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R·A·M

Geotechnical Engineering Report
Osborn Road Storm Drain Project
Thomas Road and 60th Street to
Indian Bend Wash and Earll Drive
Scottsdale, Arizona
R.A.M. Project No. G02939

Registered Professional Engineer (Civil)
CERTIFICATE NO.
10971
KENNETH L.
RICKER
Date Signed 8-6-99
ARIZONA U.S.A.

RICKER • ATKINSON • McBEE & ASSOCIATES, INC.

Geotechnical Engineering • Construction Materials Testing

Geotechnical Engineering Report
Osborn Road Storm Drain Project
Thomas Road and 60th Street to
Indian Bend Wash and Earll Drive
Scottsdale, Arizona
R.A.M. Project No. G02939

For:
PB
1501 West Fountainhead Parkway, Suite 400
Tempe, Arizona 85282

◆◆◆

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

PB
1501 West Fountainhead Parkway, Suite 400
Tempe, Arizona 85282

August 31, 1999

Attention: Frank Medina, P.E.

Subject: Geotechnical Engineering Report
Osborn Road Storm Drain Project
Thomas Road and 60th Street to
Indian Bend Wash and Earll Drive
Scottsdale, Arizona

R.A.M. Project No. G02939
Supplement No. 1

At the request of FCDMC we have reviewed the subject report with respect to our opinion on the use of cast-in-place concrete pipe. We understand that the pipe will range from 96 to 108 inches in diameter. The site soils encountered at the test boring locations were clayey sands and sandy clays with various amounts of gravel. These soils become moderately cemented with depth.

It is our opinion that cast-in-place concrete pipe could be used; however, excavation and forming of the trench bottom in the moderately cemented soils may be slow and difficult to accomplish. In addition where existing wet or loose backfill zones are encountered caving should be anticipated.

If you have any questions please do not hesitate to call. This supplement should be attached to and made a part of the original report.

Respectfully submitted,

RICKER, ATKINSON, MCBEE & ASSOCIATES, INC.

Registered Professional Engineer (Civil)
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KENNETH L.
RICKER
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By: Kenneth L. Ricker, P.E.

Registered Professional Engineer (Civil)
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CHARLES H.
ATKINSON
Date Signed 8-31-99
ARIZONA, U.S.A.

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

/mp
Copies to: Addressee (5)

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RICKER • ATKINSON • McBEE & ASSOCIATES, INC.

Geotechnical Engineering • Construction Materials Testing

PB
1501 West Fountainhead Parkway, Suite 400
Tempe, Arizona 85282

August 6, 1999

Attention: Frank Medina, P.E.

Subject: Geotechnical Engineering Report
Osborn Road Storm Drain Project
Thomas Road and 60th Street to
Indian Bend Wash and Earll Drive
Scottsdale, Arizona

R.A.M. Project No. G02939

Attached to this letter is the Geotechnical Engineering Report for the proposed Osborn Road Storm Drain Project to be located in Scottsdale, Arizona.

The proposed project will include two basins and 2-1/2 miles of storm drain. 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 Soil:

- Use as fill in pavement, basin and storm drain 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 is shown in the report.
- If based on City of Scottsdale design procedure, a pavement section is shown in the report.

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.

If you have any questions please do not hesitate to call.

Respectfully submitted,

RICKER-ATKINSON-MCBEE & ASSOCIATES, INC.

Registered Professional Engineer (Civil)
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Kenneth L. Ricker, P.E.

/bc
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REPORT

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INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Osborn Road Storm Drain Project in Phoenix/Scottsdale, 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, site development, pavement design, 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 building design parameters (location, type, size, structural loads), site use or conditions encountered during construction differ from those presented herein.

PROPOSED CONSTRUCTION

The Osborn Road Storm Drain project will include two retention basins and 2-1/2 miles of 36- to 96-inch diameter storm drain. The storm drain will begin at the Marriott's Brighton Garden Retention (MBGR) Basin on the south side of Thomas Road east of 60th Street. The storm drain will extend east along Thomas Road to 61st Place then north to Catalina Drive, then east to 64th Street, then north to Paiute Park (east of 64th Street) where the second retention basin will be constructed. At the east end of the retention basin/park the storm drain discharges to the east for a short distance then north to Osborn Road, then east to 71st Street, then south to Earll Drive, and then east to Indian Bend Wash. At 64th Street the storm drain will be jacked under the Cross Cut Canal. The section of storm drain along 64th Street will be constructed as part of the 64th Street improvement project. The MBGR Basin will be 8 feet deep and will enlarge the existing basin. The Paiute Park Basin will be 7 feet deep. The existing and new park facilities will be placed in the new basin. The storm drains will be 6 to 22 feet deep and located in paved roadways except along short sections near the retention basins and the outlet at Indian Bend Wash. The basins will have side slopes no steeper then 4H:1V and mostly cut to grade with some minor berms. The basins will have inlet structures and outlet structures. Replacement pavement will be required along Thomas Road, 61st Place, Catalina Drive, Osborn Road, 71st Street,

and Earll Drive in Scottsdale, Arizona.

SITE CONDITIONS

The storm drain is along paved roads through residential and commercial areas. The MBGR Basin is an existing landscaped basin. The Paiute Park Basin is a landscape park area.

FIELD EXPLORATIONS

Subsurface conditions at the basins were explored by drilling two test borings (1 and 2) in the MBGR Basin and four test borings (5 to 8) in the Paiute Park Basin to depths of 20 to 20.4 feet, and the storm drain area was explored by drilling 9 test borings (3, 4 and 9 to 15) to depths of 20 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 field 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 field 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. The results of the field explorations are presented on the Test Boring Logs 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
Compression	Undisturbed	4
Direct Shear	Undisturbed	7
Percent Passing No. 200 Sieve and Atterberg Limits	Representative	30
Standard Proctor	Representative	1
pH, Soluble Salts, Sulfates and Chlorides*	Representative	9

Type of Test	Type of Sample	Number of Samples Tested
Moisture Content/Dry Density**	Undisturbed (Ring)	41

*Test performed by Laboratory Consultants, Inc.
**Reported in the Test Boring Logs

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

SUBSURFACE CONDITIONS

The subsurface conditions encountered at the test boring locations were somewhat variable. The logs of the test borings are presented in Appendix A. In general, the near surface soils encountered in the test borings and extending for the full depth of exploration (20 to 21 feet) were clayey sand and sandy clays with various amounts of gravel. These soils were of medium plasticity, medium dense to dense and stiff to very stiff. The soil moisture was described as slightly damp to damp. At the time of field explorations for the project no groundwater was encountered in our test borings. Groundwater in the project area is relatively deep and will not influence construction except at the crossing of the cross cut canal where seepage from the canal may effect 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)
0 – 2	0	Undisturbed	1000
2 – 20	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 pcf for sandy clay soils and 250 pcf for clayey 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 footing 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. Additional post-construction, differential settlement of equal magnitude 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 building 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, hydrostatic 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 Scottsdale 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 5.0 inches of base material along residential streets, 5.0 inches of asphalt concrete on 10.0 inches of base material for Osborn Road and 4.0 inches of asphalt concrete on 6.0 inches of base material for Earll Drive.

2. Design section: Based on the City of Scottsdale procedures for section and half section streets, the thickness should be as follows.

	Pavement Section (inches)	
Street	Asphalt Concrete	Base Material
Thomas Road	4.0	18.0
Residential Streets	2.0	8.0
Osborn Road	3.0	16.0

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

For asphalt pavements the asphalt concrete mix used shall be EVAC 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 Scottsdale.

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 soils 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 ¼ to ½ 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 structures 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 and underlying soils to a depth of at least 20 to 21 feet can probably be removed with conventional excavating equipment. Excavations penetrating the cemented soils may 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	17% ± 2%	22% ± 2%	28% ± 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, overexcavation, 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 soils should stand at slopes of 1/2H:1V. Locally, it may be necessary to flatten slopes to 1H:1V if very clean, loose sand zones (SP/SM) of significant thickness are encountered. 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 soils exhibit medium to high plasticity. These soils may be used as fill in pavement and basin areas 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 slabs 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 requirement of EVAC Specifications as modified by the City of Scottsdale.

Pipe Bedding:

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

Corrosion Potential:

Based on laboratory tests, site soils which are at moderate to 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 structural, 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 all existing fill zones, dumped fill piles, 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 thickness 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 foundations sections (fill thickness less than 5 feet)----------	95
Below foundation sections (fill thickness greater than 5 feet)-------	100
Below concrete slabs (above footings)----------	90
Against subsurface walls (all other areas not indicated above)------	95
Below pavements----------	95
Base Material:	
Below concrete slabs----------	95
Below pavements----------	100
Backfill:*----------	90

* Outside of facilities and exterior slabs.

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

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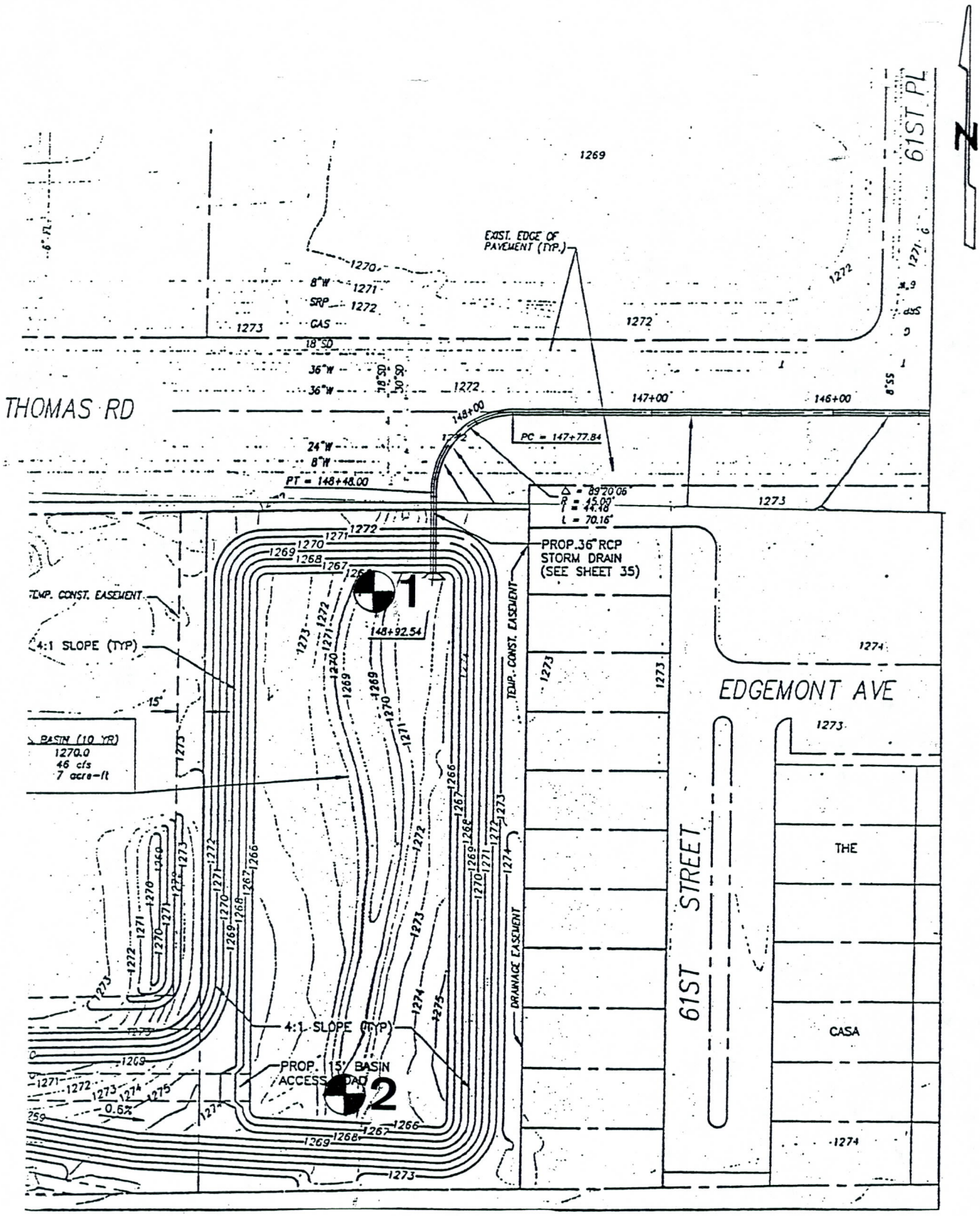
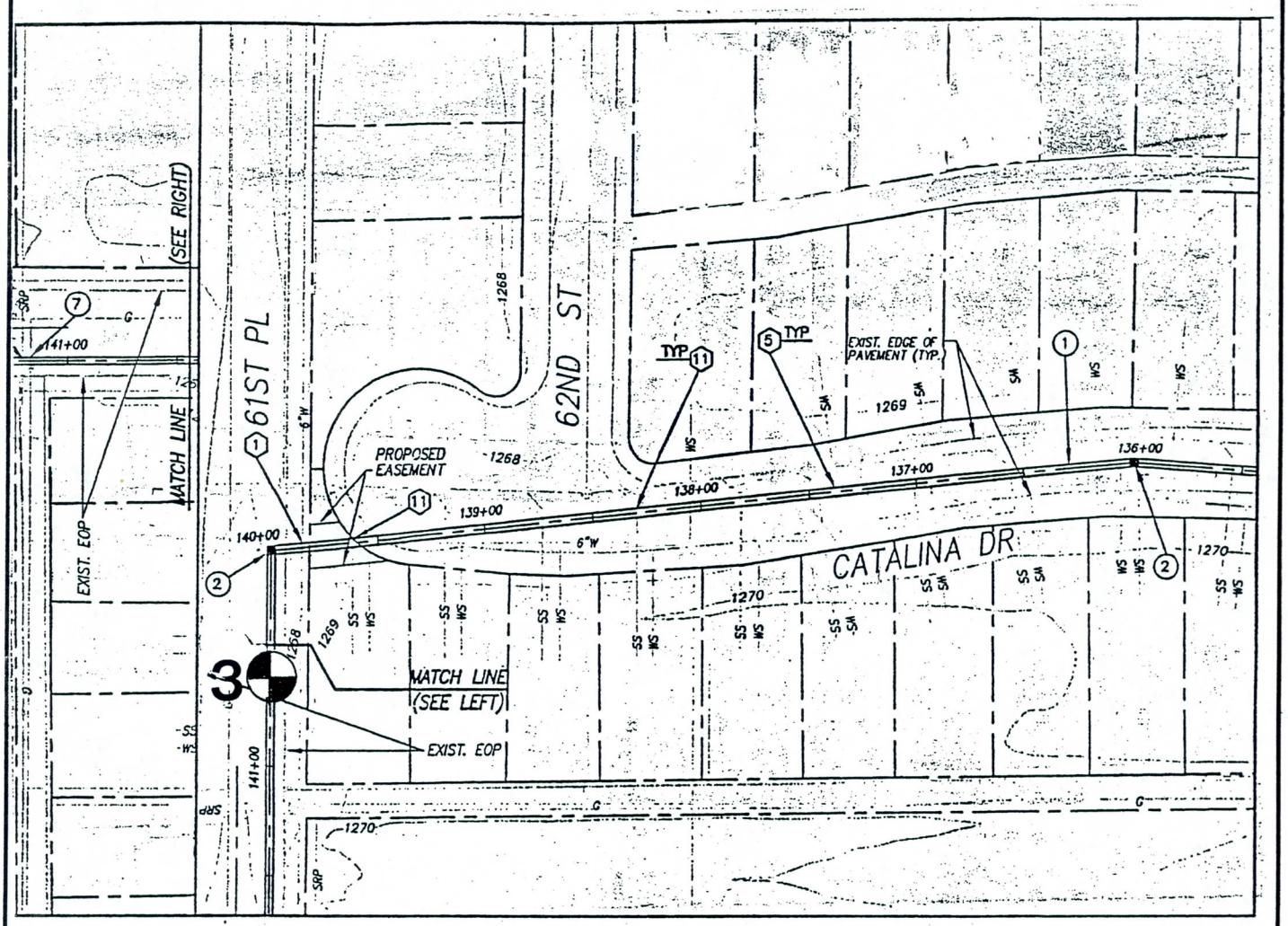


Test Boring Location

SITE PLAN



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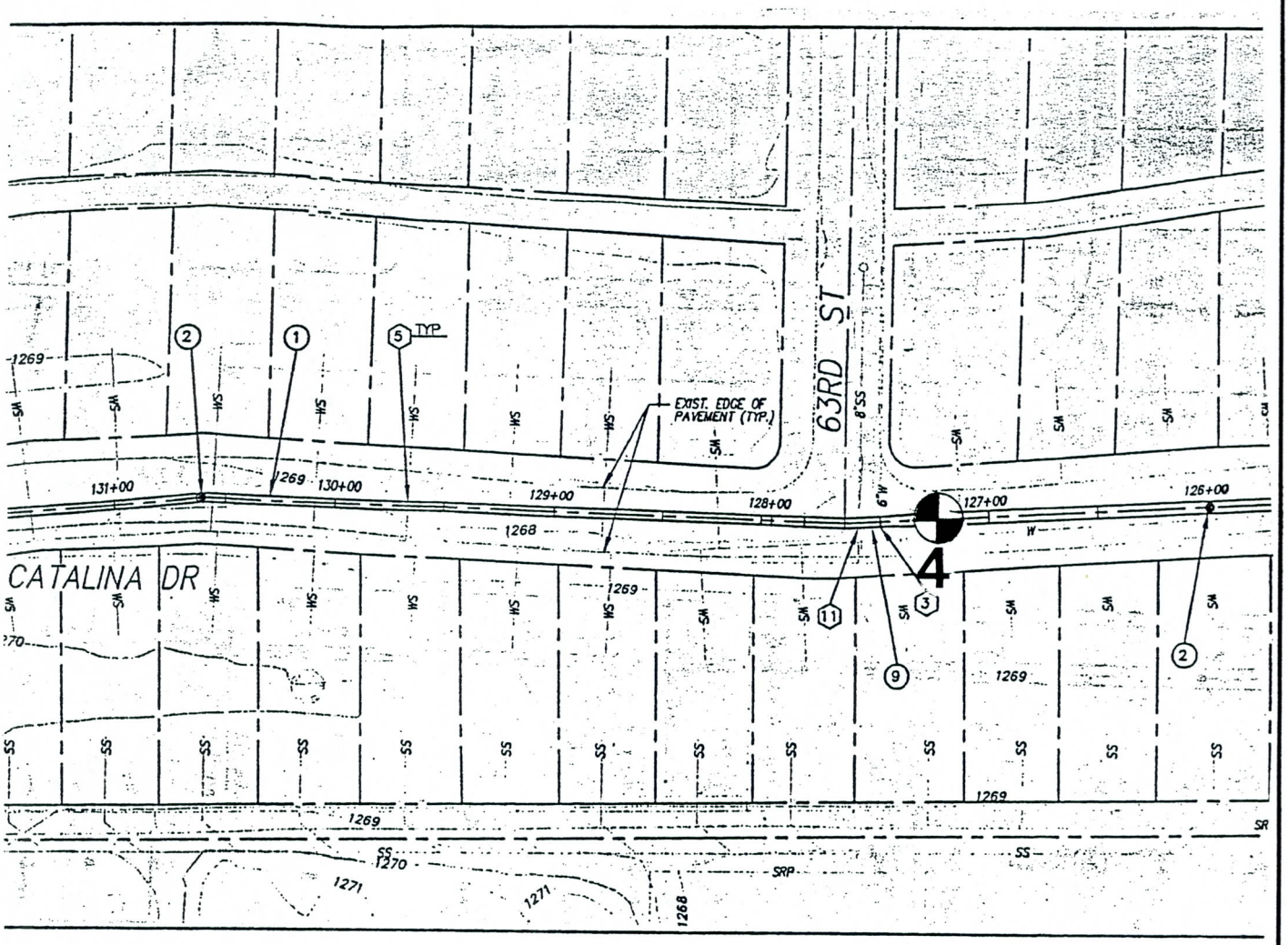

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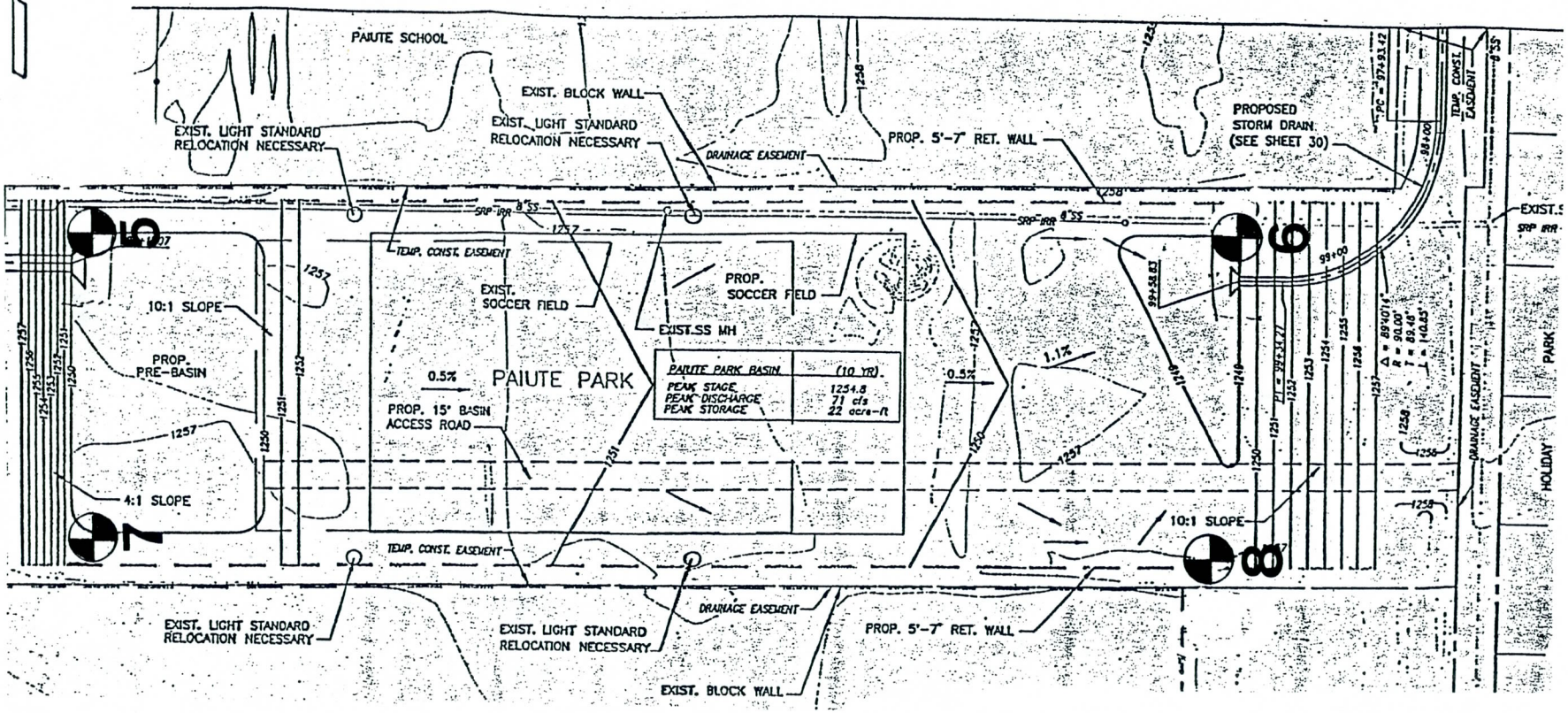


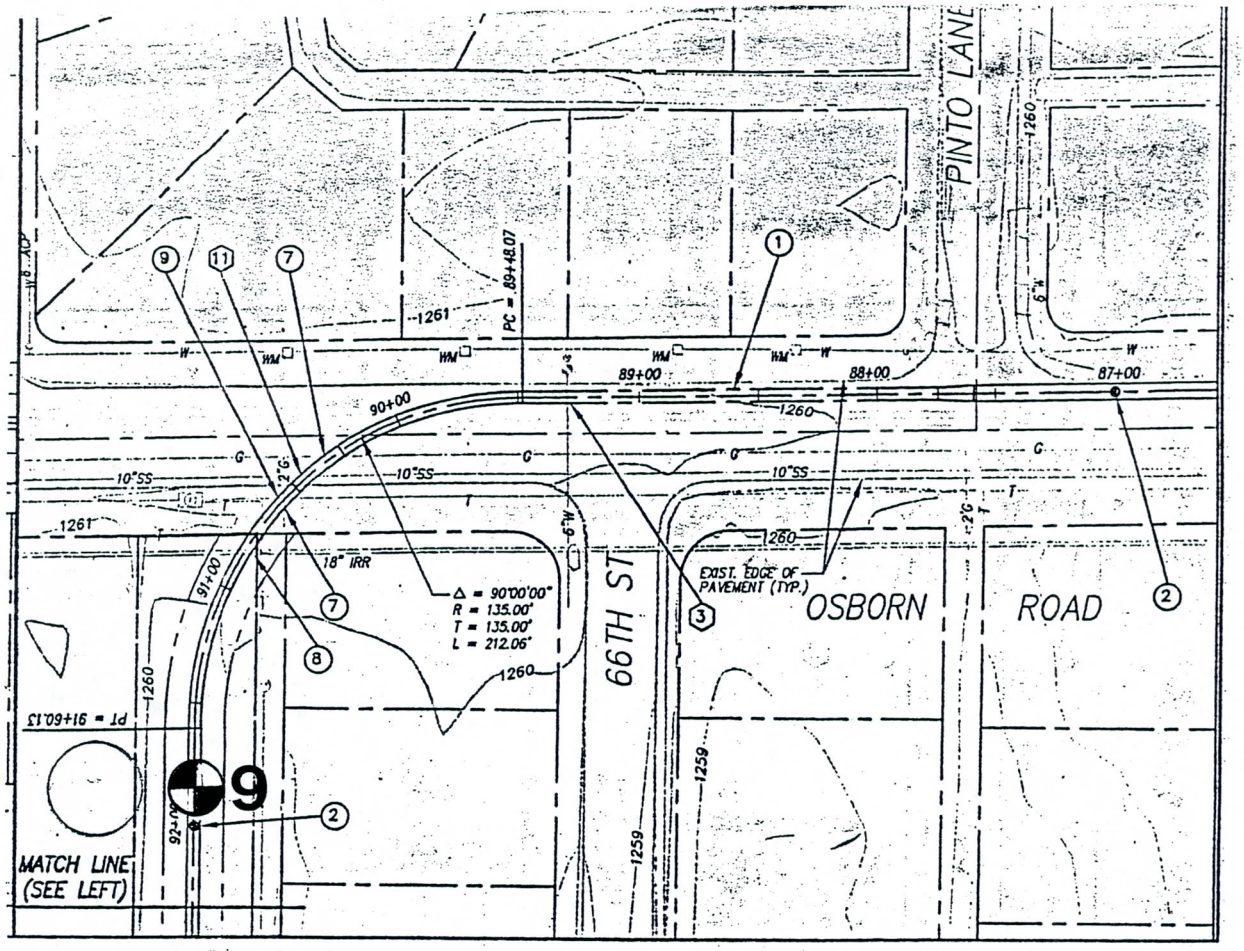
PAIUTE PARK BASIN	(10 YR)
PEAK STAGE	1254.8
PEAK DISCHARGE	71 cfs
PEAK STORAGE	22 acre-ft

SITE PLAN

Test Boring Location

R.A.M. PROJECT NO. G02939

A1-D



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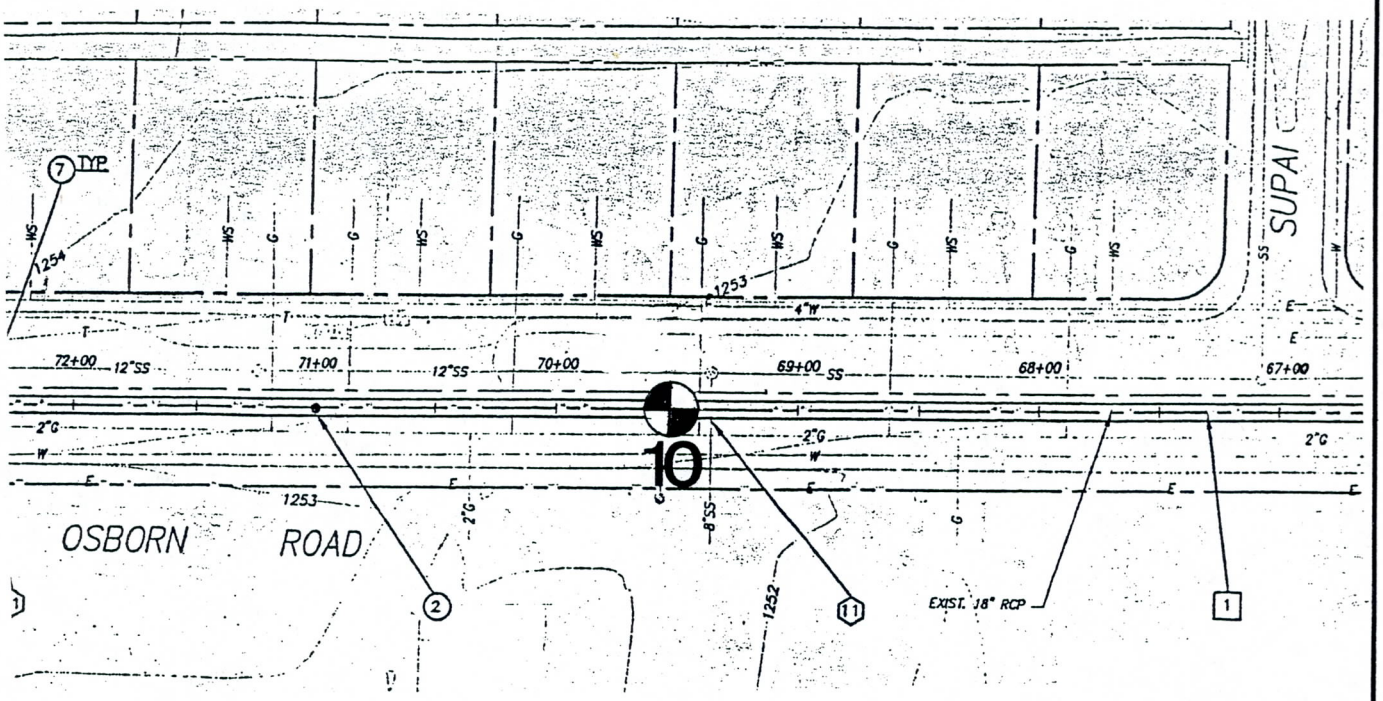

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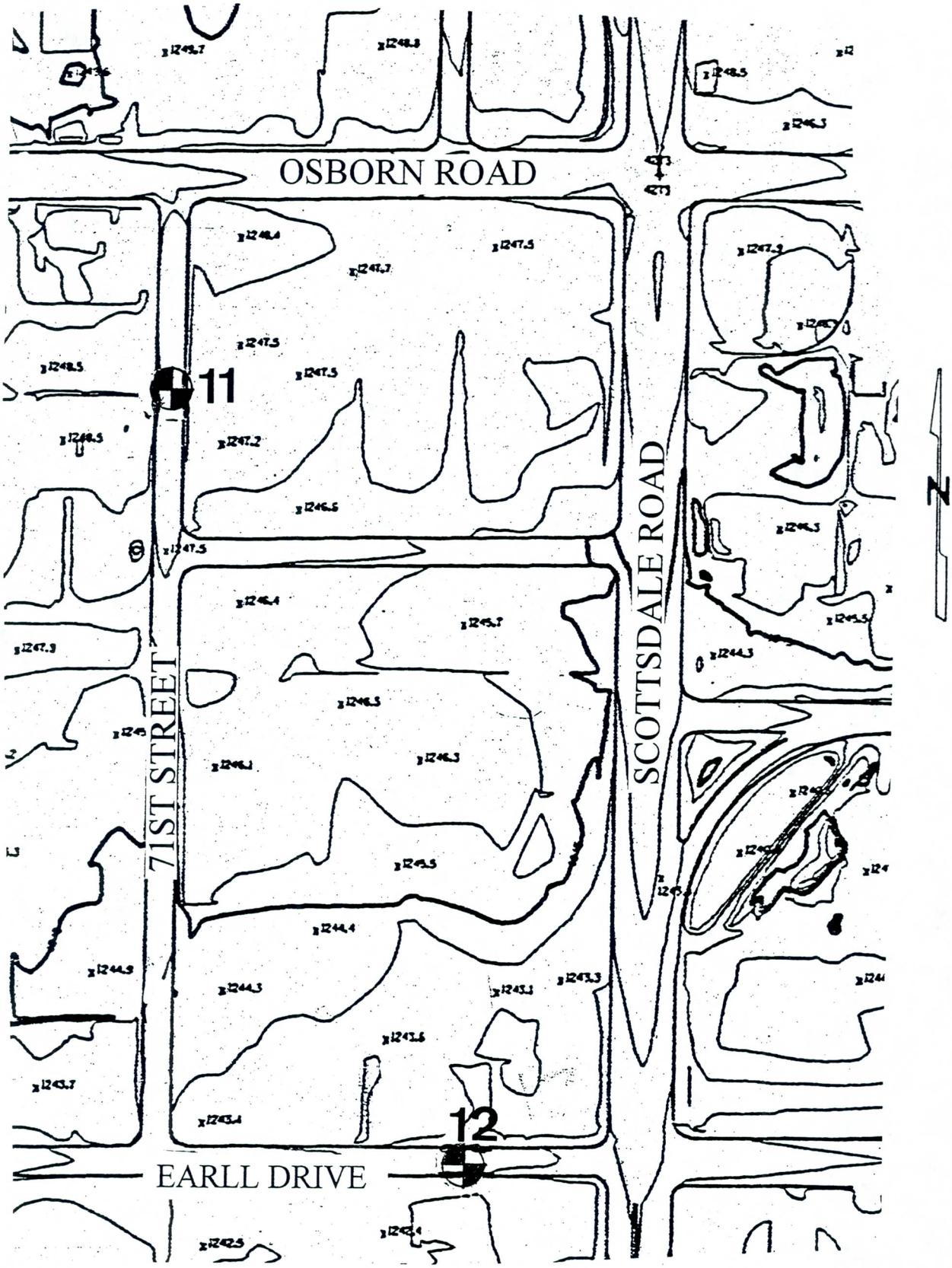

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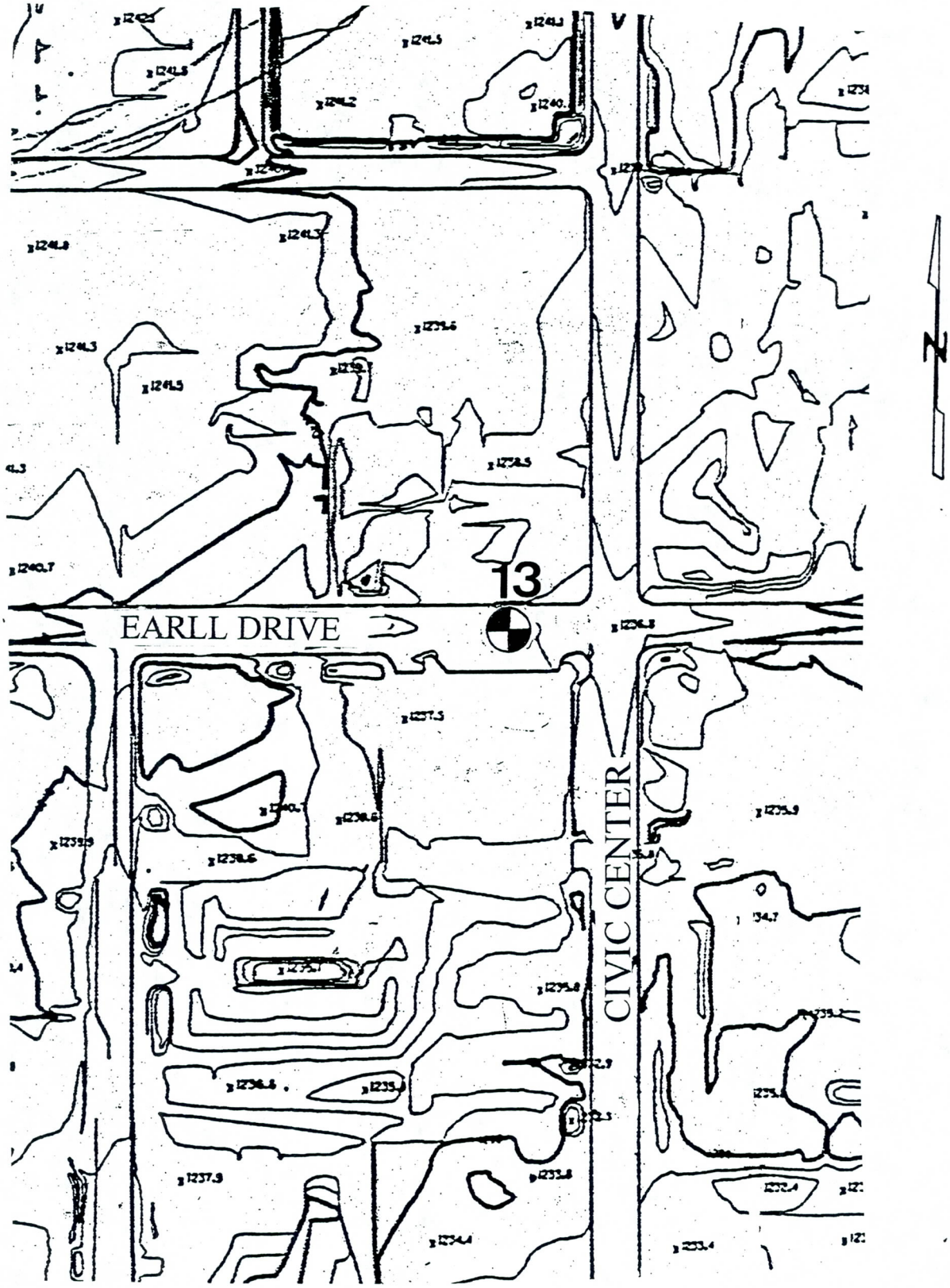

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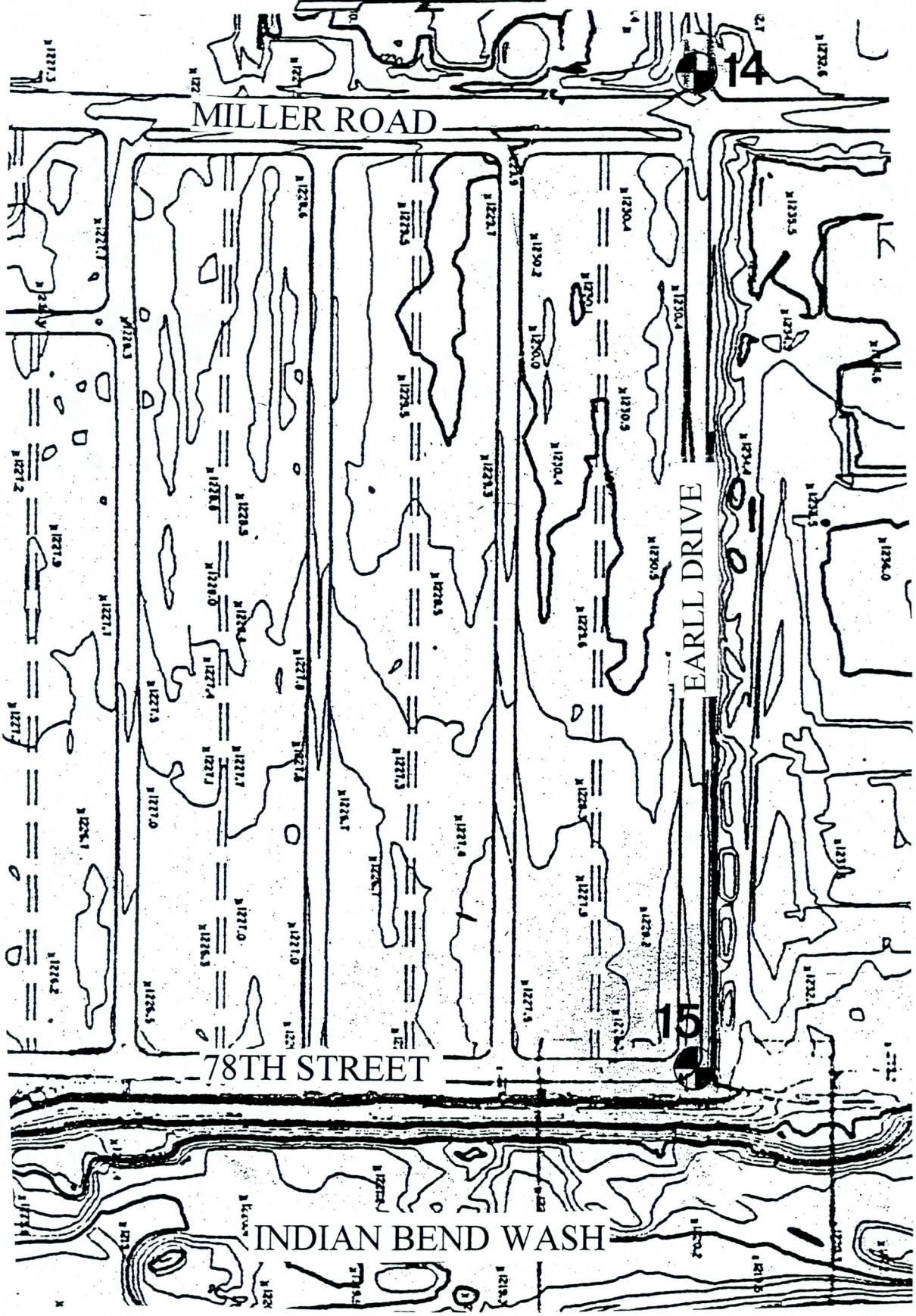


Test Boring Location

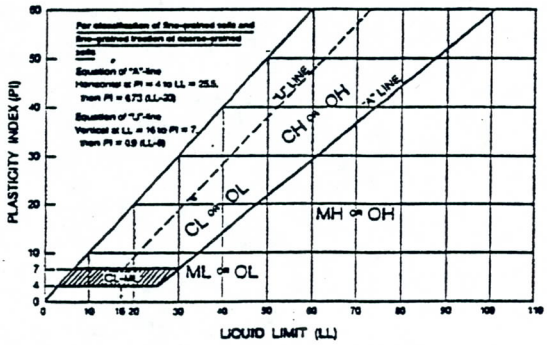
SITE PLAN

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	Soil Classification: 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	$Cu \geq 4$ and $1 \leq Cc \leq 3$	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	$Cu \geq 6$ and $1 \leq Cc \leq 3$	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)

GRAIN SIZES

U.S. STANDARD SERIES SIEVE	200	40	10	4	3/4"	3"	12"
SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

CLEAR SQUARE SIEVE OPENINGS

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: Osborn Road Storm Drain Project TEST BORING: 1

Elevation: Not Determined Datum: --- Date: 6-17-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		21	R	106	9	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5							
10		50/4"	R	107	8		Moderate cementation below 9 feet.
15							
20		50/5"	R	103	11		
							Stopped drilling at 20.4 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: Osborn Road Storm Drain Project TEST BORING: 2

Elevation: Not Determined Datum: --- Date: 6-17-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		32	R	96	13	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5		42	R	114	8		Moderate cementation below 6 feet.
10							
15		50/2"	R	NR			
20							
							Stopped drilling at 20 feet. NR = No Recovery 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: Osborn Road Storm Drain Project TEST BORING: 3

Elevation: Not Determined Datum: --- Date: 6-15-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 5" Base Material
		15	R	104	10	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5							
10							Moderate cementation below 9 feet.
		50/8"	R	111	8		
15							
20		50/1"	R	NR			
							Stopped drilling at 20 feet. NR = No Recovery 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: Osborn Road Storm Drain Project TEST BORING: 4

Elevation: Not Determined Datum: --- Date: 6-15-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 5" Base Material
		18	R	105	10	CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
5		35	R	105	15		
10							
15		34	R	102	14		
20							
							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 5

Elevation: Not Determined Datum: --- Date: 6-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		12	R	114	10	CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
5							
10		24	R	105	16		
15							
20		50/6"	R	107	13		Moderately cemented below 18 feet.
							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: Osborn Road Storm Drain Project TEST BORING: 6

Elevation: Not Determined Datum: --- Date: 6-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		13	R	102	16	CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
5		25	R	115	13		
10							
15		50/7"	R	92	18		Moderately cemented below 14 feet.
20							
							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 7

Elevation: Not Determined Datum: --- Date: 6-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		13	R	112	14	CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
5							
10		34	R	94	19		
15							Moderately cemented below 15 feet.
20		50/3"	R	NR			
							Stopped drilling at 20 feet. NR = No Recovery 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: Osborn Road Storm Drain Project TEST BORING: 8

Elevation: Not Determined Datum: --- Date: 6-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		15	R	114	10	CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
5		31	R	115	8		
10							
15							
20		44	R	101	10		
							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 9

Elevation: Not Determined Datum: --- Date: 6-17-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		30	R	109	5	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5		50/10"	R	109	7		Moderately cemented below 5 feet.
10						CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
15		28	R	97	13		
20							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 10

Elevation: Not Determined Datum: --- Date: 6-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							5" Asphalt Concrete on 10" Base Material
		11	R	113	10	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5		18	R	107	10		
10							
15		50/8"	R	105	16		Moderate cementation below 13 feet.
20							
							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 11

Elevation: Not Determined Datum: --- Date: 7-26-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							2.5" Asphalt Concrete on 6" Base Material
		19	R	117	10	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5							
10		50/10"	R	103	17		Moderate cementation below 9 feet.
15							
20		50/6"	R	92	18		
							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: Osborn Road Storm Drain Project TEST BORING: 12

Elevation: Not Determined Datum: --- Date: 7-26-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							4.5" Asphalt Concrete on 5" Base Material
		19	R	117	12	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5		13	R	112	8		
10							
15		50	R	107	15		Moderate cementation below 15 feet.
20							
							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 13

Elevation: Not Determined Datum: --- Date: 7-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							2.5" Asphalt Concrete on 7.5" Base Material
		18	R	112	15	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5							
10		50	R	98	23		
15							
20		34	R	101	22		
							Stopped drilling at 21 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: Osborn Road Storm Drain Project TEST BORING: 14

Elevation: Not Determined Datum: --- Date: 7-16-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							4" Asphalt Concrete on 6" Base Material
		15	R	110	15	SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
5		17	R	92	11		
10							
15		50/5"	R	104	10		Moderately cemented below 14 feet.
20							
							Stopped drilling at 20 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: Osborn Road Storm Drain Project TEST BORING: 15

Elevation: Not Determined Datum: --- Date: 7-26-99

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							3" Asphalt Concrete on 6.5" Base Material
		20	R	119	14	CL	Sandy Clay, trace to some Gravel; brown, slightly damp to damp, stiff to very stiff, medium plasticity.
5							
						SC	Clayey Sand, trace to some Gravel; brown, slightly damp to damp, medium dense to dense, medium plasticity fines.
10		50/2"	R	NR			Moderately cemented below 10 feet.
15							
20		50/6"	R	85	32		
							Stopped drilling at 20.5 feet. NR = No Recovery 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.

APPENDIX B
LABORATORY ANALYSIS

R·A·M

LABORATORY TEST RESULTS

Date: 2-Aug-99

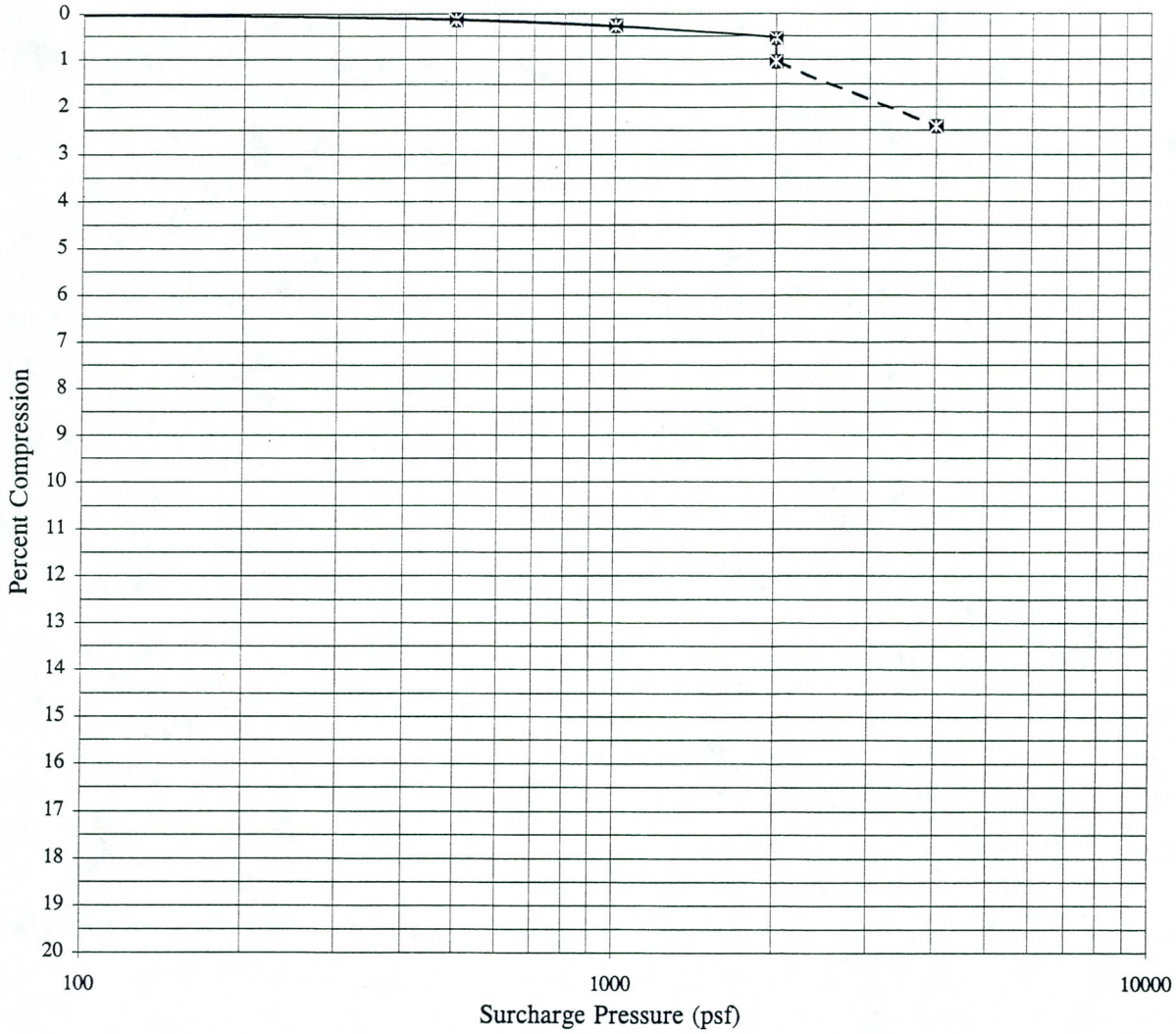
SAMPLE SOURCE: 1 @ 0'-1'

TESTING PERFORMED: Compression (ASTM D2434) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 106 Moisture Content (%): 9



REMARKS: Sample submerged at 2000 psf.

LABORATORY TEST RESULTS

Date: 2-Aug-99

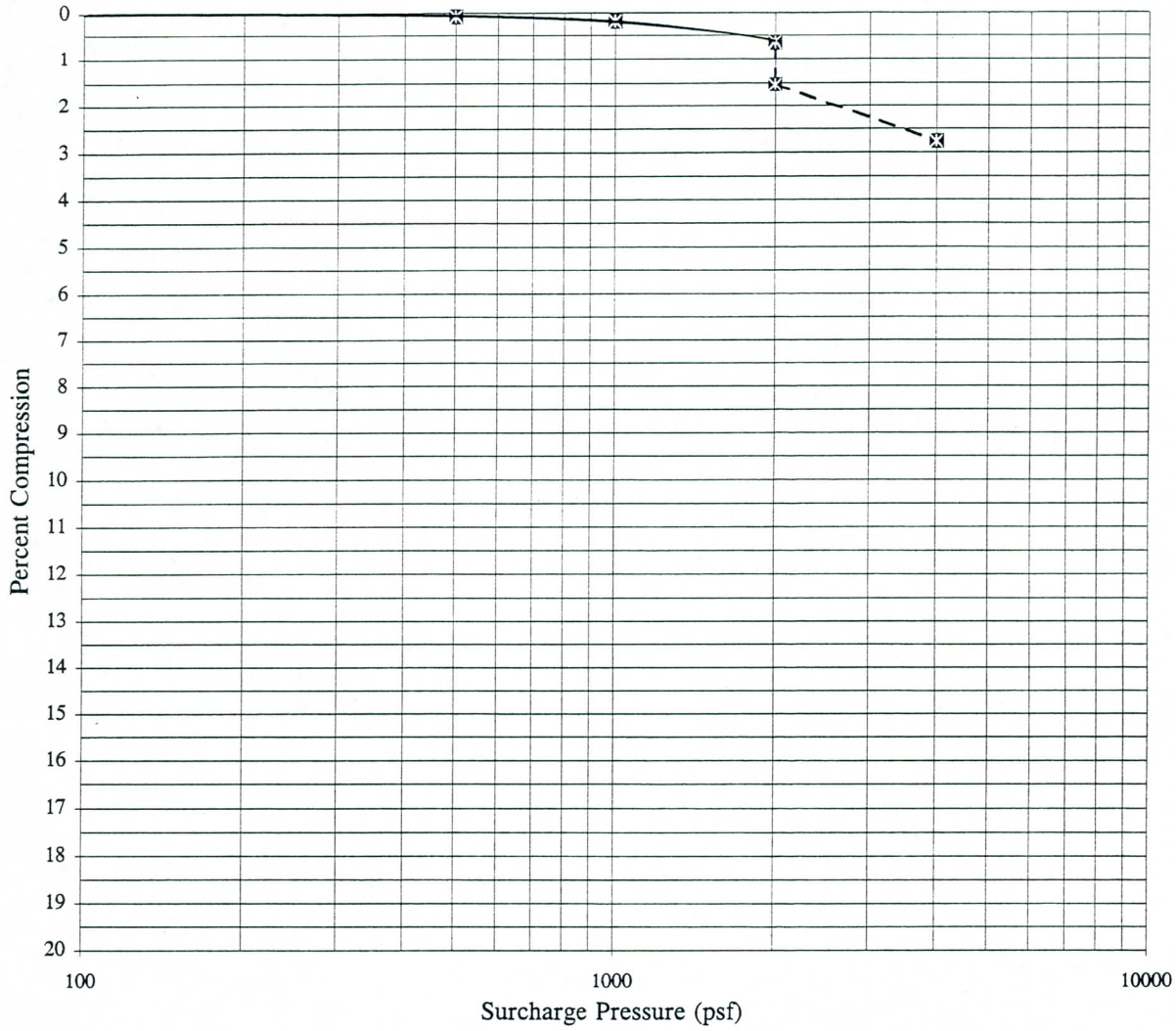
SAMPLE SOURCE: 5 @ 0'-1'

TESTING PERFORMED: Compression (ASTM D2434) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 114 Moisture Content (%): 10



REMARKS: Sample submerged at 2000 psf.

LABORATORY TEST RESULTS

Date: 2-Aug-99

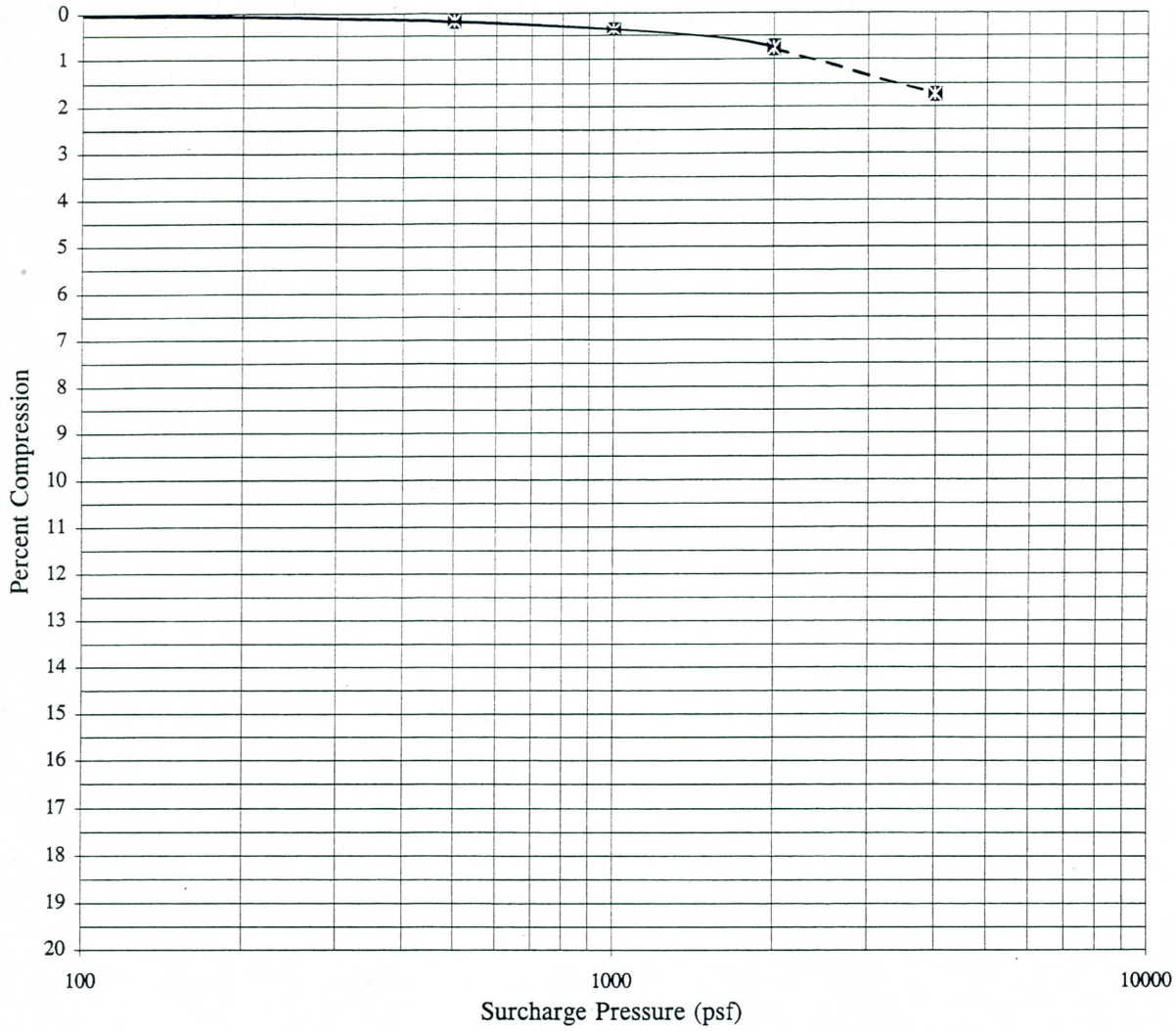
SAMPLE SOURCE: 6 @ 0'-1'

TESTING PERFORMED: Compression (ASTM D2434) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 102 Moisture Content (%): 16



REMARKS: Sample submerged at 2000 psf.

LABORATORY TEST RESULTS

Date: 2-Aug-99

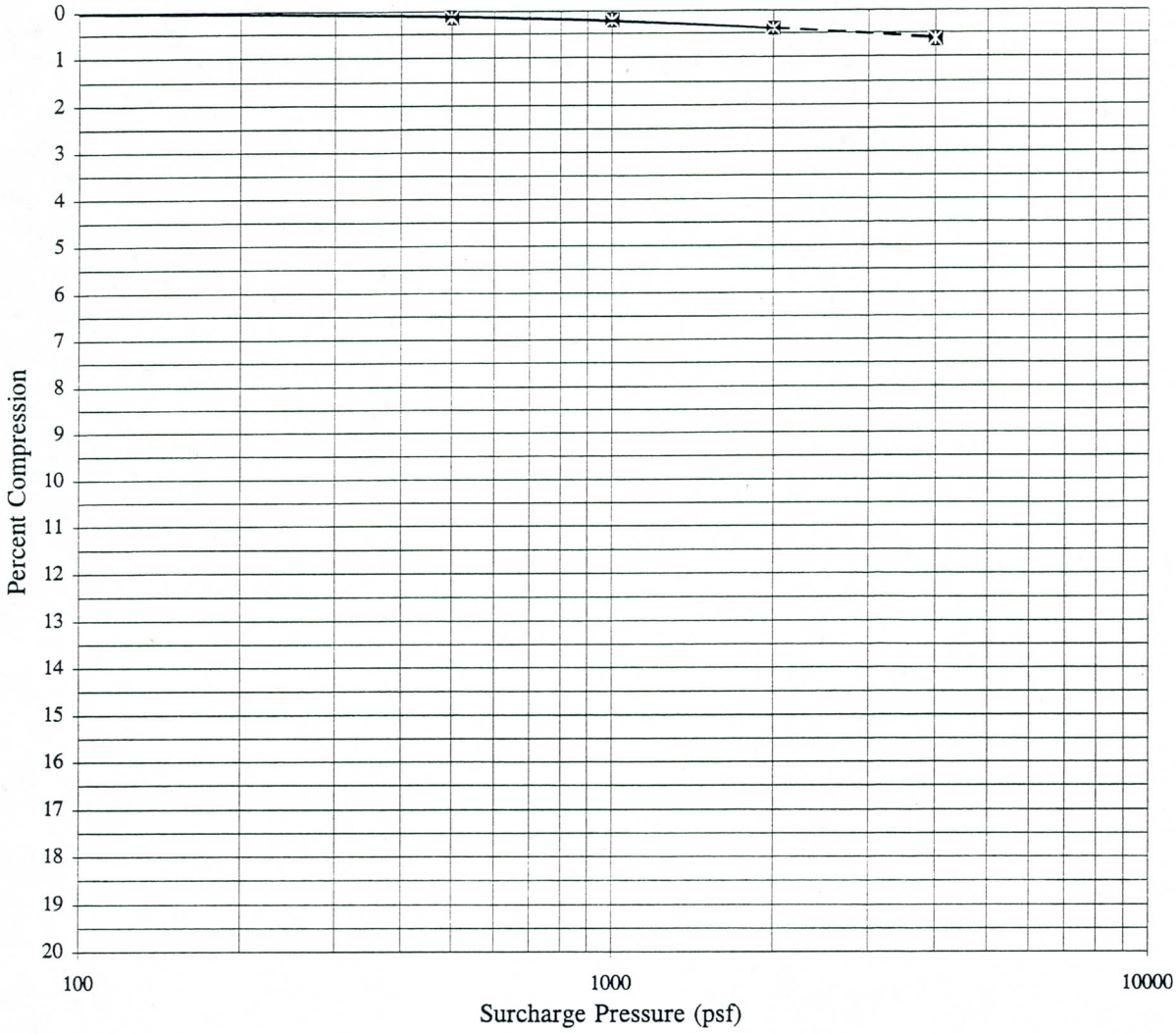
SAMPLE SOURCE: 15 @ 1'-2'

TESTING PERFORMED: Compression (ASTM D2434) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 119 Moisture Content (%): 14



REMARKS: Sample submerged at 2000 psf.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 2 @ 0' - 1'

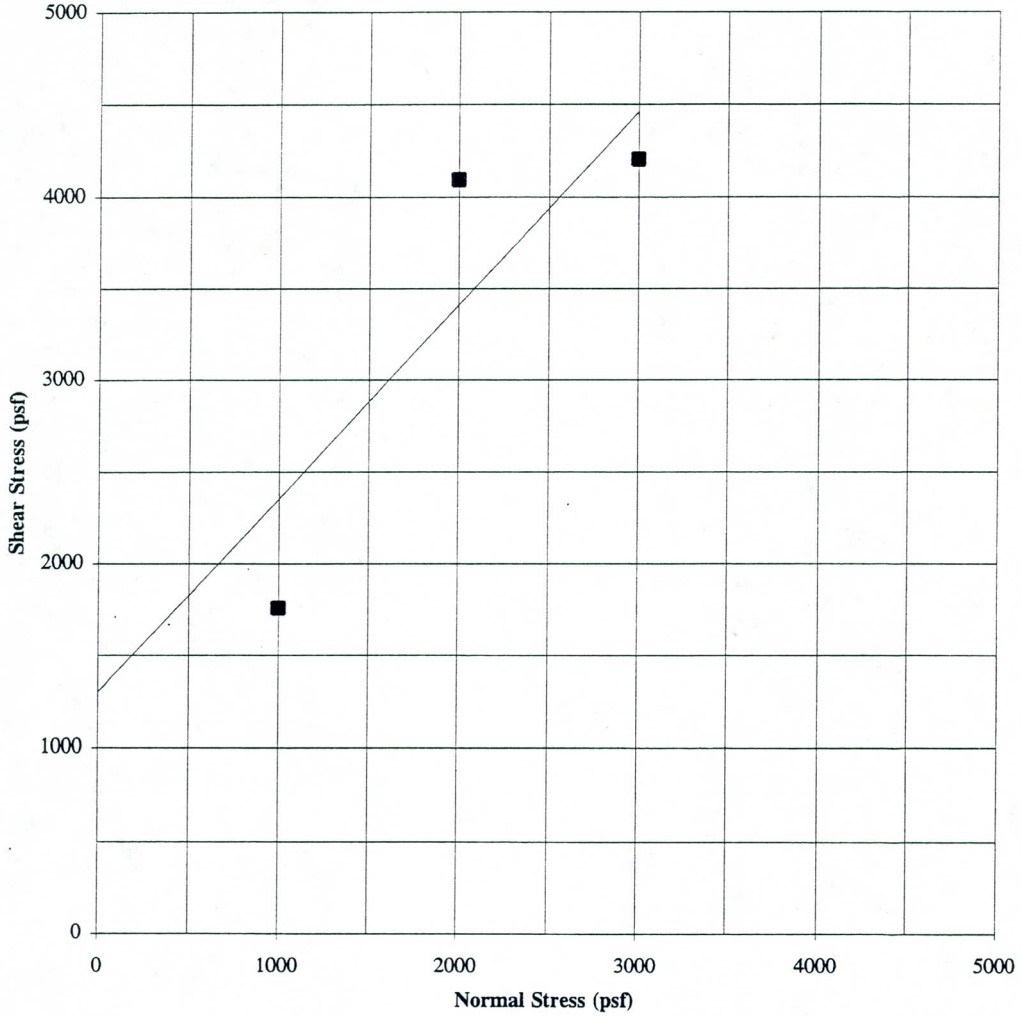
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 96 Moisture Content (%): 13

Cohesion (psf) = 1300 Friction Angle (phi) = 47



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 2 @ 5' - 6'

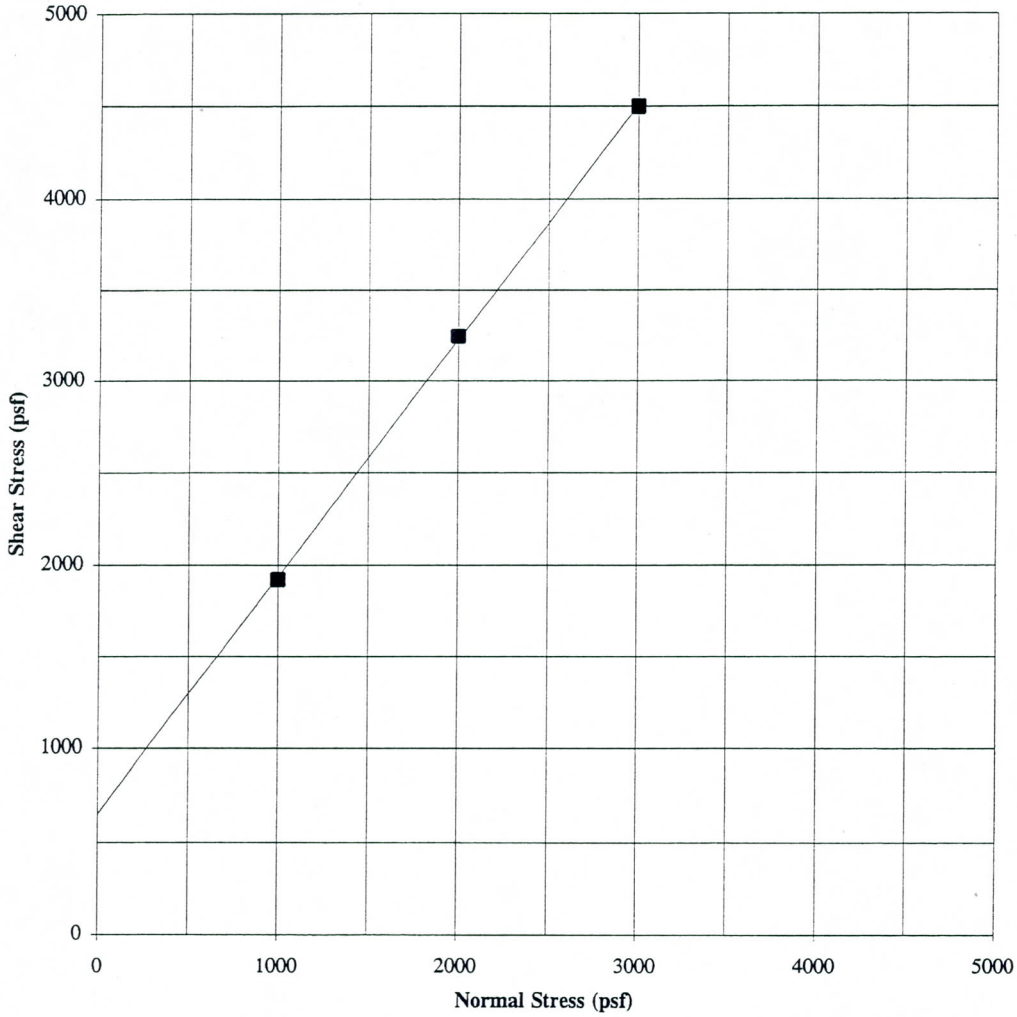
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 114 Moisture Content (%): 8

Cohesion (psf) = 650 Friction Angle (phi) = 52



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 6 @ 5' - 6'

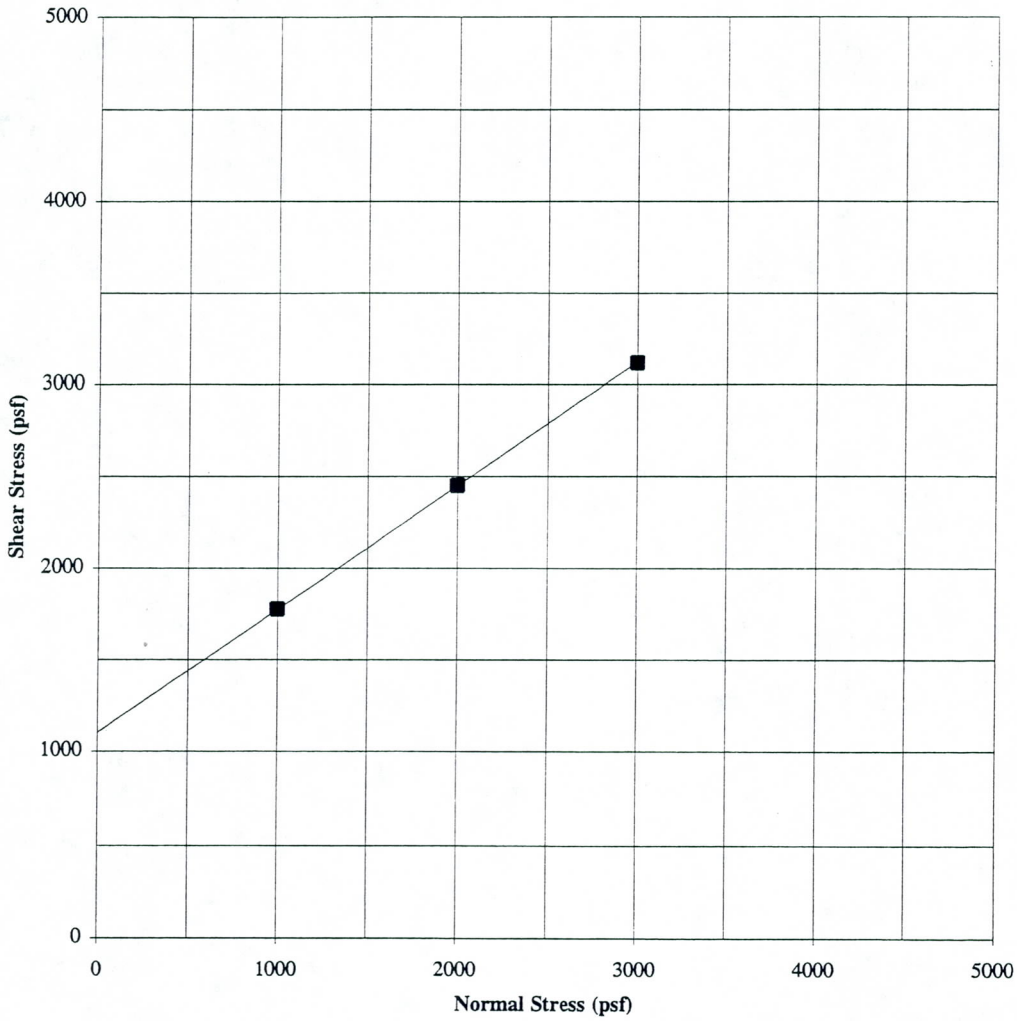
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 115 Moisture Content (%): 13

Cohesion (psf) = 1100 Friction Angle (phi) = 34



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 8 @ 0' - 1'

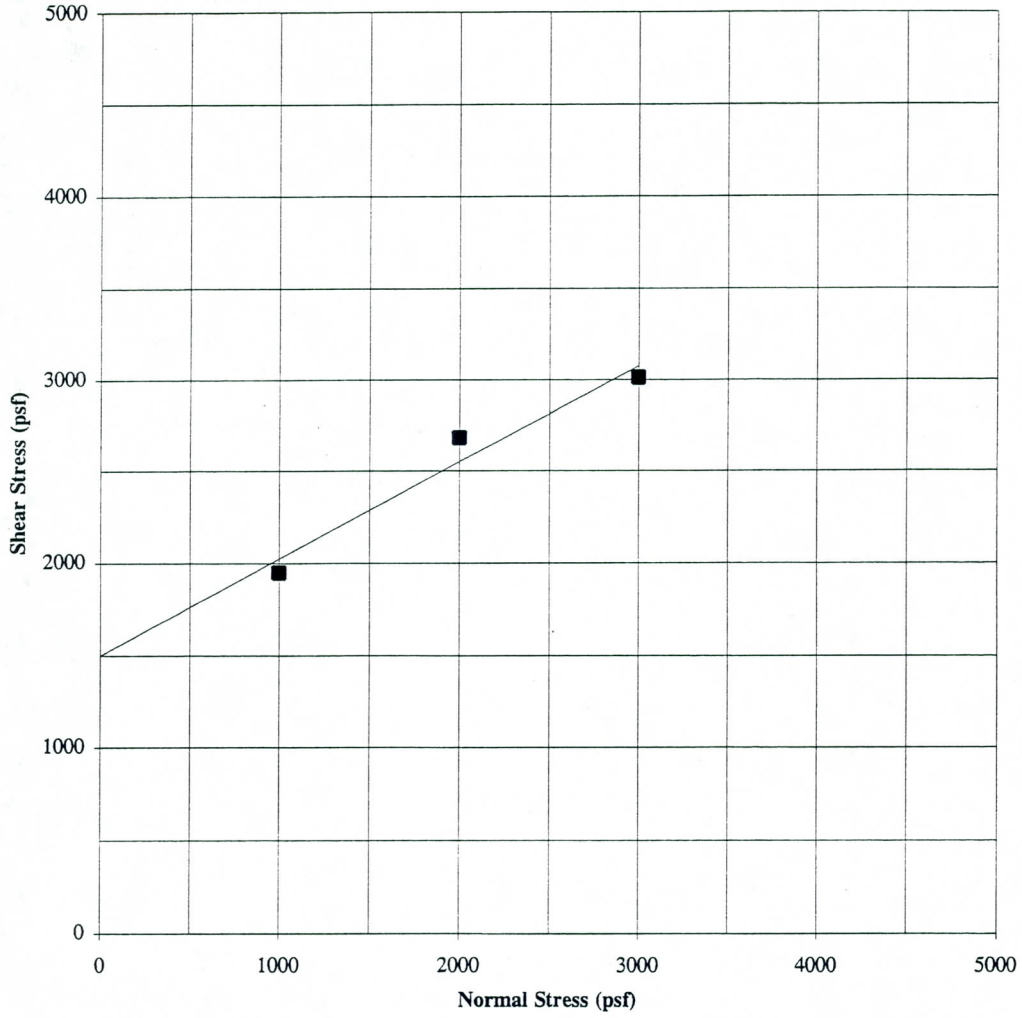
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 114 Moisture Content (%): 10

Cohesion (psf) = 1500 Friction Angle (phi) = 28



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 8 @ 5' - 6'

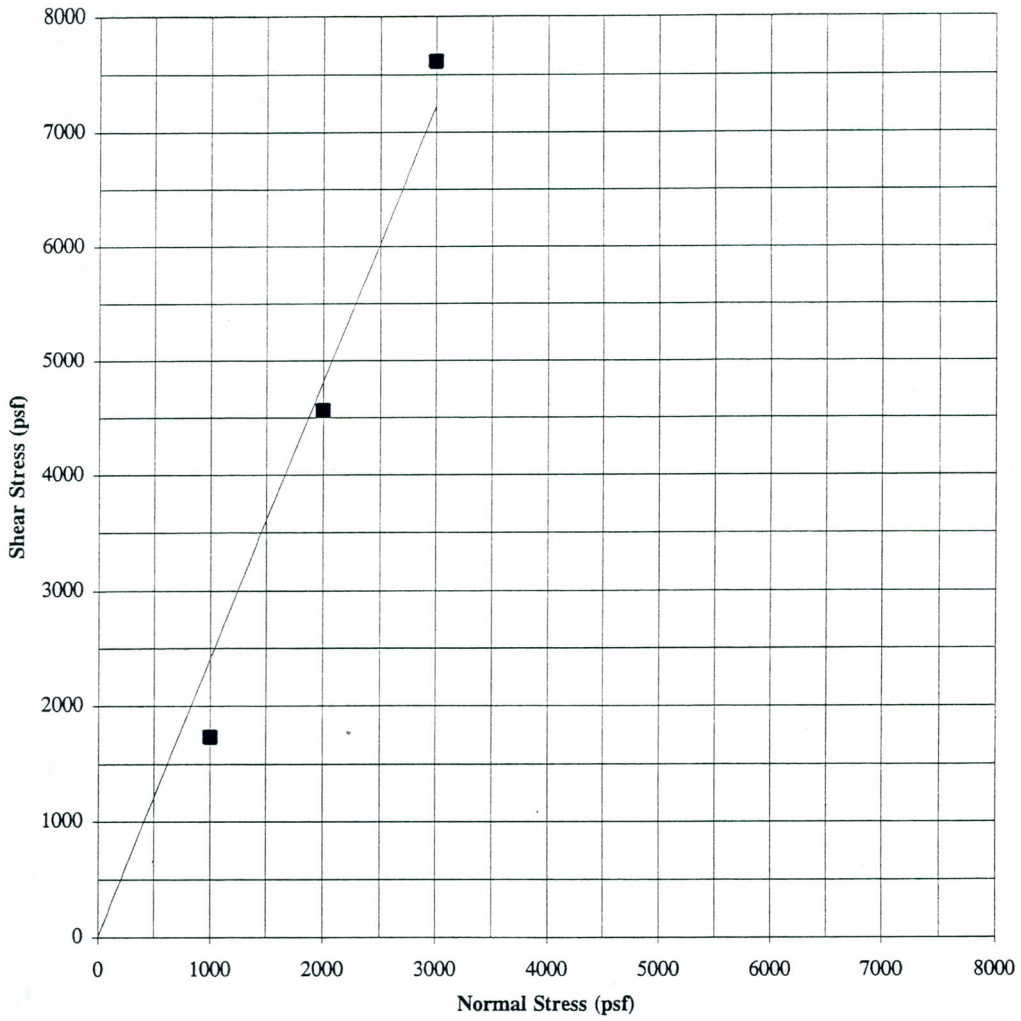
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 115 Moisture Content (%): 8

Cohesion (psf) = 0 Friction Angle (phi) = 67



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 11 @ 10' - 11'

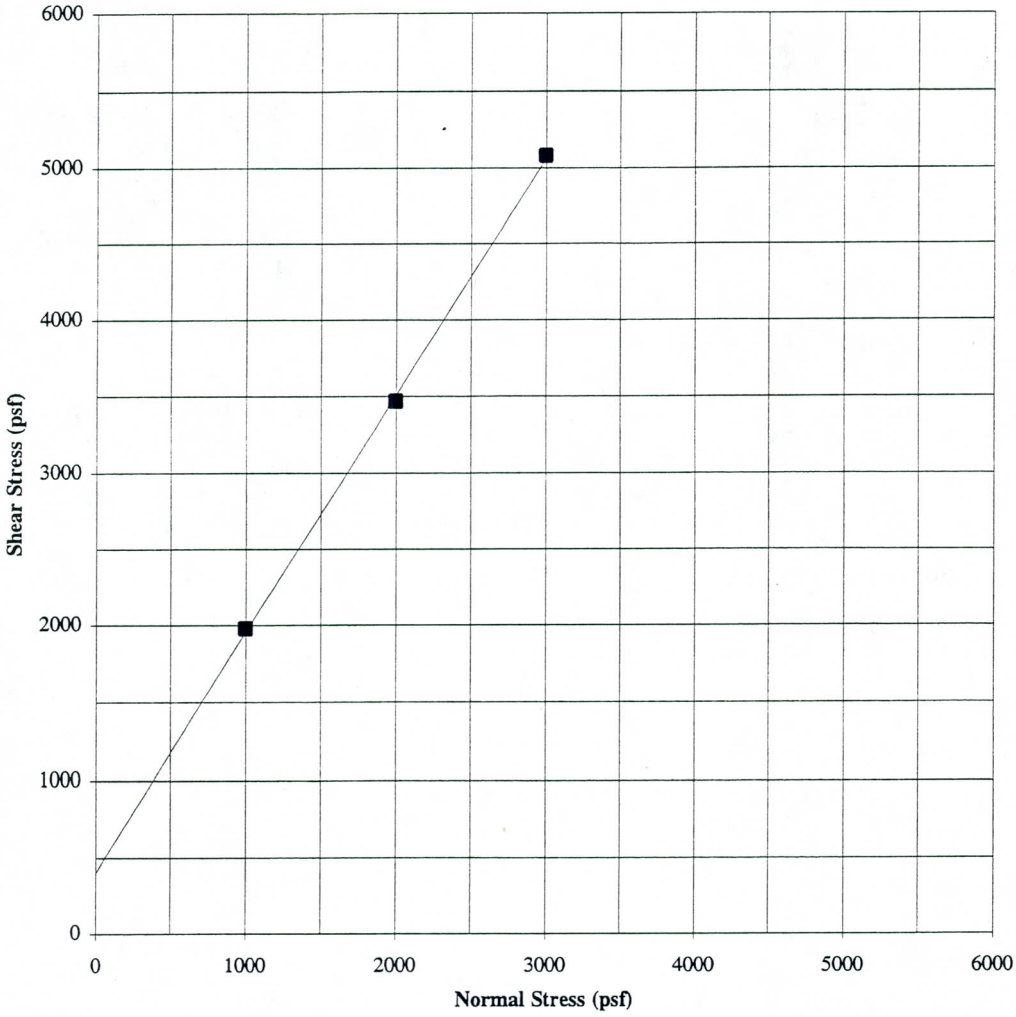
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 103 Moisture Content (%): 13

Cohesion (psf) = 400 Friction Angle (phi) = 57



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: 14 @ 5' - 6'

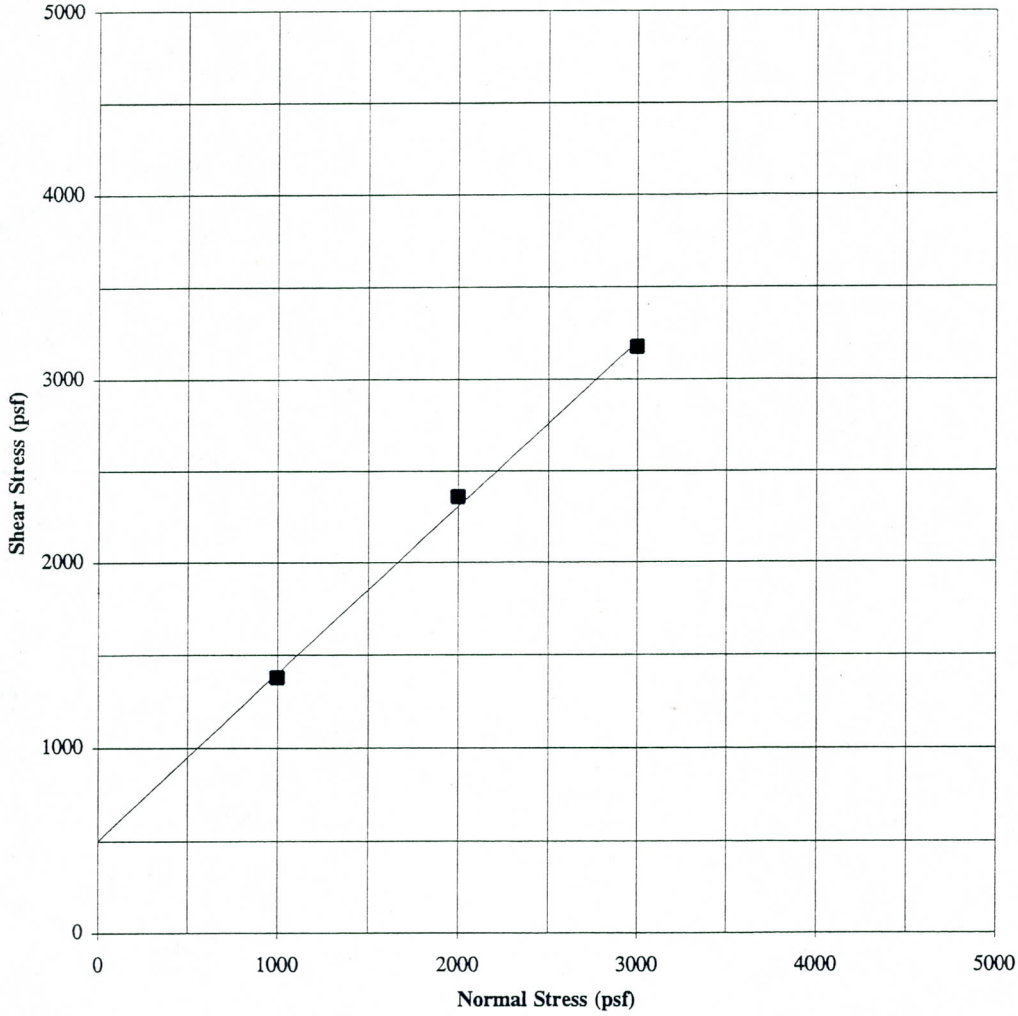
TESTING PERFORMED: Direct Shear (ASTM D3080) - Driven Ring Sample

SAMPLED BY: RAM/Miller

RESULTS:

Dry Density (pcf): 92 Moisture Content (%): 11

Cohesion (psf) = 500 Friction Angle (phi) = 42



REMARKS: Samples not submerged prior to testing.

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: As noted below

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

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	Percent Retained No. 4 Sieve	Percent Passing No. 200 Sieve	Liquid Limit	Plasticity Index
1 @ 0'-5'	13	45	38	19
1 @ 5'-10'	19	37	57	29
2 @ 0'-5'	17	38	64	29
2 @ 10'-15'	16	29	51	23
3 @ 0'-5'	18	42	41	17
3 @ 10'-15'	16	41	53	25
4 @ 0'-5'	14	52	39	20
4 @ 15'-20'	7	53	61	36
5 @ 0'-5'	7	54	39	20
5 @ 5'-10'	4	63	69	39
6 @ 0'-5'	3	59	67	36
6 @ 10'-15'	3	59	64	37
7 @ 0'-5'	8	54	65	35
7 @ 15'-20'	4	60	55	27
8 @ 0'-5'	7	56	32	16
8 @ 5'-10'	9	52	41	20

LABORATORY TEST RESULTS

Date: 2-Aug-99

SAMPLE SOURCE: As noted below

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

SAMPLED BY: RAM/Miller

RESULTS:

Sample Source	Percent Retained No. 4 Sieve	Percent Passing No. 200 Sieve	Liquid Limit	Plasticity Index
9 @ 0'-5'	11	41	29	11
9 @ 15'-20'	4	61	60	32
10 @ 0'-5'	14	41	29	13
10 @ 10'-15'	4	45	45	22
11 @ 0'-5'	13	47	38	19
11 @ 15'-20'	15	38	62	34
12 @ 0'-5'	10	35	28	12
12 @ 15'-20'	17	29	57	32
13 @ 0'-5'	18	45	38	20
13 @ 15'-20'	17	41	73	48
14 @ 0'-5'	18	42	58	36
14 @ 15'-20'	19	38	62	38
15 @ 0'-5'	8	74	37	19
15 @ 15'-20'	26	33	52	29

LABORATORY TEST RESULTS

Date: 2-Aug-99

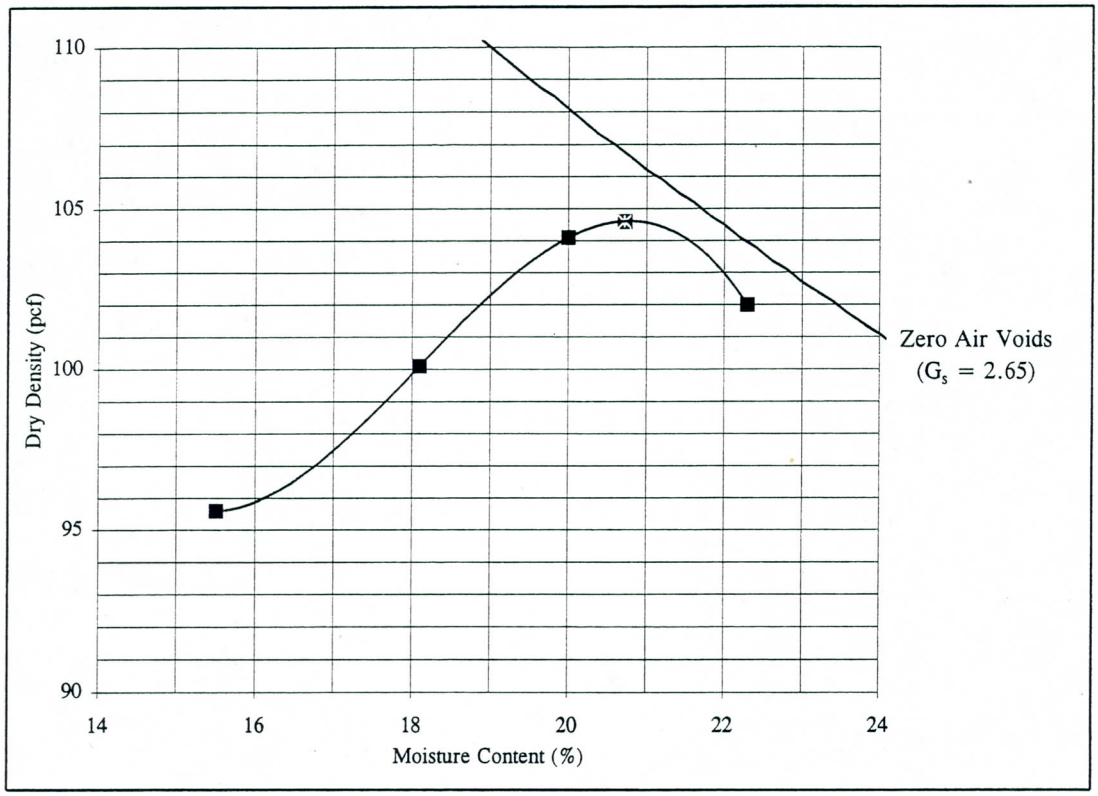
SAMPLE SOURCE: Composite: 13 @ 5'-10' & 13 @ 10'-15'

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

SAMPLED BY: RAM/Miller

RESULTS:

Maximum Density (pcf) = 104.6 Optimum Moisture (%) = 20.7



Laboratory Consultants, Ltd.

Ricker-Atkinson-McBee & Associates
2105 South Hardy Drive, Suite #13
Tempe, AZ 85282

Sample Number: 990960-01
Date Reported: 7/1/99
Date Received: 6/28/99
Project Number: G02939

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
3 @ 10-15	pH	ADOT237	8.7	S.U.
3 @ 10-15	CHLORIDE	CA422M	0.0078	%
3 @ 10-15	SOLUBLE SALTS	ENG. SOIL	0.082	%
3 @ 10-15	SULFATE	CA417	0.020	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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MEMBER ACIL

Laboratory Consultants, Ltd.

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2105 South Hardy Drive, Suite #13
Tempe, AZ 85282

Sample Number: 990960-02
Date Reported: 7/1/99
Date Received: 6/28/99
Project Number: G02939

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
4 @ 15-20	pH	ADOT237	8.3	S.U.
4 @ 15-20	CHLORIDE	CA422M	0.0063	%
4 @ 15-20	SOLUBLE SALTS	ENG. SOIL	0.10	%
4 @ 15-20	SULFATE	CA417	0.017	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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Sample Number: 991228-01
Date Reported: 8/2/99
Date Received: 7/27/99
Project Number: G02939

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
11 @ 15-20	pH	ADOT237	8.1	S.U.
11 @ 15-20	CHLORIDE	CA422M	0.011	%
11 @ 15-20	SOLUBLE SALTS	ENG. SOIL	0.038	%
11 @ 15-20	SULFATE	CA417	0.0046	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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Sample Number: 991228-02
Date Reported: 8/2/99
Date Received: 7/27/99
Project Number: G02939

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
12 @ 15-20	pH	ADOT237	8.5	S.U.
12 @ 15-20	CHLORIDE	CA422M	0.0075	%
12 @ 15-20	SOLUBLE SALTS	ENG. SOIL	0.050	%
12 @ 15-20	SULFATE	CA417	0.0096	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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Sample Number: 991228-03
Date Reported: 8/2/99
Date Received: 7/27/99
Project Number: G02939

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
13 @ 15-20	pH	ADOT237	8.1	S.U.
13 @ 15-20	CHLORIDE	CA422M	0.0060	%
13 @ 15-20	SOLUBLE SALTS	ENG. SOIL	0.048	%
13 @ 15-20	SULFATE	CA417	0.0075	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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Sample Number: 991228-04
Date Reported: 8/2/99
Date Received: 7/27/99
Project Number: G02939

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
14 @ 15-20	pH	ADOT237	8.1	S.U.
14 @ 15-20	CHLORIDE	CA422M	0.015	%
14 @ 15-20	SOLUBLE SALTS	ENG. SOIL	0.080	%
14 @ 15-20	SULFATE	CA417	0.032	%

Approved By: Badang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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Sample Number: 991244-01
Date Reported: 8/2/99
Date Received: 7/29/99
Project Number: G02938

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
C17 @ 0-5	CHLORIDE	CA422M	0.018	%
C17 @ 0-5	SOLUBLE SALTS	ENG. SOIL	0.097	%
C17 @ 0-5	SULFATE	CA417	0.013	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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Laboratory Consultants, Ltd.

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Tempe, AZ 85282

Sample Number: 991244-02
Date Reported: 8/2/99
Date Received: 7/29/99
Project Number: G02938

Analyses Results

Client Sample ID	Analysis	Method	Result	Units
C18 @ 0-5	CHLORIDE	CA422M	0.022	%
C18 @ 0-5	SOLUBLE SALTS	ENG. SOIL	0.087	%
C18 @ 0-5	SULFATE	CA417	0.0036	%

Approved By: Dadang

There were no problems with the analyses and all data met laboratory quality assurance specifications.

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