R·A·M

Geotechnical Engineering Report
Northern/Orangewood Storm Drain Project
Phase IIA
83rd Avenue to Agua Fria Freeway
Peoria, Arizona
R.A.M. Project No. G01522

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

Geotechnical Engineering Report
Northern/Orangewood Storm Drain Project
Phase IIA
83rd Avenue to Agua Fria Freeway
Peoria, Arizona
R.A.M. Project No. G01522

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

♦♦♦

By:
Ricker, Atkinson, McBee & Associates, Inc.
2105 South Hardy Drive, Suite 13
Tempe, Arizona 85282

R·A·M

RICKER • ATKINSON • McBEE & ASSOCIATES, INC.

Geotechnical Engineering • Construction Materials Testing

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

April 30, 1997

Attention: Ashok Patel, P.E.

Subject: Geotechnical Engineering Report
Northern/Orangewood Storm Drain Project
Phase IIA
83rd Avenue to Agua Fria Freeway
Peoria, Arizona

R.A.M. Project No. G01522

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

The proposed project will include a detention basin, 3/4 mile of storm drain along Butler Avenue and approximately 3/4 mile of storm drain around and connecting to the detention basin. 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. Foundations:
- Mat foundations or spread footings may be used for inlet/outlet storm structures.
- Support on native site soils as recommended herein.
- See report for allowable bearing capacities for various foundation depths and types.

B. Site Soils:
- Use as fill in pavement and detention basin areas.
- Do not use as backfill against inlet/outlet structures.

C. Replacement Pavement:
- If existing pavements are to be replaced in kind, then the minimum section should be 3 inches of asphalt concrete on 6 inches of base material for Butler Avenue and 2.5 inches of asphalt concrete on 8 inches of base material for 83rd Avenue.
- If based on City of Peoria design procedure, a pavement section of 3 inches of asphalt concrete on 15 inches of base material is required for all streets.

2105 South Hardy Drive, Suite 13, Tempe, AZ 85282 • Telephone (602) 921-8100 • Facsimile (602) 921-4081

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,

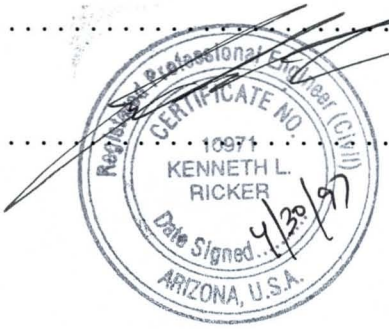
RICKER, ATKINSON, MCBEE & ASSOCIATES, INC.

By: Kenneth L. Ricker, P.E.

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

/nk
Copies to: Addressee (5)

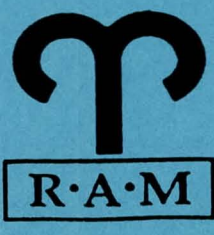
TABLE OF CONTENTS



APPENDIX A - FIELD EXPLORATION

APPENDIX B - LABORATORY ANALYSIS

REPORT



INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Northern/Orangewood Storm Drain Project in Peoria, 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 foundation design, pavement design, site development, material suitability and requirements, 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 will include a storm drain along Butler Avenue, a detention basin on 85th Avenue and Griswold Road (future), a short section of storm drain south and east of the basin and an inlet storm drain along Griswold Road (future) and 83rd Avenue. The Butler Avenue facility will be a 36- to 48-inch diameter storm drain along the south side of Butler Avenue from 87th Avenue to a drainage channel along the Agua Fria Freeway. This line will be 6.5 to 13 feet deep. The area between 87th Avenue and 91st Avenue will require replacement pavements. The detention basin will be located on the west side of 85th Avenue and on the south side of the future Griswold Road alignment. The rectangular basin will be approximately 770 feet wide (east-west) by 810 feet long by 10 feet deep with 5H:1V cut-side slopes. A 66-inch diameter storm drain enters the basin at the northwest corner. A 72-inch storm drain exists at the southeast corner of the basin and extends south to Northern Avenue where it turns east. A 24- to 27-inch diameter bypass storm drain extends from the 66-inch storm drain at the northeast corner of the basin around the east and south side of the basin to the southwest corner of the basin where the storm drain turns south to Northern Avenue then west on Northern Avenue. The inlet storm drain at the northeast corner

extends east along the Griswold Road (future alignment) to 83rd Avenue where it turns north to Las Palamaritas Drive. This section of storm drain is 66-inches in diameter and is buried approximately 10 to 15 feet deep. Replacement pavement will be required along 83rd Avenue.

SITE CONDITIONS

The Butler Avenue section of the storm drain is along a farm road from the Agua Fria Freeway to 91st Avenue, then along a two lane paved road with dirt shoulders and housing on one side and farm land on the other. The detention basin, the bypass storm drain and outlet storm drain are located in active farm land. The 66-inch diameter inlet storm drain extends along a farm road from 85th Avenue to 83rd Avenue. The alignment turns north along the center line of 83rd Avenue which is a two lane paved road with dirt shoulders. A majority of the project is in Peoria, Arizona with a small area near the detention basin being in an unincorporated portion of Maricopa County, Arizona.

FIELD EXPLORATIONS

Subsurface conditions at the detention basin were explored by drilling three test borings (B1 to B3) to depths of 20.5 to 21.5 feet and the storm drain was explored by drilling 15 test borings (1 to 15) to depths of 15.5 to 26.5 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.

Type of Test	Type of Sample	Number of Samples Tested
Sieve Analysis and Atterberg Limits (ASTM C136, D1140, D4318)	Representative	36
Standard Proctor (ASTM D698)	Representative	3
pH/Minimum Resistivity (ADOT 236A)	Representative	2
R-Value (ASTM D2844)	Representative	3
Moisture Content/Dry Density*	Undisturbed (Ring)	44
Moisture Content	Split-Spoon	32

*Reported on the test boring logs

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

SUBSURFACE CONDITIONS

The subsurface conditions encountered at test boring locations 1 to 9 in the storm drain alignment along Butler Avenue were variable. In Test Borings 1, 3, 5, 7, 8 and 9 the surface soils to depths of 5 to 15 feet were sandy clays of medium to high plasticity. This deposit was stiff to very stiff and underlain by dense to very dense clayey sand with various amounts of gravel and trace to some cobbles. An occasional silty sand layer was encountered. The clayey sand deposit was underlain by clayey sand, gravel and cobbles in Test Borings 1, 3 and 7 at depths of 14.0 to 16.5 feet. The surface soils in Test Borings 2, 4 and 6 were medium dense clayey sands with various amounts of gravel and a trace to some cobbles. In Test Boring 2, the surface deposit was underlain by silty sand at a depth of 15 feet. In Test Borings 4 and 6 the clayey sand surface soils were underlain by clayey sand and gravel with cobble deposit with some silty sand layers. In Test Borings 3, 4, 5, 7, 8 and 9 the surface soils were overlain by 3 to 6 inches of asphalt concrete on 0 to 18 inches of base material. Refusal to auger penetration occurred in Test Borings 1, 2 and 3 at depths of 16.5 to 17.0 feet.

The subsurface conditions in the storm drains near the detention basin (Test Borings 10 to 15) were also variable. In Test Borings 10, 11, 12, 13 and 14 the near surface soils to depths of 4 to 18 feet were sandy clay of medium to high plasticity. These soils were stiff to very stiff. In Test Boring 15 the surface soils were clayey sands. The surface soils were underlain by mixed deposits of clayey sand, silty sand and sandy clay. In Test Borings 14 and 15 the surface soils were overlain by 2.5 inches of asphalt concrete on 8 inches of base material.

The subsurface conditions in the detention basin (Test Borings B1 to B3) were somewhat variable. The surface soils to a depth of 10 feet were sandy clays of medium to high plasticity. These soils were stiff to very stiff and were underlain by silty sands and/or clayey sands.

The soil moisture was described as nearly dry to moist. 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.

FOUNDATION DESIGN RECOMMENDATIONS

Foundations:

The proposed inlet and outlet structures may be supported on shallow spread footings and/or mat foundations founded on native undisturbed site soils. Foundations thus founded may be designed using the following allowable bearing pressures:

Foundation Depth Below			
Existing Grade (feet)	Finished Grade* (feet)	Bearing Material	Allowable Bearing Pressure (psf)
N.A.	0	Undisturbed	1000
0-15	1.0	Undisturbed	1500

*Lowest adjacent finished grade within 5 feet of the facility.

All foundation excavations should be reviewed by the geotechnical engineer prior to placing reinforcement steel. Foundation bearing surfaces should not contain fills, loose or soft soils or debris. Where encountered these materials must be removed and replaced with compacted fill or lean concrete. Structural loads for the above footings should not exceed 5 kips per linear foot for walls and 70 kips for columns. A modulus of subgrade reaction of 150 pci for sandy clay soils and 250 pci for clayey sand and silty sand soils may be used in design of mat foundations.

The allowable bearing capacity should be applied to maximum, design dead plus live loads and may be increased by one-third when considering temporary loads such as transient wind or seismic loads. A one-third increase may also be used for toe pressures due to eccentric or lateral loadings, assuming the entire footing bearing surface remains in compression. The weight of the footing concrete below grade may be neglected in dead load computations. The recommended minimum footing widths are 2.0 and 1.33 feet for isolated columns and continuous wall footings, respectively.

The estimated total and differential foundation settlements for the loading conditions described above are less than 1/2 inch if soils below footing level remain at or below the construction moisture content. Some additional post-construction, differential settlement could occur if bearing soils become wet after construction. Therefore, continuous footings and stem walls should be reinforced and masonry walls constructed with properly designed reinforcement and with frequent expansion/contraction joints. Positive drainage away from the perimeter of the facility is essential to minimize the potential for moisture infiltration into bearing soils.

Lateral Earth Pressures:

The following tabulation presents the recommended lateral earth pressures and base friction values which should be used in the lateral design of footings and retaining walls. The lateral pressures are equivalent fluid pressures for average anticipated conditions.

Backfill Pressures:
Unrestrained walls---------- 30 psf/ft
Restrained walls---------- 55 psf/ft
Passive Pressures:
Continuous---------- 250 psf/ft
Coefficient of Base Friction:
Concrete to soil---------- 0.40

The above equivalent fluid pressures are for vertical walls with horizontal backfills and do not include temporary loads imposed by compaction equipment or permanent loads resulting from backfill swell pressures or surcharge loads. All retaining walls should contain weep holes to reduce the potential for the buildup of hydrostatic pressures.

PAVEMENT DESIGN RECOMMENDATIONS

Replacement Pavements:

The City of Peoria 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 3.0 inches of asphalt concrete on 6.0 inches of base material along Butler Avenue and 2.5 inches of asphalt concrete on 8 inches of base material for 83rd Avenue.

2. Design section: Based on the City of Peoria procedures for section and half section streets, the thickness should be 3.0 inches of asphalt concrete on 15.0 inches of base material for all pavements.

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

For the 2.5 and 3-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 Peoria.

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.

SITE DEVELOPMENT RECOMMENDATIONS

Subsurface Wall Backfills:

On-site clay soils should not be used as backfill against retaining walls and subsurface walls. However, granular sites with plasticity indexes less than 10 may be used. All fill placed against the subsurface walls should be mechanically compacted to the densities described in the "Site Preparation and Grading Procedures" part of this report. Water jetting or flooding of backfill zones must be avoided.

Sidewalks, stairways, retaining walls, fences, planters, pavements, underground utilities and other elements founded on or in the backfill zone may undergo some differential movements with respect to the structures and undisturbed areas. The amount of movement can be limited by properly placing and compacting the backfill zone. However, even properly placed backfill may undergo post-compaction settlement equivalent to 1/4 to 1/2 percent of the backfill height. Therefore, those elements which are on or in the backfill zone should be structurally supported on the facility wall and the nearby undisturbed soils or an allowance made for differential movements of the elements in the backfill zone.

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 and various amounts of cobbles 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

95%	100%
1.0" to 2.0"	1.5" to 2.5"

* 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

Depth of Excavation	95%	100%	105%
0 to 10 feet	20%± 2%	25% ± 2%	30% ± 2%
10 to 20 feet	15%± 2%	20% ± 2%	25% ± 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 deeper 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 Peoria (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 Peoria.

Corrosion Potential:

Based on laboratory resistivity tests, site soils which are at high moisture content or which become wetted will exhibit some potential for corrosion.

SITE PREPARATION AND GRADING PROCEDURES

Facility and 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 the areas within and extending 5 feet beyond the footprint of facilities, exterior slabs and pavement areas.

1. Clear and grub the site by removing and disposing of all vegetation, debris, rubble and remnants of former developments.

2. Strip the site of any existing fill zones, backfill zones and unstable soils. During stripping observe the surface for evidence of buried debris, vegetation or disturbed materials which will require additional removal. If encountered, these materials should be removed. Areas steeper than 5H to 1V should be benched and any depressions widened to accommodate compaction equipment.

3. Prepare the ground surface in fill areas and in areas cut to grade by scarifying, moisture conditioning and compacting the exposed surface soils to a depth of 8 inches.

4. 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.

5. 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 foundation sections (fill thickness less than 5 feet)	95
Below foundation sections (fill thickness greater than 5 feet)	100
Below concrete floor slabs (above footings)	90
Against subsurface walls (all other areas not indicated above)	95
Below pavements	95
Base Material:	
Below concrete floor slabs	95
Below pavements	100
Backfill:*	90

* Outside of facilities and exterior slab.

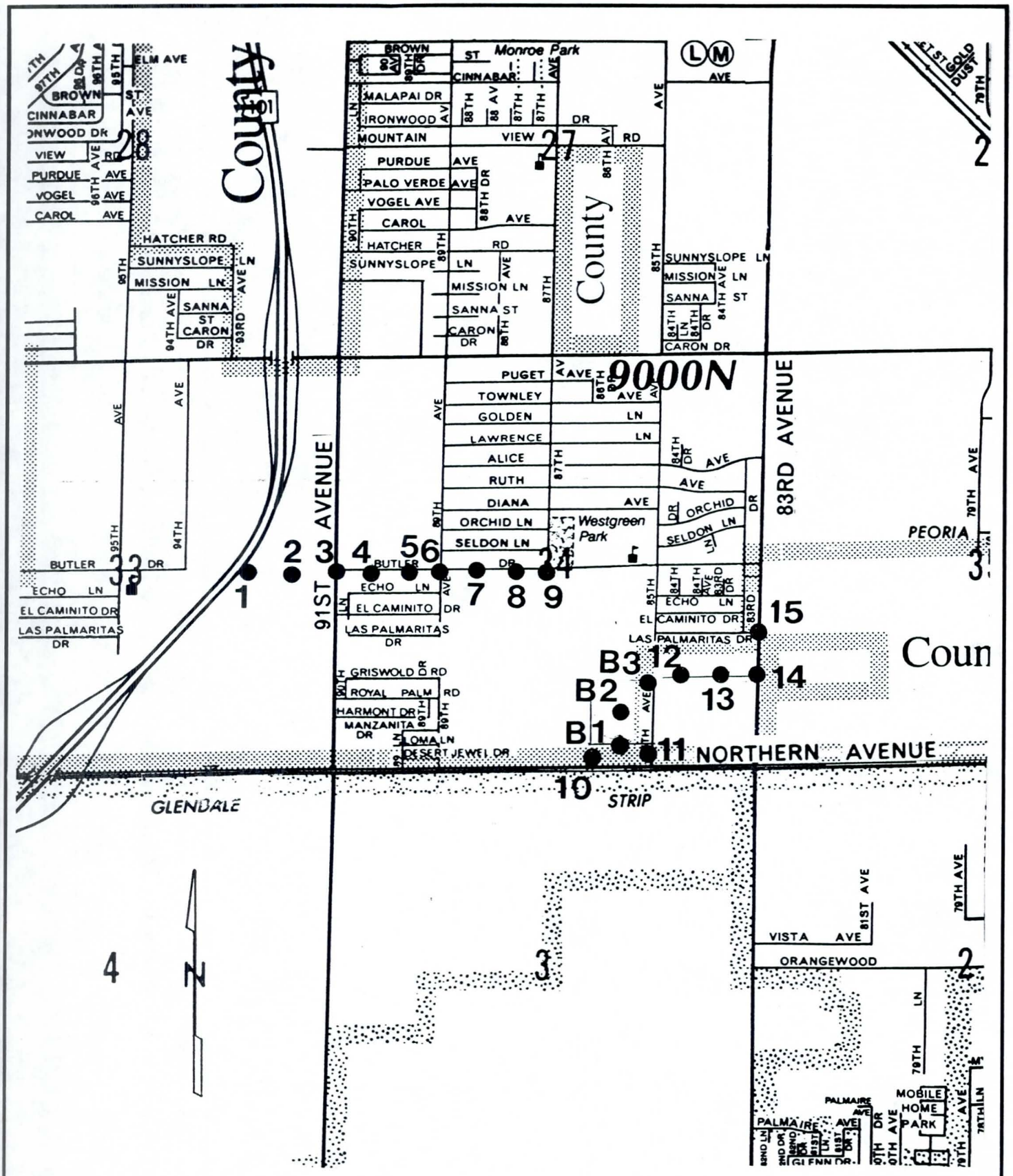
6. The moisture content of soil and base materials at the time of compaction should be:

Type	Area of Use	Moisture Content
On-site	Facility, Exterior Slab	Not recommended as fill.
On-site	Pavement	2% below optimum or lower
Imported	Facility, Exterior Slab	Optimum plus or minus 3%
Imported	Pavement	2% below optimum or lower
Base Material	Facility	Optimum plus or minus 3%

7. 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

R·A·M


9000N
91ST AVENUE
83RD AVENUE
NORTHERN AVENUE
GLENDALE
PEORIA
Monroe Park
Westgreen Park
STRIP
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
B1
B2
B3
● Test Boring Location

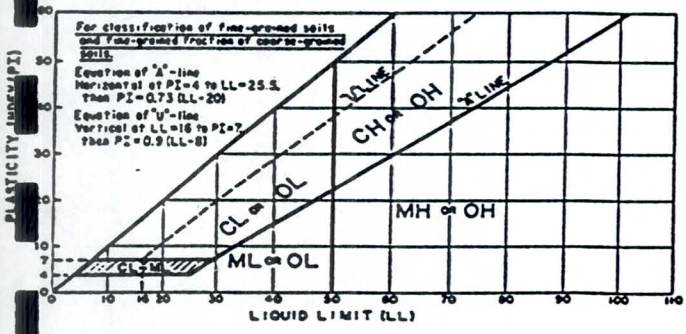
SITE PLAN

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
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay
			PI plots below "A" line	MH	Elastic silt
		Organic	Liquid limit - oven dried / Liquid limit - not dried <0.75	OH	Organic clay / Organic silt
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			PT	Peat



TEST BORING LOG DEFINITIONS

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

Depth, feet	Blows/Foot		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 Phase IIA TEST BORING: 1
Elevation: Not Determined Datum: --- Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		37	R	103	7	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		22	N		20		
10		38	R	117	5	SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines.
15		50/6"	N		5	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles. More Gravel, Less Clay and Some Cobbles Below 16 Feet.
20							Refusal at 17 feet on clayey sand, gravel & cobbles. 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 Phase IIA TEST BORING: 2
Elevation: Not Determined Datum: --- Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50	R	109	5	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, medium dense, medium plasticity fines, trace to some cobbles.
							Moderate Cementation Below 2 to 3 Feet.
5		50/4"	R	102	5		
10		30	N		4		
15		38	R	107	10	SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines.
							Refusal at 17 feet on silty sand, gravel & cobbles.
20							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 Phase IIA TEST BORING: 3
Elevation: Not Determined Datum: --- Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							6" Asphalt Concrete.
		20	R	117	12	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5							5
		35	R	116	10	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
10							10
		50/5"	N	NR			Moderate Cementation Below 10 Feet.
15							15
		50/3"	R	NR			
							Refusal at 16.5 feet on clayey sand, gravel & cobbles.
							No Groundwater Observed.
20							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 Phase IIA TEST BORING: 4
Elevation: Not Determined Datum: --- Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 6" Base Material.
		26	R	112	11	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, medium dense, medium plasticity fines, trace to some cobbles.
5		18	N		14		
						GC/ SC	Clayey Sand and Gravel, with Cobbles; brown, nearly dry, dense, medium plasticity fines.
10		25	R	113	3		
15		50/6"	N		6		
						SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity.
20		50/6"	R	115	9		Stopped drilling at 20.5 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 Phase IIA TEST BORING: 5
Elevation: Not Determined Datum: --- Date: 3-11-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 6" Base Material.
		20	R	115	13	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5							5
		16	R	103	18		
						SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
10							10
		35	N		2		
15							15
		50/2"	R	NR			
20							20
		50/3"	N		5		
							Stopped drilling at 21 feet. No Groundwater Observed. NR= No Recovery.
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 Phase IIA TEST BORING: 6
Elevation: Not Determined Datum: --- Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		33	R	111	11	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, medium dense, medium plasticity fines, trace to some cobbles.
5		28	R	115	4		
10		51	N		8	GC/ SC	Clayey Sand and Gravel, with Cobbles; brown, nearly dry, dense, medium plasticity fines.
15		50/6"	R	NR			
20		50/3"	N	NR			Stopped drilling at 20 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 Phase IIA TEST BORING: 7
Elevation: Not Determined Datum: --- Date: 3-11-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 8" Base Material.
		36	R	112	15	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		10	N		18		
						SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
10		33	R	NR			
15		28	N	NR		GC/ SC	Clayey Sand and Gravel, with Cobbles; brown, nearly dry, dense, medium plasticity fines.
							Stopped drilling at 16.5 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 Phase IIA TEST BORING: 8
Elevation: Not Determined Datum: --- Date: 3-14-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 6" Base Material.
		36	R	118	15	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		23	N		18		
10		41	R	104	20		
		22	N		10	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
15							
							Stopped drilling at 16.5 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 Phase IIA
Elevation: Not Determined Datum: ---

TEST BORING: 9
Date: 3-14-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 1.5' Base Material with Cobbles.
						CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		24	R	98	22		
10		26	R	115	10		
15		21	N		8	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
							Stopped drilling at 16.5 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 Phase IIA TEST BORING: 10
Elevation: Not Determined Datum: --- Date: 3-7-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		12	R	101	8	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		31	N		8	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles. Intermittent Light to Moderate Cementation Below 8 Feet.
10		50/11"	R	107	11		
15		50/6"	N		11		Stopped drilling at 15.5 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 Phase IIA TEST BORING: 11
Elevation: Not Determined Datum: --- Date: 3-7-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
5		50/11"	R	100	8	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
		14	N		11	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
10		39	R	115	6	SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines.
15		59	N		13	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles. Some Moderate Cementation Below 15 Feet.
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 Phase IIA TEST BORING: 12
Elevation: Not Determined Datum: --- Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		12	R	91	13	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		46	N		23		5
10		40	R	100	16	SM	10 Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines. Light to Moderate Cementation Below 12 Feet.
15		50/4"	N		12		15
20		50/7"	R	85	31	CL/ CH	20 Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
25		39	N		25		25 Stopped drilling at 26.5 feet. No Groundwater Observed.

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project Phase IIA — TEST BORING: 13
Elevation: Not Determined — Datum: --- — Date: 3-26-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		13	R	108	10	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5							
		11	R	105	13	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
10							
		16	N		8		
15							
		50/4"	R	105	15		
						CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
20							
		50/5"	N		20		
							Stopped drilling at 25 feet. No Groundwater Observed. NR= No Recovery.
25							
		50/2"	R	NR			

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 Phase IIA — TEST BORING: 14
Elevation: Not Determined — Datum: --- — Date: 3-11-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							2.5" Asphalt Concrete on 8" Base Material.
		17	R	114	10	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		6	N		16		
10		41	R	98	18		Light to Moderate Cementation Below 9 Feet.
15		50/3"	N		12		
						SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
20		50/6"	R	108	7		
25		50/5"	N		10		Stopped drilling at 25.5 feet. No Groundwater Observed.

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project Phase IIA
Elevation: Not Determined Datum: ---

TEST BORING: 15
Date: 3-11-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							2.5" Asphalt Concrete on 8" Base Material.
		28	R	106	10	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
5		43	R	101	20		
10		47	N		15	SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines. Moderate Cementation Below 12 Feet.
15		48	R	99	15		
20		38	N		23		
						CL/CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
25		50/4"[2]	R	104	13		Stopped drilling at 25.5 feet. No Groundwater Observed.

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

TEST BORING LOG

Project: Northern/Orangewood Storm Drain Project Phase IIA TEST BORING: B1
Elevation: Not Determined Datum: --- Date: 3-7-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		10	R	96	11	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		35	R	101	22		
10		35	N		7	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
15		50/8"	R	125	5		
20		50/6"	N		6		Stopped drilling at 20.5 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 Phase IIA
Elevation: Not Determined Datum: ---

TEST BORING: B2
Date: 3-7-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		9	R	101	8	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		21	N		13		
10		50	R	96	22	SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines.
15		23	N		4		
20		50/7"	R	*	10		Stopped drilling at 20.5 feet. No Groundwater Observed. * = Sample too disturbed to determine density.
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 Phase IIA TEST BORING: B3
Elevation: Not Determined Datum: --- Date: 3-7-97

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		10	R	95	11	CL/ CH	Sandy Clay, Trace Gravel; brown, slightly damp to moist, stiff to very stiff, medium to high plasticity.
5		50	R	115	11		
10		19	N		8	SM	Silty Sand; brown, nearly dry, medium dense, no to low plasticity fines.
15		50/9"	R	84	15	SC	Clayey Sand, Trace to with Gravel; brown, nearly dry to damp, dense to very dense, medium plasticity fines, trace to some cobbles.
20		28	N		18		Moderate Cementation Below 17 Feet.
25							Stopped drilling at 21.5 feet. No Groundwater Observed.

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

APPENDIX B
LABORATORY ANALYSIS

R·A·M

LABORATORY TEST RESULTS

Date: 9-Apr-97

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	Atterberg Limits		Sieve Size - Accumulative Percent Passing											Soil
Source	LL	PI	200	100	50	30	16	8	4	3/4"	1"	2"	3"	Class.*
1 @ 5'-10'	49	30	71	76	79	84	88	91	94	100				CL
1 @ 10'-15'	37	23	39	44	49	56	66	78	86	100				SC
2 @ 0'-5'	42	21	46	52	58	65	74	82	89	100				SC
2 @ 10'-15'	31	13	14	16	19	24	36	54	71	100				SC
3 @ 0'-5'	43	26	56	63	69	76	83	89	94	100				CL
3 @ 10'-15'	35	10	21	24	28	34	41	49	59	95	99	100		SM
4 @ 0'-5'	44	24	43	50	57	65	74	83	90	100				SC
4 @ 10'-15'	36	19	15	18	21	31	47	60	69	89	94	100		SC
5 @ 0'-5'	42	24	58	66	71	80	88	93	97	100				CL
5 @ 15'-20'	35	19	22	25	29	40	53	64	78	97	100			SC
6 @ 0'-5'	43	22	18	21	25	30	36	48	65	92	95	100		SC
6 @ 15'-20'	36	20	12	14	16	20	25	33	44	79	91	100		GC
7 @ 0'-5'	44	26	70	77	82	88	92	95	97	100				CL
7 @ 10'-15'	42	25	41	46	51	59	66	73	81	100				SC
8 @ 0'-5'	47	31	65	74	79	85	89	93	95	100				CL
8 @ 5'-10'	53	35	78	85	90	94	97	99	100					CH
9 @ 0'-5'	50	33	77	85	90	94	97	98	99	100				CH
9 @ 10'-15'	53	35	64	74	81	86	91	95	99	100				CH
10 @ 0'-5'	34	16	49	58	67	77	82	88	93	100				SC
10 @ 10'-15'	36	19	26	31	39	56	71	82	91	100				SC
11 @ 0'-5'	41	20	58	65	70	74	79	85	90	98	100			CL
11 @ 10'-15'	33	16	44	52	62	75	84	91	95	100				SC
12 @ 5'-10'	60	40	78	85	91	95	98	99	100					CH
12 @ 20'-25'	42	23	76	82	87	92	95	97	99	100				CL
13 @ 0'-5'	40	19	58	65	71	76	81	87	93	100				CL
13 @ 15'-20'	38	19	53	58	64	68	73	79	86	100				CL
14 @ 0'-5'	37	20	60	66	70	76	81	87	92	100				CL
14 @ 10'-15'	52	29	66	73	80	87	92	95	98	100				CH

NP = Non-Plastic

* Unified Soil Classification System

LABORATORY TEST RESULTS

Date: 9-Apr-97

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	Atterberg Limits		Sieve Size - Accumulative Percent Passing											Soil
Source	LL	PI	200	100	50	30	16	8	4	3/4"	1"	2"	3"	Class.*
15 @ 0'-5'	44	24	43	51	59	67	74	83	92	100				SC
15 @ 20'-25'	40	21	74	82	87	92	95	96	98	100				CL
B1 @ 5'-10'	65	43	76	83	88	93	96	97	98	100				CH
B1 @ 15'-20'	37	21	31	36	42	53	61	69	77	95	100			SC
B2 @ 0'-5'	40	22	52	62	72	83	90	95	98	100				CL
B2 @ 10'-15'	22	5	20	24	35	63	79	86	91	100				SC-SM
B3 @ 5'-10'	49	28	74	83	90	95	98	99	99	100				CL
B3 @ 15'-20'	33	15	38	43	49	55	62	70	80	98	100			SC

NP = Non-Plastic

* Unified Soil Classification System

LABORATORY TEST RESULTS

Date: 9-Apr-97

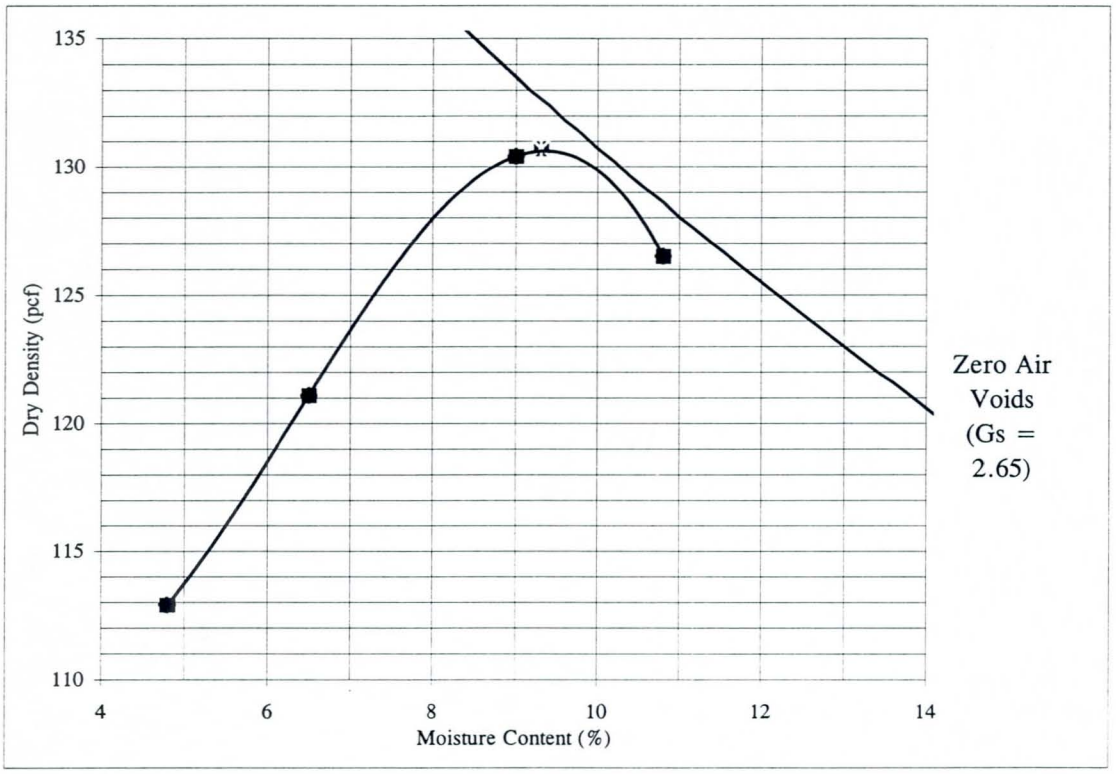
SAMPLE SOURCE: 6 @ 15'-20'

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

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 130.7 Optimum Moisture (%) = 9.3



LABORATORY TEST RESULTS

Date: 9-Apr-97

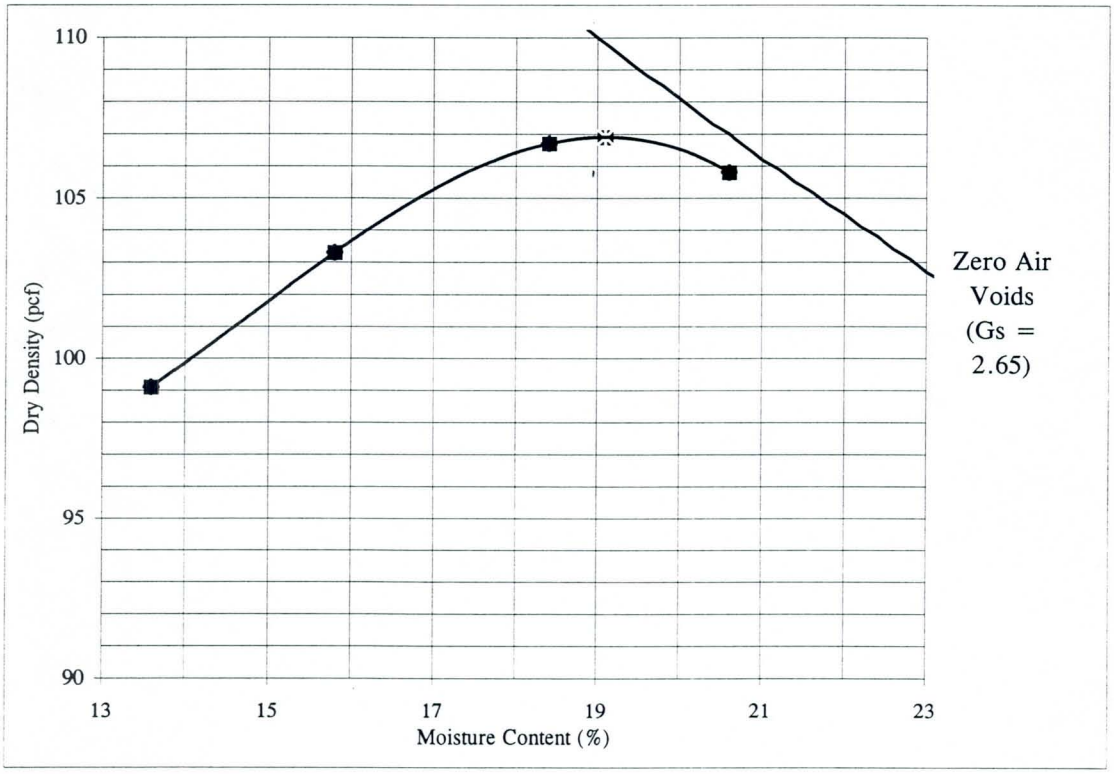
SAMPLE SOURCE: 14 @ 10'-15'

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

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 106.9 Optimum Moisture (%) = 19.1



LABORATORY TEST RESULTS

Date: 9-Apr-97

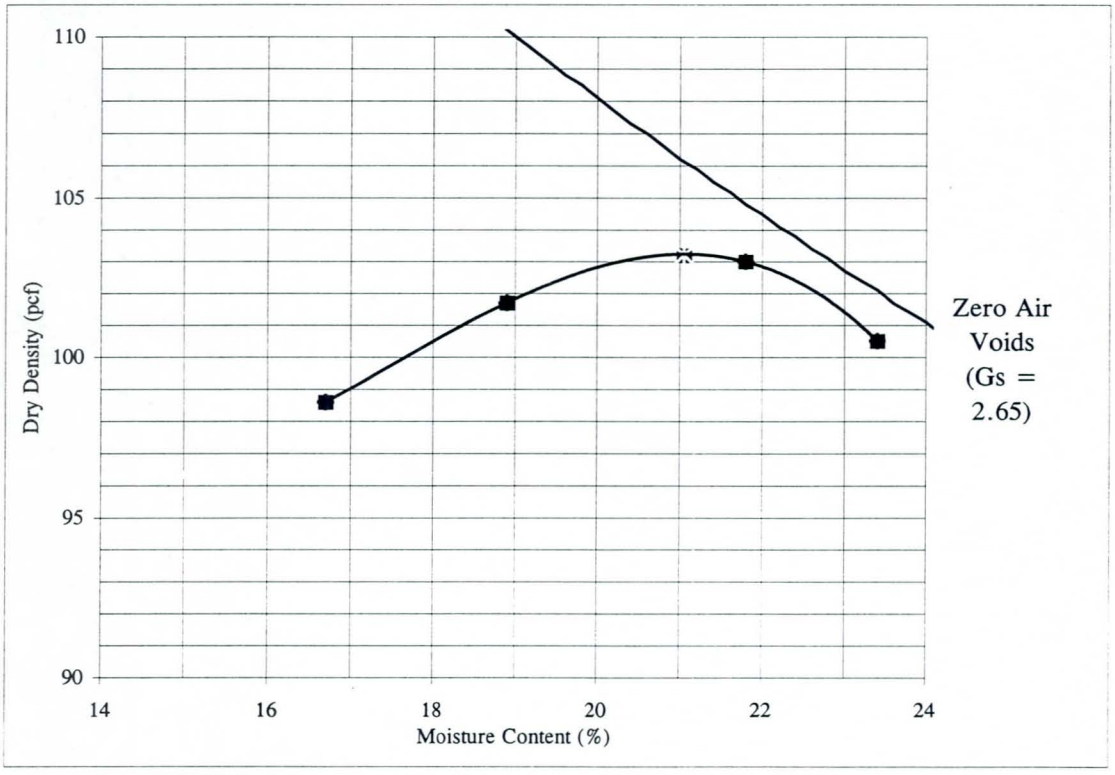
SAMPLE SOURCE: B1 @ 5'-10'

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

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 103.2 Optimum Moisture (%) = 21.1



LABORATORY TEST RESULTS

Date: 9-Apr-97

SAMPLE SOURCE: As noted below

TESTING PERFORMED: pH, Minimum Resistivity (ADOT 236a)

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	pH	Minimum Resistivity (ohm-cm)
4 @ 15'-20'	8.7	2656
15 @ 15'-20'	8.4	3234

REPORT ON R-VALUE TESTS

Project: Laboratory Materials Testing
Ricker, Atkinson, McBee & Assoc.
Project No. G01522

Source: 3 @ 0-5'

Sampled By: RAM

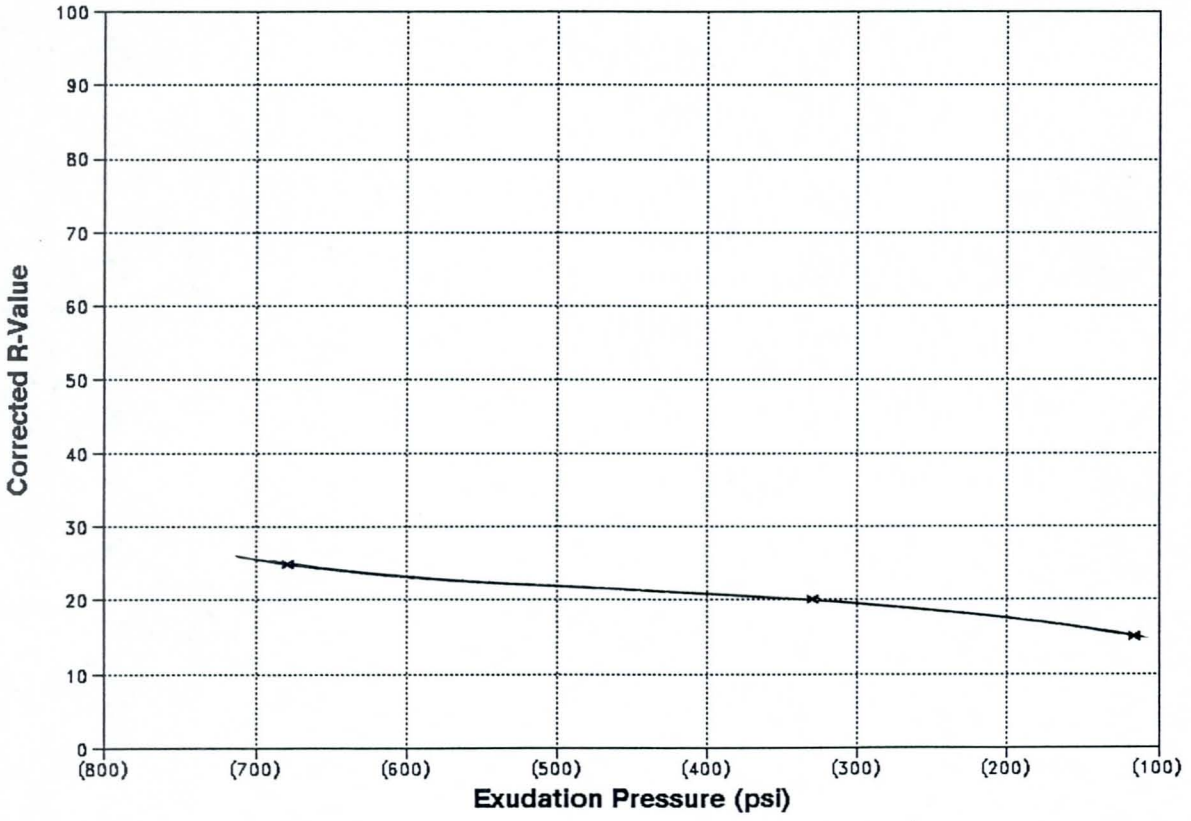
Report No.: 61077
Client No.: 3710080

Date: 26-Mar-97

Submitted: 17-Mar-97

TEST METHOD: ASTM D2844 SAMPLE GRADING: MINUS 3/4

Moisture Content(%)	Dry Density(pcf)	Expansion Pressure(psi)	Exudation Pressure(psi)	Corrected R-Value
16.3	120.4	0.00	679	25
18.7	108.1	0.00	115	15
17.3	112.6	0.00	329	20



Corrected R-Value at 300 PSI = 19

REPORT ON R-VALUE TESTS

Project: Laboratory Materials Testing
Ricker, Atkinson, McBee & Assoc.
Project No. G01522

Source: 8 @ 0-5'

Sampled By: RAM

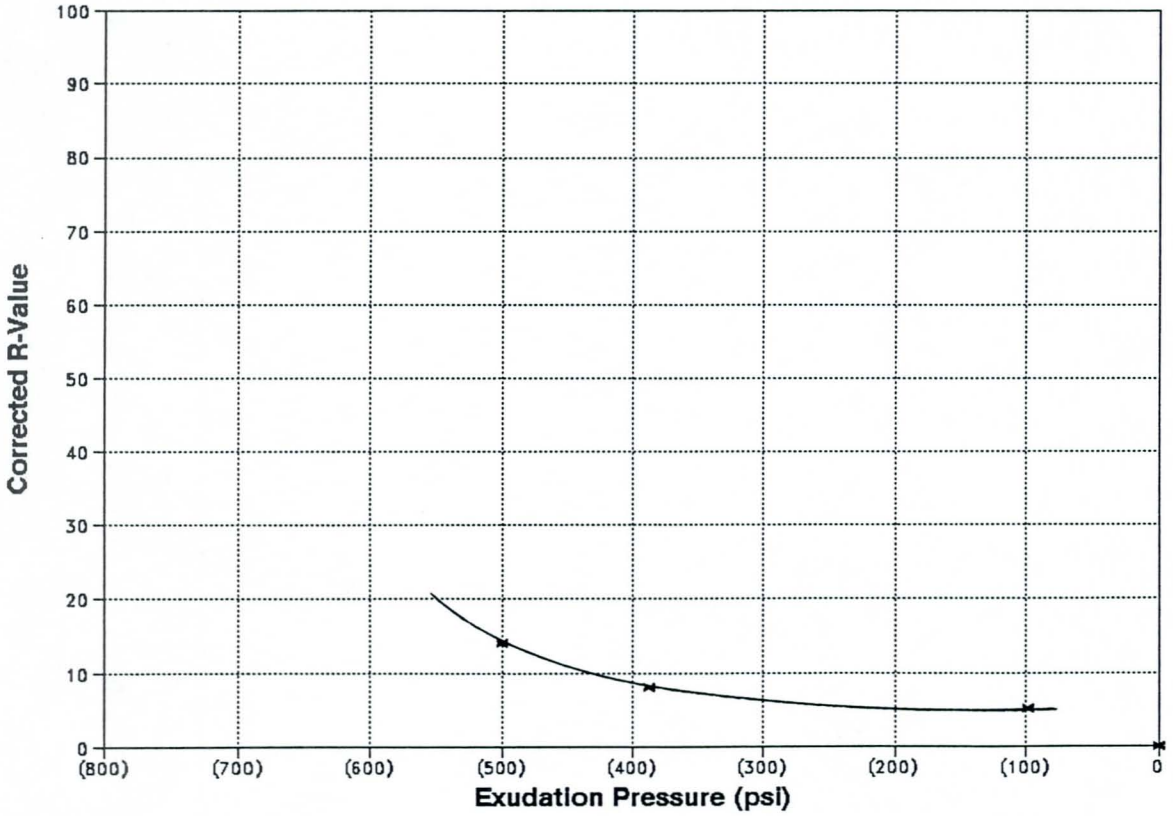
Report No.: 61077
Client No.: 3710080

Date: 26-Mar-97

Submitted: 17-Mar-97

TEST METHOD: ASTM D2844 SAMPLE GRADING: MINUS 3/4

Moisture Content(%)	Dry Density(pcf)	Expansion Pressure(psi)	Exudation Pressure(psi)	Corrected R-Value
19.7	107.8	0.00	500	14
22.0	103.2	0.00	388	8
24.4	101.0	0.00	98	5



Corrected R-Value at 300 PSI = 6

REPORT ON R-VALUE TESTS

Project: Laboratory Materials Testing
Ricker, Atkinson, McBee & Assoc.
Project No. G01522

Source: 15 @ 0-5'

Sampled By: RAM

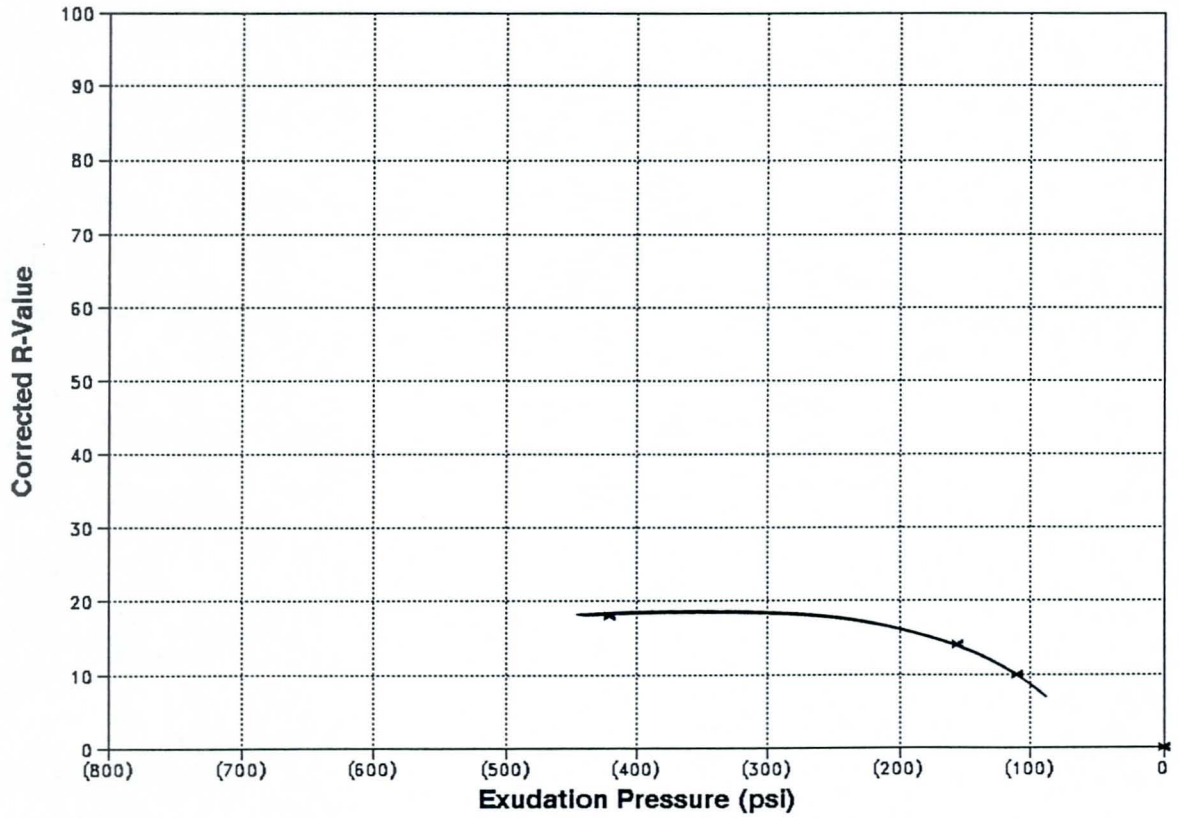
Report No.: 61077
Client No.: 3710080

Date: 26-Mar-97

Submitted: 17-Mar-97

TEST METHOD: ASTM D2844 SAMPLE GRADING: MINUS 3/4

Moisture Content(%)	Dry Density(pcf)	Expansion Pressure(psi)	Exudation Pressure(psi)	Corrected R-Value
17.6	109.8	0.00	111	10
14.7	117.8	0.00	421	18
15.9	115.1	0.00	156	14



Corrected R-Value at 300 PSI = 18