 feet. No Groundwater Observed.
25							

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 96+00

TEST BORING: 20

Elevation: 1094.5

Datum: City of Glendale

Date: 12-26-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							10" Asphalt Concrete on 14" Base Material.
10	30	N			14	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
15	23	R	NR			SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
20	14	N			7		Stopped drilling at 16 feet. No Groundwater Observed. NR= No Recovery.
25							This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project, Sta. 101+00
 Elevation: 1096 Datum: City of Glendale

TEST BORING: 21
 Date: 12-26-97

Depth, feet	Blows/Foot		Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
	C	N/R					
5							8.5" Asphalt Concrete on 14" Base Material.
8	8		R	119	6	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff, medium to high plasticity.
10	16		N		11		
15						SC	Clayey Sand, Trace to Some Gravel; brown, slightly damp, medium dense, medium plasticity fines.
20	33		R	NR			Stopped drilling at 15 feet. No Groundwater Observed. NR= No Recovery.
25							

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

APPENDIX B
LABORATORY ANALYSIS

LABORATORY TEST RESULTS

Date: 9-Jan-98

SAMPLE SOURCE: As noted below

TESTING PERFORMED: Sieve Analysis, Percent Passing No. 200 Sieve, Atterberg Limits (ASTM C136, D1140, D4318)

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	Atterberg Limits		Sieve Size - Accumulative Percent Passing											Soil Class.*
	LL	PI	200	100	50	30	16	8	4	3/4"	1"	2"	3"	
1 @ 0'-5'	41	26	55	63	72	81	88	92	95	98	100			CL
1 @ 10'-16'	29	15	17	21	26	33	40	49	59	94	98	100		SC
2 @ 0'-5'	39	22	58	66	77	86	92	96	99	100				CL
2 @ 5'-10'	20	6	25	33	47	62	74	84	90	100				SC-SM
3 @ 0'-5'	34	18	44	51	61	75	85	92	96	100				SC
3 @ 10'-15'	20	5	12	16	23	37	55	72	84	100				SC-SM
4 @ 0'-5'	38	20	49	55	63	75	84	91	95	97	100			SC-CL
4 @ 5'-10'	29	13	25	28	39	52	66	78	87	97	100			SC
5 @ 0'-5'	32	17	46	52	59	70	79	88	91	98	100			SC
5 @ 10'-15'	29	14	17	20	24	31	43	58	70	92	100			SC
6 @ 0'-5'	27	11	16	20	25	33	39	46	55	95	100			GC
6 @ 5'-10'	22	7	17	22	30	41	53	66	76	96	100			SC-SM
7 @ 0'-5'	27	13	27	32	40	51	63	77	89	100				SC
7 @ 10'-17'		NP	9	12	17	29	41	55	68	91	94	100		SP-SM
8 @ 0'-5'	28	12	33	40	47	56	64	71	79	97	100			SC
8 @ 5'-10'	24	10	17	21	26	34	44	56	70	92	100			SC
9 @ 0'-5'	29	13	31	37	42	51	63	75	84	96	100			SC
9 @ 10'-17'		NP	12	16	26	41	55	71	85	100				SM
10 @ 0'-5'	35	18	57	64	70	78	84	90	93	100				CL
10 @ 5'-10'	37	20	47	54	62	71	78	84	87	96	100			SC
11 @ 0'-5'	38	23	59	66	72	80	88	93	96	100				CL
11 @ 10'-15'	35	18	9	11	12	14	17	24	35	88	96	100		GP-GC
12 @ 0'-5'	44	27	49	57	64	73	81	88	93	100				SC-CL
12 @ 5'-10'	40	26	51	58	67	78	85	90	94	100				CL-SC
13 @ 0'-5'	44	27	41	48	54	60	66	73	79	90	93	100		SC
13 @ 10'-17'	53	32	48	53	58	65	73	81	87	97	100			SC-CH
14 @ 0'-5'	35	18	32	39	44	53	61	69	77	94	100			SC
14 @ 15'-20'	42	24	23	26	31	42	52	61	71	99	100			SC

NP = Non-Plastic

* Unified Soil Classification System

LABORATORY TEST RESULTS

Date:

9-Jan-98

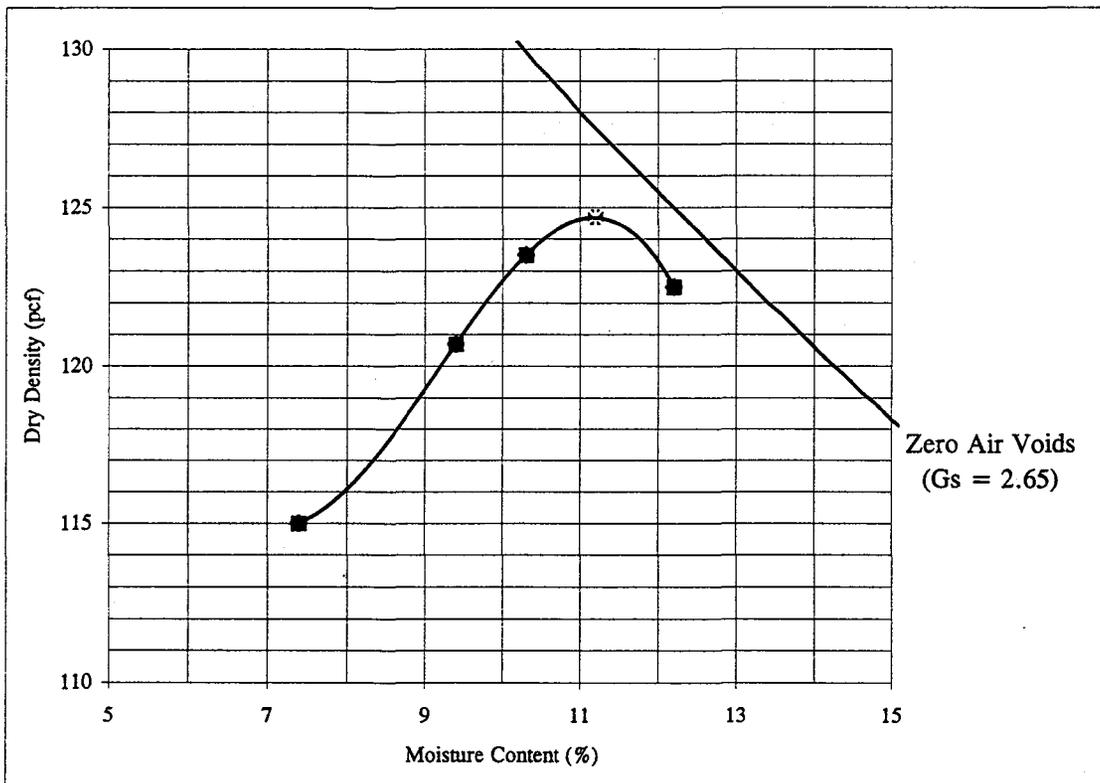
SAMPLE SOURCE: Composite: 4 @ 0'-5', 4 @ 5'-10'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 124.7 Optimum Moisture (%) = 11.2



LABORATORY TEST RESULTS

Date:

9-Jan-98

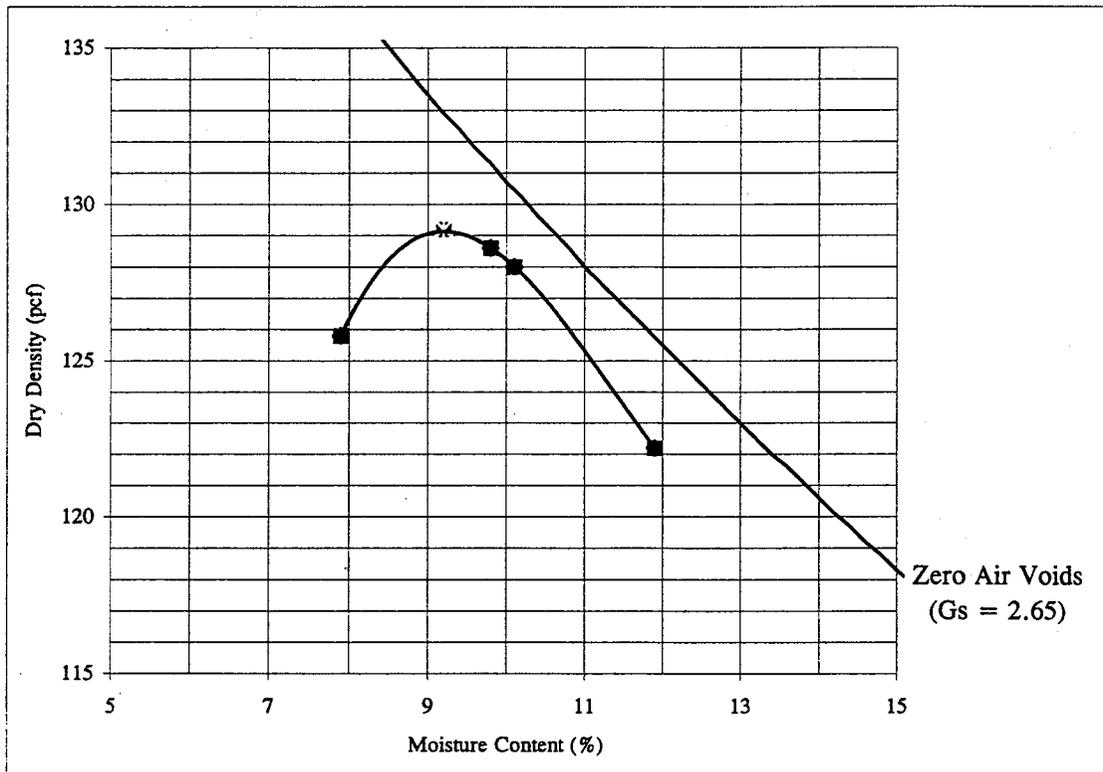
SAMPLE SOURCE: Composite: 11 @ 5'-10', 11 @ 10'-15'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 129.2 Optimum Moisture (%) = 9.2



LABORATORY TEST RESULTS

Date:

9-Jan-98

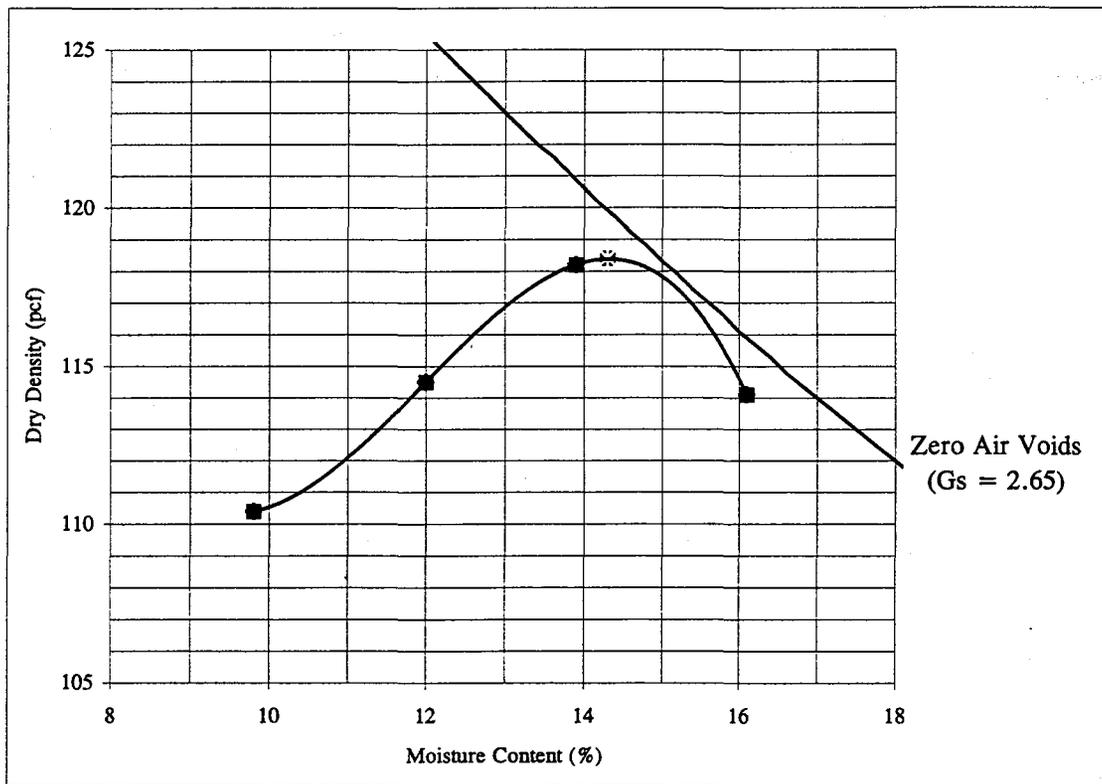
SAMPLE SOURCE: Composite: 18 @ 5'-10', 18 @ 10'-16'

TESTING PERFORMED Maximum Density-Optimum Moisture Determination (ASTM D698 Method A)

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 118.4 Optimum Moisture (%) = 14.3



REPORT ON R-VALUE TESTS

Project: Ricker Atkinson & McBee
 Laboratory Materials Testing
 G01522
Source: 2 & 3 @ 0-5'

Report No: 67319
Project No: 9748448
Date: 14-Jan-98

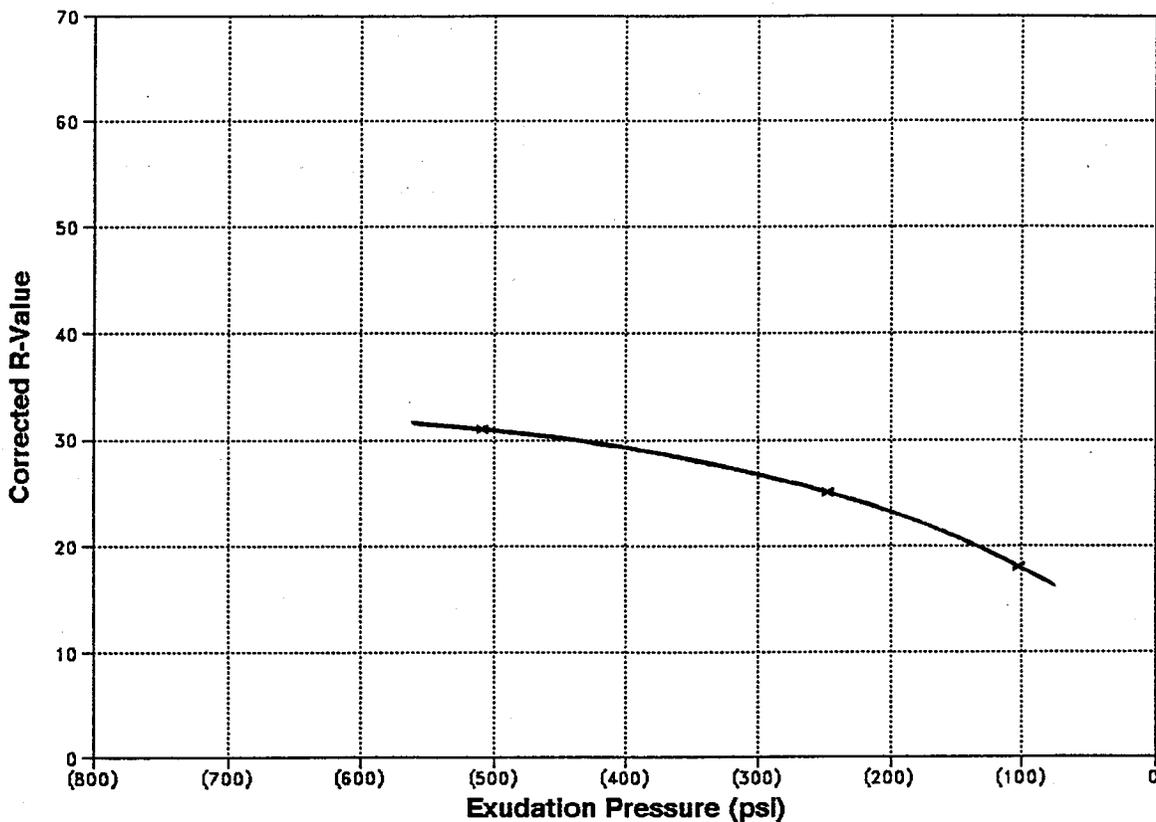
Submitted: 30-Dec-97

Sampled By: RAM

TEST METHOD: ASTM D2844

SAMPLE GRADING: MINUS -3/4"

Moisture Content(%)	Dry Density(pcf)	Expansion Pressure(psi)	Exudation Pressure(psi)	Corrected R-Value
15.4	114.6	0.00	102	18
14.0	120.0	0.00	247	25
13.0	125.4	1.23	508	31



Corrected R-Value at 300 PSI = 26

REPORT ON R-VALUE TESTS

Project: Ricker Atkinson & McBee
 Laboratory Materials Testing
 G01522

Report No: 67319
 Project No: 9748448
 Date: 12-Jan-98

Source: 19 & 20 @ 0-5'

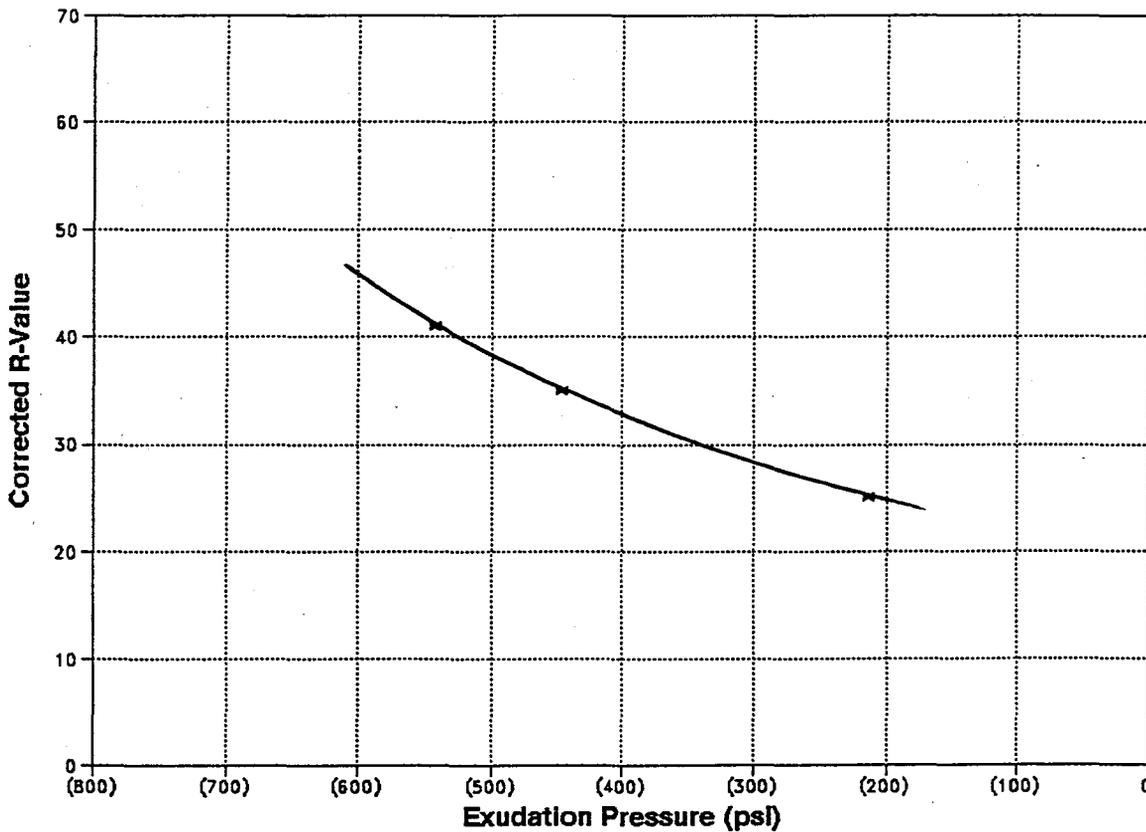
Submitted: 30-Dec-97

Sampled By: RAM

TEST METHOD: ASTM D2844

SAMPLE GRADING: MINUS -3/4"

Moisture Content (%)	Dry Density (pcf)	Expansion Pressure (psi)	Exudation Pressure (psi)	Corrected R-Value
15.4	113.6	0.00	213	25
13.8	120.6	0.88	543	41
14.5	119.2	0.35	446	35



Corrected R-Value at 300 PSI = 38

REPORT ON R-VALUE TESTS

Project: Ricker Atkinson & McBee
 Laboratory Materials Testing
 G01522

Report No: 67319
 Project No: 9748448
 Date: 12-Jan-98

Source: 12 & 13 @ 0-5'

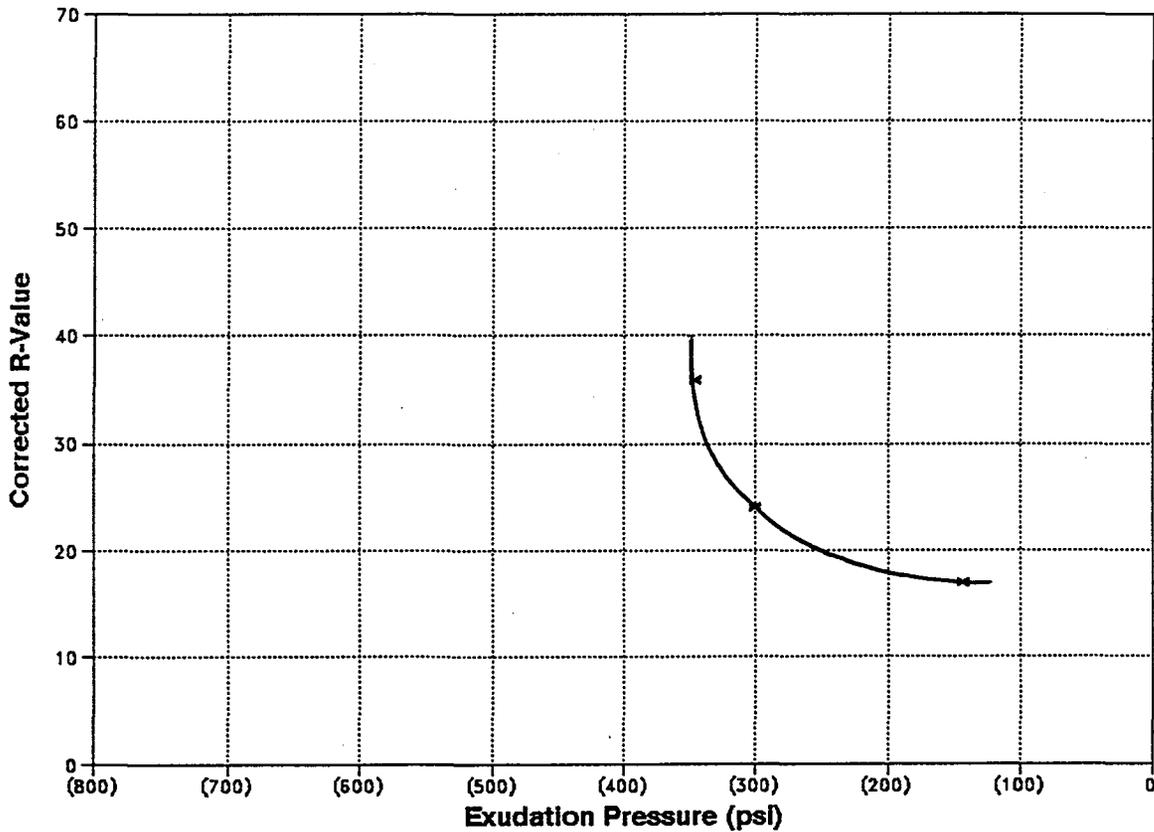
Submitted: 30-Dec-97

Sampled By: RAM

TEST METHOD: ASTM D2844

SAMPLE GRADING: MINUS -3/4"

Moisture Content(%)	Dry Density(pcf)	Expansion Pressure(psi)	Exudation Pressure(psi)	Corrected R-Value
16.4	113.2	0.00	143	17
14.4	118.4	0.00	300	24
13.6	118.3	0.82	346	36



Corrected R-Value at 300 PSI = 24

REPORT ON R-VALUE TESTS

Project: Ricker Atkinson & McBee
 Laboratory Materials Testing
 G01522
 Source: 8 & 9 @ 0-5'

Report No: 67319
 Project No: 9748448
 Date: 12-Jan-98

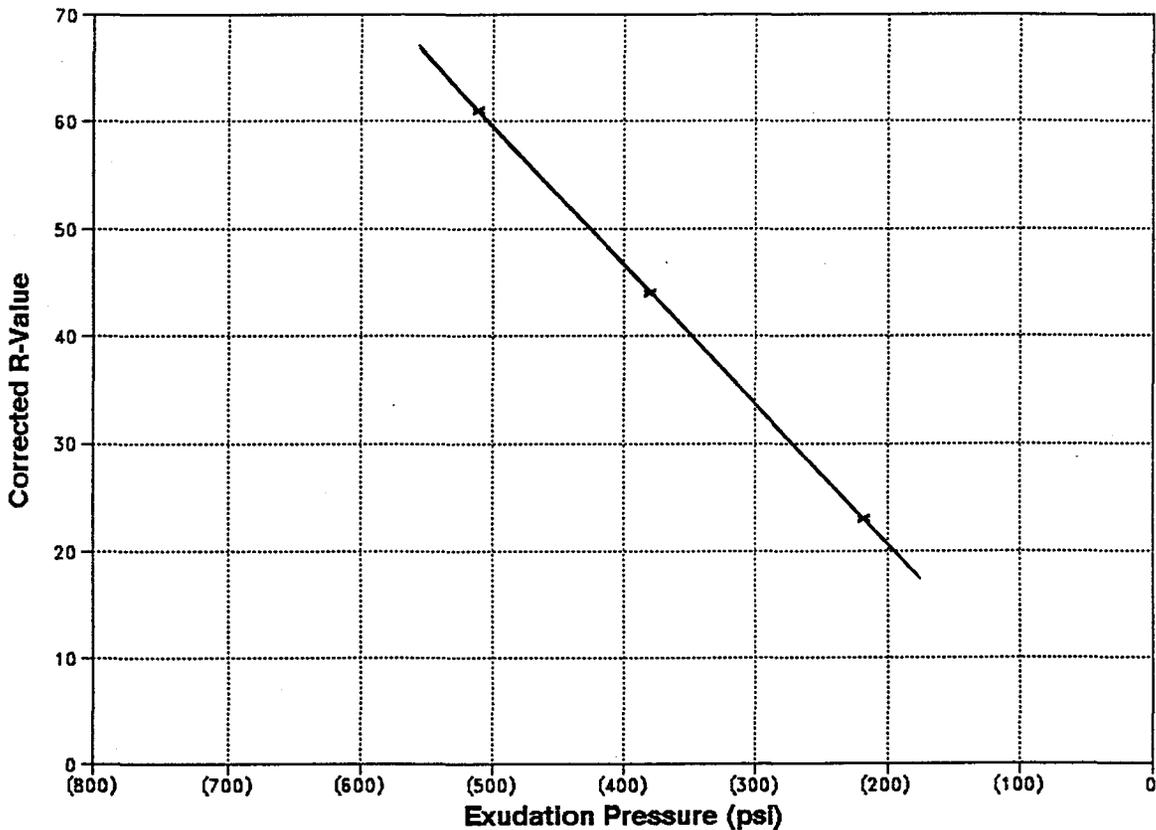
Submitted: 30-Dec-97

Sampled By: RAM

TEST METHOD: ASTM D2844

SAMPLE GRADING: MINUS -3/4"

Moisture Content (%)	Dry Density (pcf)	Expansion Pressure (psi)	Exudation Pressure (psi)	Corrected R-Value
10.4	129.7	0.00	217	23
8.6	128.6	0.51	510	61
9.6	128.2	0.41	381	44



Corrected R-Value at 300 PSI = 34