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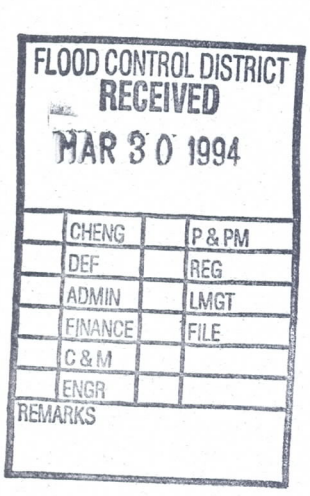
Huntingdon

REPORT FOR
GEOTECHNICAL ENGINEERING SERVICES
DETENTION BASIN NO. 1 - 10TH STREET WASH
FCD 93-31
CAVE CREEK ROAD NORTH OF CHERYL DRIVE
PHOENIX, ARIZONA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REPORT FOR
GEOTECHNICAL ENGINEERING SERVICES
DETENTION BASIN NO. 1 - 10TH STREET WASH
FCD 93-31
CAVE CREEK ROAD NORTH OF CHERYL DRIVE
PHOENIX, ARIZONA

Submitted To:

Stanley Consultants, Inc.
Attention: Scott Buchannan
2929 East Camelback Road, Suite 130
Phoenix, Arizona 85016-4425

Project No. 95-0041

24 March 1995

MESSAGE DISPLAY FOR DON RERICK

To: wfr
Cc: mal
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From: Don Rerick:TALOS
Postmark: 03/30/95 01:32PM
Status:

Host: TALOS
Delivered: 03/30/95 01:32PM

Subject: TSW - Basin #1 Geotech Report

Message:
I have received 3 copies of the subject report, and will forward one copy to you.

This is to be Engineering Division copy, and for your use in review of the project P&S and calcs.

Please review and file for future reference in the P&S review process.

If you have any comments requiring action and a possioble addendum, let me know NLT April 12.

Thanks.

Huntingdon

Huntingdon Engineering & Environmental, Inc.
7031 West Oakland Street
Chandler, AZ 85226
(602) 961-1169
Fax (602) 940-0952

Stanley Consultants, Inc.
2929 East Camelback Road, Suite 130
Phoenix, Arizona 85016-4425

24 March 1995

Attention: Scott Buchannan

Subject: Report for Geotechnical Engineering Services
Detention Basin No. 1 - 10th Street Wash
FCD 93-31
Cave Creek Road North of Cheryl Drive — Project No. 95-0041
Phoenix, Arizona — Reference Project No. 94-0337

In accordance with your authorization this firm has performed four (4) additional test borings to evaluate geotechnical design recommendations for inlet structures and the west retaining wall of the retention basin. Test boring logs and a site plan showing the locations of the additional borings are attached.

The west basin retaining wall will be designed assuming:

(1) Hydrostatic loading, including an overflow condition from the basin side;
(2) the basin empty and the wall loaded by saturated backfill on the wash side to a height of 5 feet from the top of the wall;
(3) the wall free standing with wash side fill removed by scour and hydrostatic loadings on either side; and
(4) the foundation soils fully saturated (buoyant condition). A sketch of this wall by Stanley consultants is included with this report.

Soil Conditions: Subsurface profiles in the four additional test borings (Nos. 4 through 9, inclusive) were similar to profiles encountered in the original test borings, except that existing fills were present at the surface of Test Borings 6 and 7 and a recent wash channel deposit was present at the surface in Test Boring 8. Soils below these anomalous materials were clayey, gravelly sand deposits of medium plasticity and medium to high density. Moderately sound schist formation materials were not

encountered in these additional test borings. The subsurface profiles are presented on the attached boring logs.

Except for the surficial anomalies which will be penetrated by the proposed inlet structures, and/or removed in the mass excavation for the detention basin, the soil conditions are similar to conditions discussed in the initial geotechnical engineering services report, Project No. 94-0337, dated 24 June 1994. Therefore, the findings of prior report 94-0337 are recommended with the following modifications or clarifications:

1. Foundations: The foundation design recommendations on pages 5 and 6 of report 94-0337 are valid for design of the proposed inlet structures. These design recommendations also remain valid for buoyant conditions, and are, therefore, valid for design of the west basin retaining wall.

2. Lateral Design Parameters: Lateral backfill pressures are presented in the following tabulation for design of the west basin retaining wall which will support a backfill sloping away from the wall at 5:1 (horizontal: vertical) on the wash side of the wall. Values are presented for both normally dry, and temporarily saturated (buoyant) conditions.

[1]Lateral Backfill Pressures:

Above Water Level:	
Unrestrained Walls	33 psf/ft.
Restrained Walls	58 psf/ft.
Below Water Level:	
Unrestrained Walls	80 psf/ft.
Restrained Walls	95 psf/ft.

[1] Equivalent fluid pressures for vertical walls and backfill surfaces sloping at 5H:1V away from the wall. Pressures do not include temporary forces imposed during compaction of the backfill, swelling pressures developed by over-compacted clayey backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

3. Channel Embankment Fills: The channel embankment fill along the west side of the west basin retaining wall should be constructed with the cohesive clayey, gravelly sand soils of medium plasticity predominant below depths of approximately 5 feet within the proposed detention basin areas to obtain an earth embankment with as much erosion resistance as possible, using only on site soils. Any cohesionless wash channel deposits or low to non-plastic sand or gravelly sand layers from detention basin excavation would be more easily eroded than the clayey deposits and should be excluded from the embankment fill. The embankment fill should be compacted to a minimum 95 percent of the maximum ASTM D698 density at optimum moisture content ±3 percent.

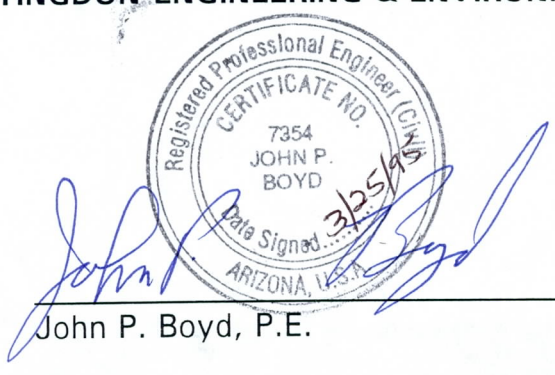
4. Piping: Piping beneath the retaining wall footing is not considered a possibility since insufficient time (a maximum impoundment of 36 hours) is available for interconnected seepage to develop from the basin floor, proceed under the retaining wall footing and exit upward to the channel. However, filter fabric should be provided to envelop the rip rap blanket above the retaining wall footing. This blanket would then function as a filtered foundation drain.

Report 94-0337, dated 14 March 1995 is included with this report.

Please call if we may be of further service.

Respectfully submitted,

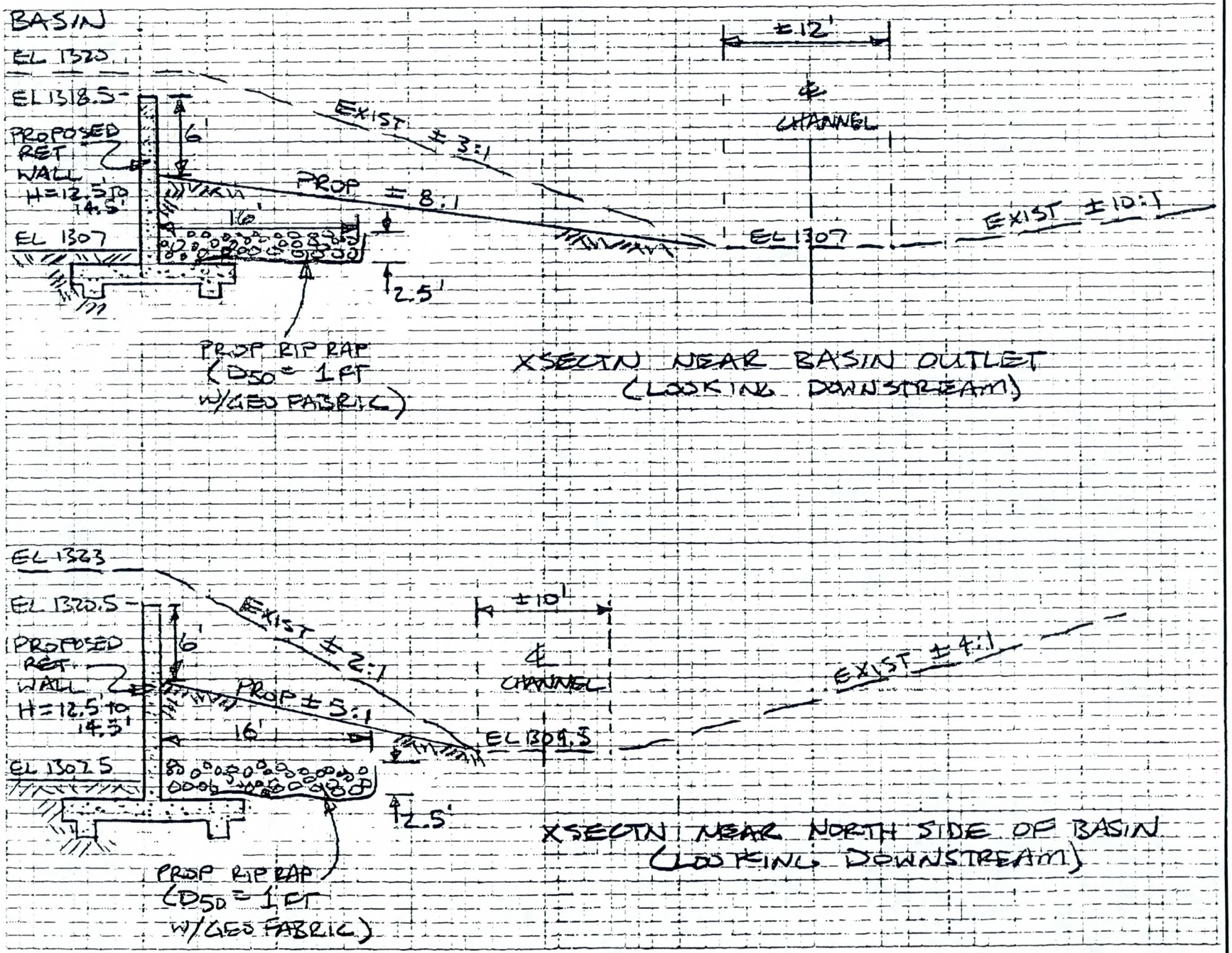
HUNTINGDON ENGINEERING & ENVIRONMENTAL, INC.

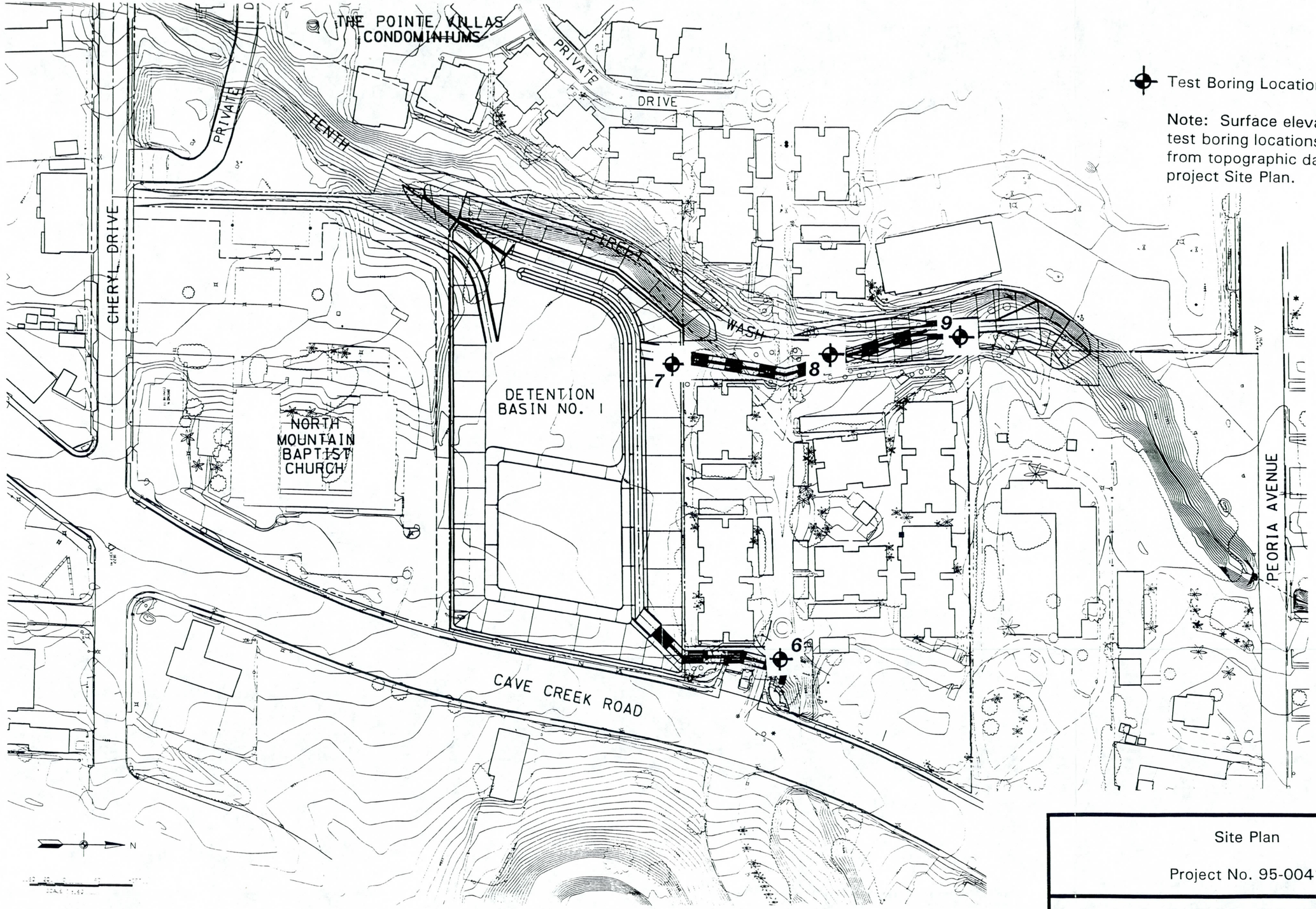


By: _____
John P. Boyd, P.E.

/trs
Copies to: Addressee (5)

DESIGNED BY ..... DATE 2-10-95 SHEET NO. 1 PAGE NO. .....
CHECKED BY ..... DATE ..... OF 4 JOB NO. 12185
REVIEWED BY ..... DATE ..... SUBJECT: 10th ST WASH DRAIN
APPROVED BY ..... DATE ..... WEST RET WALL





Test Boring Location

Note: Surface elevation at test boring locations interpolated from topographic data on project Site Plan.

Site Plan

Project No. 95-0041

Huntingdon Engineering & Environmental, Inc.

LEGEND

Soil Classification

COARSE-GRAINED SOIL

More than 50% larger than 200 sieve size

SYMBOL	LETTER	DESCRIPTION	MAJOR DIVISIONS
	GW	Well-graded gravels or gravel sand mixtures. Less than 5% -#200 fines	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
	GP	Poorly-graded gravels or gravel sand mixtures. Less than 5% -#200 fines	
	GM	Silty gravels or gravel-sand-silt mixtures. More than 12% -#200 fines	
	GC	Clayey gravels or gravel-sand-clay mixtures. More than 12% -#200 fines	
	SW	Well-graded sands or gravelly sands. Less than 5% -#200 fines	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
	SP	Poorly-graded sands or gravelly sands. Less than 5% -#200 fines	
	SM	Silty sands or sand-silt mixtures. More than 12% -#200 fines	
	SC	Clayey sands or sand-clay mixtures. More than 12% -#200 fines	

FINE-GRAINED SOIL

More than 50% smaller than 200 sieve size

SYMBOL	LETTER	DESCRIPTION	MAJOR DIVISIONS
	ML	Inorganic silts, rock flour, and fine sandy or clayey silts of low to medium plasticity	SILTS AND CLAYS Liquid limit less than 50
	CL	Inorganic clays, gravelly clays, sandy clays, and lean clays of low to medium plasticity	
	MH	Inorganic silts, micaceous or diatomaceous, and fine sandy or clayey silts of high plasticity	SILTS AND CLAYS Liquid limit greater than 50
	CH	Inorganic clays, fat clays, and silty or sandy clays of high plasticity	

GRAIN SIZES

U.S. Standard Series Sieves — Clear Square Sieve Openings

200	40	10	4	3/4"	3"	12"
Silts and clays distinquished on basis of plasticity	Sand			Gravel		Cobbles / Boulders
	Fine	Medium	Coarse	Fine	Coarse	

MOISTURE CONDITION

Dry — Slightly Damp — Damp — Moist (Plastic Limit) — Very Moist — Wet (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)

Sampler blow counts and 2.0" O.D. bullnose penetration resistance shown on logs are blows per foot using 140 lb. hammer with 30" free-fall unless otherwise noted.

LIMITATIONS

The data presented on the test pit logs represent subsurface conditions only at the specific locations and at the times designated. These data may not represent conditions at other locations and/or times. Contacts between soil strata may be gradual rather than abrupt. These data were compiled primarly for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the test pit logs.

TEST BORING LOG

Sheet 1 of 1

Job Number: 95-0041
Project: Detention Basin No. 1
Date Started: 2/6/95
Date Completed: 2/6/95

Boring No.: 6
Drill Type: CME 75/7" HSA
Ground Elev.: 1323
Elev. Datum: See Site Plan

Legend of Symbols: 2.5" Ring Sample; Standard Split Spoon Sample; Thin Wall Tube; Water Table Encountered; Stabilized Water Table

Elevation (ft)	Depth (ft)	Graphic Log	Sampler Blow Count	Sample Type	Dry Density (pcf)	Water Content (%)	SOIL DESCRIPTION	Bullnose Penetration Resistance Blows/ft) 0 50 100
1320	0						**FILL: SANDY CLAY TO CLAYEY SAND (CL/SC);** brown; medium plasticity; traces to some angular to subangular gravel fragments; firm but does not appear to be uniformly well compacted; damp to slightly damp.	
	5		11				**CLAYEY GRAVELLY SAND (SC);** brown to light grayish brown; medium plasticity fines; medium dense at the surface and dense below 8 feet; traces to light cementation to 8 feet, and intermittent moderate to heavy cementation (caliche) below 8 feet; traces to some angular to subangular gravel; slightly damp.	
1315								
	10		50/3"					
1310								
	15		75/6"					
1305							Bottom of Test Boring No. 6 at 18 feet.	
	20							
1300								

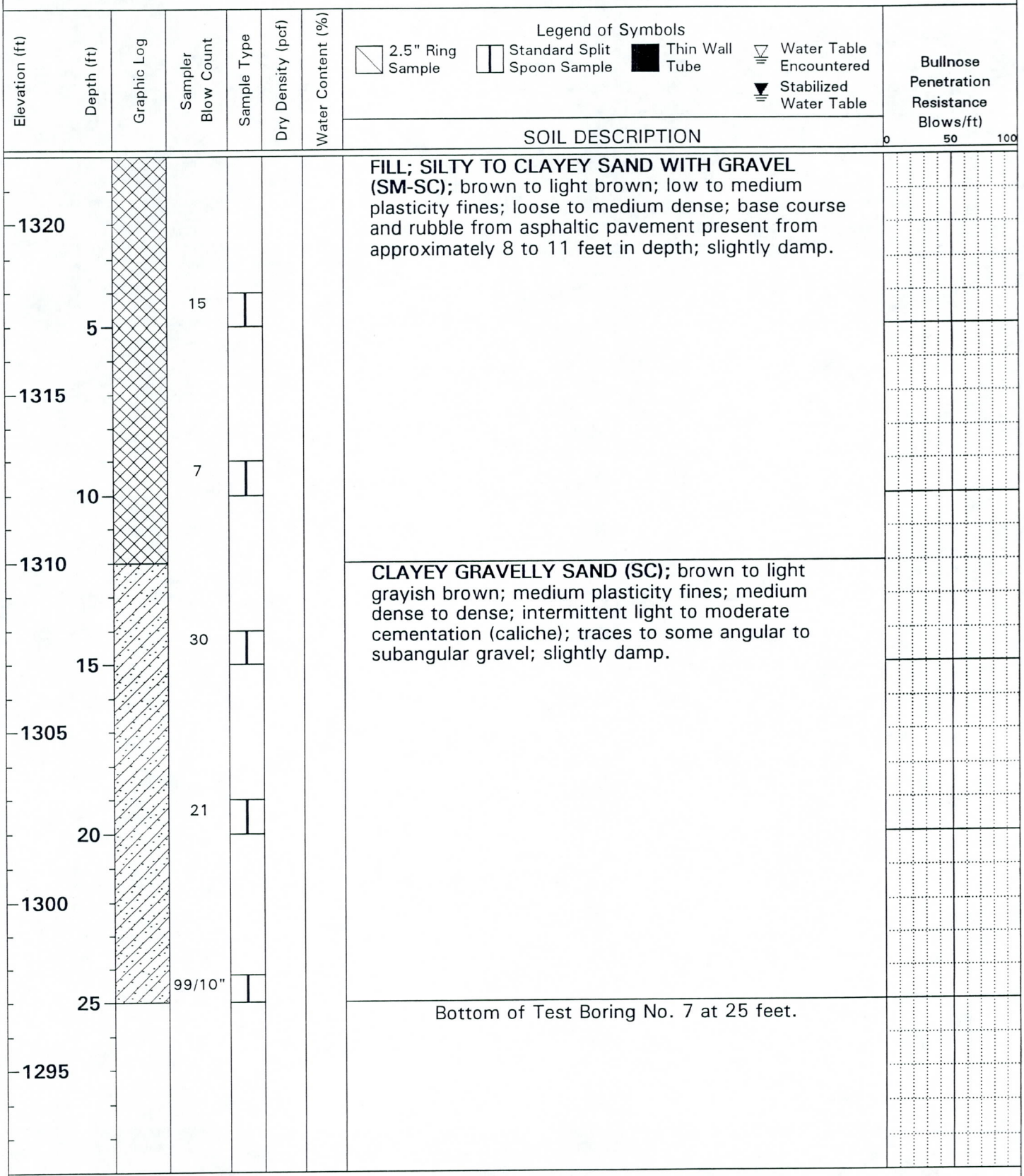
Huntingdon Engineering & Environmental, Inc.

TEST BORING LOG

Sheet 1 of 1

Job Number: 95-0041
Project: Detention Basin No. 1
Date Started: 2/16/95
Date Completed: 2/16/95

Boring No.: 7
Drill Type: CME 75/7" HSA
Ground Elev.: 1322
Elev. Datum: See Site Plan



FILL; SILTY TO CLAYEY SAND WITH GRAVEL (SM-SC); brown to light brown; low to medium plasticity fines; loose to medium dense; base course and rubble from asphaltic pavement present from approximately 8 to 11 feet in depth; slightly damp.

CLAYEY GRAVELLY SAND (SC); brown to light grayish brown; medium plasticity fines; medium dense to dense; intermittent light to moderate cementation (caliche); traces to some angular to subangular gravel; slightly damp.

Bottom of Test Boring No. 7 at 25 feet.

Huntingdon Engineering & Environmental, Inc.

TEST BORING LOG

Job Number: 95-0041
Project: Detention Basin No. 1
Date Started: 2/15/95
Date Completed: 2/15/95

Boring No.: 8
Drill Type: CME 75/7" HSA
Ground Elev.: 1315
Elev. Datum: See Site Plan

Legend of Symbols
2.5" Ring Sample | Standard Split Spoon Sample | Thin Wall Tube | Water Table Encountered | Stabilized Water Table

Elevation (ft)	Depth (ft)	Graphic Log	Sampler Blow Count	Sample Type	Dry Density (pcf)	Water Content (%)	SOIL DESCRIPTION	Bullnose Penetration Resistance Blows/ft (0 50 100)
1315							**SANDY GRAVEL WITH SILTY AND CLAY FINES (GM-GC/GP);** brown to light brown; low plasticity fines; medium dense; angular to subangular gravel size rock fragments in a silty to clayey sand matrix; poorly graded; slightly damp.	
			69/6"					
1310	5						**CLAYEY GRAVELLY SAND (SC);** brown to light grayish brown; medium plasticity fines; dense; variable moderate to heavy cementation with some breccia like layers; traces to some angular to subangular gravel; slightly damp.	
			57/6"					
1305	10							
							Bottom of Test Boring No. 8 at 14 feet.	
1300	15							
1295	20							
1290								

Huntingdon Engineering & Environmental, Inc.

TEST BORING LOG

Sheet 1 of 1

Job Number: 95-0041
Project: Detention Basin No. 1
Date Started: 2/15/95
Date Completed: 2/15/95

Boring No.: 9
Drill Type: CME 75/7" HSA
Ground Elev.: 1317
Elev. Datum: See Site Plan

Legend of Symbols: 2.5" Ring Sample; Standard Split Spoon Sample; Thin Wall Tube; Water Table Encountered; Stabilized Water Table

Elevation (ft) / Depth (ft)	Graphic Log	Sampler Blow Count	Sample Type	Dry Density (pcf)	Water Content (%)	SOIL DESCRIPTION	Bullnose Penetration Resistance Blows/ft) 0 50 100
1315 / 0						**CLAYEY GRAVELLY SAND (SC);** brown to light grayish brown; medium plasticity fines; medium dense to approximately 10 to 11 feet, becoming dense below 11 feet; intermittent traces to light cementation to approximately 13 feet with variable light to moderate cementation (caliche) below 13 feet; possibly transitioning into weathered schist below approximately 18 feet; traces to some angular to subangular gravel; slightly damp.	
		10					
1310 / 5							
		12					
1305 / 10							
		50/5"					
1300 / 15							
		50/3"					
1295 / 20						Note: Sample at 19 feet was moist. Bottom of Test Boring No. 9 at 19.25 feet.	

Huntingdon Engineering & Environmental, Inc.

PROJECT NO. 94-0337

HUNTINGDON

REPORT FOR
GEOTECHNICAL ENGINEERING SERVICES
DETENTION BASIN NO. 1 - 10TH STREET WASH
FCD 93-31
CAVE CREEK ROAD NORTH OF CHERYL DRIVE
PHOENIX, ARIZONA

Submitted To:

Stanley Consultants, Inc.
Attention: Mike Hunzinger
2929 East Camelback Road, Suite 130
Phoenix, Arizona 85016

Project No. 94-0337

24 June 1994

Huntingdon

Huntingdon Engineering & Environmental, Inc.
7031 West Oakland Street
Chandler, AZ 85226
(602) 961-1169
Fax (602) 940-0952

Stanley Consultants, Inc.
2929 East Camelback Road, Suite 130
Phoenix, Arizona 85016

24 June 1994

Attention: Mike Hunzinger

Subject: Report for Geotechnical Engineering Services
Detention Basin No. 1 - 10th Street Wash
FCD 93-31
Cave Creek Road north of Cheryl Drive
Phoenix, Arizona

Project No. 94-0337

This report presents the results of the geotechnical engineering services authorized on the site for the proposed Detention Basin No. 1 - 10th Street Wash located at Cave Creek Road north of Cheryl Drive in Phoenix, Arizona.

The purpose of these services is to determine the soil conditions at the locations indicated which thereby provide a basis for the design discussions and recommendations presented herein. This firm should be notified for evaluation if conditions other than described herein are encountered during construction.

The services performed provide an evaluation at selected locations of the soils throughout the zone of significant foundation influence. Our field services have not included exploration for underlying geologic conditions or evaluation of potential geologic hazards such as seismic activity, faulting, or the presence of contamination.

The recommendations presented in this report are based upon the project information received and described in "Scope" Part I. This firm should be contacted for review if the design conditions are changed substantially.

If requested, we will be available to review project plans and specifications relative to compliance to the intent of this report.

Respectfully submitted,

HUNTINGDON ENGINEERING & ENVIRONMENTAL, INC.

By: Registered Professional Engineer (Civil) CERTIFICATE NO. 10971 KENNETH L. RICKER Date Signed 6/24/94 ARIZONA, U.S.A.

Reviewed By: Registered Professional Engineer (Civil) CERTIFICATE NO. 24033 KENNETH D. WALSH Date Signed 6/24/94 ARIZONA, U.S.A.

/trm
Copies to: Addressee (5)

TABLE OF CONTENTS

SCOPE

The proposed Detention Basin No. 1 - 10th Street Wash will include a 3.2 acre detention basin located west of Cave Creek Road and east of the 10th Street wash as shown on the Site Plan in Appendix A. The following major features will be constructed:

1. An inlet structure at the northwest corner of the basin.

2. An outlet structure at the southwest corner of the basin.

3. Erosion protection along the 10th Street wash.

4. The detention basin will be approximately 15 feet in depth and will be cut into the site. This will result in an embankment along the west side between the basin and the 10th Street wash and a lower embankment along the western quarter of the south side.

SITE DESCRIPTION

The site is 3 ± acres of vacant land located on the west side of Cave Creek Road, approximately 600 feet north of Cheryl Drive in Phoenix, Arizona. The site was relatively level containing some surface debris and a sparse cover of weeds. A zone of spread fill two to five feet thick exists along the west side adjacent to the wash, which is depressed approximately 20 feet below the site. The slopes of the wash contain some debris and a moderate growth of weeds and some trees. The surface of the slope appears to contain relatively loose fill material which was pushed over the crest of the slope.

INVESTIGATION

Test borings were drilled at five locations across the site and a percolation test hole was drilled at one location, as shown on the attached site plan. The test borings were drilled to depths of 16 to 19.5 feet with a CME-75 drill rig using 7-inch diameter hollow-stem flight augers. The percolation test was drilled to a

depth of 12 feet with a 12-inch diameter auger. Relatively undisturbed soil samples were obtained from the test borings by driving a 2.42 inch I.D., ring-lined soil sampler at selected intervals. During the test drilling soils encountered were visually classified, and representative soil samples were obtained at selected depths. The results of the test drilling are presented in Appendix A, "Field Results." The results of the percolation test are presented in the text.

Representative samples obtained during the test drilling were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Compression	Undisturbed (1)	Foundation settlement analyses
Direct Shear	Undisturbed (3)	Slope stability analysis
Permeability	Undisturbed (1)	Seepage analysis
Sieve Analysis and Atterberg Limits	Representative soil (5)	Correlate engineering properties
Moisture Density Relationship Curve, ASTM D698, Method A	Representative surface soil (1)	Compaction characteristics
Dry Density and Moisture Content	Undisturbed (18)	In-situ density and moisture determination to correlate engineering properties

Results of the density and moisture testing are presented on the graphical boring logs in Appendix A. The results of remaining geotechnical testing are presented in Appendix B. The results of the calculations are presented in Appendix C.

SOIL CONDITIONS

Detailed soil stratigraphy and descriptions are presented on the graphical boring logs in Appendix A. The nearsurface soils at the test boring locations to depths

of 8 to greater than 19.5 feet were clayey gravelly sand with occasional zones of silty gravelly sand. These soils extended for the full depth of auger penetration in Test Borings 1, 4, 5, and P1 and were medium dense at the surface, and dense to very dense below depths of 3 to 4 feet, and moderately to heavily cemented below depths of 4 to 8 feet. In Test Borings 2 and 3, the surface soils were underlain at depths of 8 and 13 feet, respectively, by schist. Auger refusal occurred in the schist in Test Borings 2 and 3 at depth of 16 and 18 feet, respectively. The schist was weathered, highly foliated and hard. In Test Boring 5, the surface soils are overlain by 5 feet of dense to medium dense clayey gravelly sand fill containing some debris. Soil moisture contents were described as slightly damp to nearly dry, and no free groundwater surface was detected in any of the test borings during drilling.

DISCUSSION AND RECOMMENDATIONS

General: Geotechnical engineering recommendations for detention basin design and construction are presented in the following sections. These recommendations are based upon the results of the field and laboratory testing which are presented in Appendices A and B of this report. Alternative recommendations may be possible and will be considered upon request.

Excavation Conditions: The test drilling and field sampling at the site were performed for design purposes. It is not possible to accurately correlate auger drilling results with the ease or difficulty of digging for various types and sizes of excavation equipment. We present the following general comments regarding excavatability for the designers' information with the understanding that they are approximations based only on test boring data. More accurate information regarding excavatability should be evaluated by contractors or other interested parties from test excavations using the intended equipment.

The fills and near surface native soils to depths 4 to 8 feet can probably be removed with conventional excavating equipment. However, moderate to heavy

carbonate cemented soils (caliche) and schist were encountered below depths of 4 to 8 feet, and excavations into these hard, cemented soils could be somewhat more difficult and may require specialized equipment. All excavations should be braced or sloped as required to provide personnel safety and satisfy local safety regulations.

Slope Stability: Temporary unbraced excavations should be no steeper than the following:

Material	Slopes
Fill (Existing)	2H:1V
Clayey Gravelly Sand	1H:1V
Cemented Clayey Gravelly Sand	1/2H:1V

If thick, relatively clean sand lenses are encountered, localized bracing or shoring or flattening slopes to about 1H:1V may be required.

The existing fill soils along the existing side slope of the 10th Street wash are erodible and will not be stable during and following flows in the wash. We recommend that the fill along the slope of the wash and along the crest of the wash on the detention basin side be removed and reconstructed as recommended in Part III of this report. Slope protection should be provided along 10th Street Wash and near the inlet and outlet works of the basin.

Permanent detention basin cut slopes or compacted fill berms constructed with site soils should be stable at slopes as steep as 2H:1V. However, for ease of maintenance or for landscaping purposes, permanent cut or fill slopes are typically constructed at 3H:1V to 4H:1V or flatter. If vegetation, slope paving, or some other form of slope protection is not provided, some rills or gullies may form on permanent slopes during periods of intense rainfall or runoff.

Embankment Seepage and Basin Infiltration Rated: The seepage through the embankment to the creek was evaluated based on the measured laboratory permeability tests, the site soil condition, 36 hour maximum duration of retention, the water rentention level at design maximum water level, and the wash being dry. Due to the short duration of retention, seepage through the embankment will not occur and will not effect either the interior detention basin slope or the 10th Street Wash slope.

The basin infiltration rate was evaluated by performing a field percolation test in a 12-inch diameter, 12 foot deep percolation hole. The measured rate was 10 minutes per inch. However, siltation and compaction of the basin bottom will substancially reduce these rates to values typically on the order of 60 minutes per inch.

Foundations: The inlet and outlet structures may include the construction of head walls and/or wing wall sand retaining walls placed several feet below the ground surface on the dense site soils. These soils are slightly compressible at existing moisture contents and only slightly more compressible at an increased moisture content. Footings and stem walls should be reinforced, and any masonry walls should be constructed with frequent joints and both vertical and horizontal reinforcement to better resist distress if some differential movements occur.

Spread footings or mat foundation founded at various depths below the adjacent finished grades were analyzed for support of the proposed loads. The following tabulation presents foundation bearing design recommendations for selected footing or mat foundation depths. Bearing materials should be natural undisturbed soils. Recommendations for other foundation conditions are possible and will be considered upon request.

Footing Depth Below Finish Grade	Allowable Foundation Bearing Pressure
1.5 ft.	2000 psf
2.0 ft.	2500 psf
3.0 ft.	3000 psf
5.0 ft. or more	5000 psf

Finish grade is defined as the lowest adjacent grade within 5 feet of foundations for head walls, footings, mats, or vault foundations. The recommended foundation bearing pressures should be considered allowable maximums for dead plus design live loads and may be increased by one-third when considering total loads including transient wind or seismic forces. The weight of the foundation concrete below grade may be neglected in dead load computations. Two (2.0) feet and 1.33 feet are recommended as the minimum width of isolated column and continuous wall footings, respectively.

Estimated foundation settlements for anticipated light vault or mat loading conditions are on the order of 1/4 inch or less provided foundation bearing soils remain at existing moisture conditions. Additional post-construction differential foundation movements of comparable or somewhat greater magnitude could be experienced if the natural bearing soils below foundations experience a significant moisture buildup after construction.

Lateral Design Parameters: The following tabulation presents recommendations for lateral stability analyses:

[1]Foundation Toe Pressures . . . . . 1.33 x allowable
[2]Lateral Backfill Pressures:
  Unrestrained walls . . . . . 35 psf/ft.
  Restrained walls . . . . . 60 psf/ft.
Lateral Passive Pressures:
  Continuous walls/footings . . . . . 250 psf/ft.
  Spread columns/footings . . . . . 350 psf/ft.
Coefficient of Base Friction:
  Independent of passive resistance 0.40
  In conjunction with passive resistance 0.30

[1]Increase in allowable foundation bearing pressure (previously tabulated) for foundation toe pressures due to eccentric or lateral loading. The entire footing bearing surface should remain in compression.

[2]Equivalent fluid pressures for vertical walls and horizontal backfill surfaces. Pressures do not include temporary forces imposed during compaction of the backfill, swelling pressures developed by over-compacted clayey backfill, hydrostatic pressures from inundation of backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

Compaction of the backfill soils against embedded footings or walls designed to provide passive resistance should be accomplished to a minimum 95 percent of the maximum ASTM D698 density to develop this resistance with low strains.

Deep Backfills: Backfill intended for structural support or intended to provide passive lateral resistance should be compacted to density criteria presented in the "Site Grading" section of this report. Compaction of all structural fill adjacent to structural walls should be done by mechanical methods. If backfills are not compacted as recommended, subsidence may result in areas adjoining backfilled structures or over utilities. Even for well compacted granular backfills, long term settlements may approach 1/2 percent of the fill height, or more if water is introduced into the fill after construction. Even properly compacted deep backfills may tend to settle differentially relative to structural walls and should not be used for support of adjoining facilities or utilities prone to damage from differential settlements.

FILL MATERIALS

All fill materials should be inorganic soils free of vegetation, debris, organic contaminants, and fragments larger than *6 inches in size. Site soils may be used for required fills in all areas.

Any imported fill or backfill materials for use within structure and exterior slab areas should conform with the following specification requirements:

Maximum particle size . . . . . 6 inches*
Maximum percent expansion 1.5

*Maximum size may be reduced at architect's direction to satisfy trenching and landscaping requirements, etc.

**Performed on sample remolded to 95 percent of the maximum ASTM D698 density and 2 percent below optimum moisture under a 100 psf surcharge pressure.

BASE COURSE

Base course materials for use beneath concrete slabs should be well graded sand and gravel materials meeting the Maricopa Association of Governments' Specifications for Aggregate Base Course Materials (Section 702).

SITE GRADING

The following recommendations are presented for site grading within and extending 5 feet beyond embankments and inlet/outlet facilities. All phases of earthwork should be performed under observation and testing directed by the geotechnical engineer.

1. Remove vegetation and organic contaminants, subsurface remnants of any former facilities, all surface fills, any backfills, and any unstable soils (loose, disturbed, wet, etc.) from embankment and structure areas. Excavate materials as necessary to achieve final detention basin grades.

2. Widen any resulting depressions as necessary to accommodate compac-tion equipment and provide a level base for placing fill.

3. Scarify, moisture condition and compact exposed native surface soils to a minimum 8-inch depth in areas beneath structures and embankments.

4. Place backfill or fill materials required to elevate site areas to specified subbase grade. Fill materials should be placed and compacted in horizontal lifts of thicknesses compatible with the compaction equipment used.

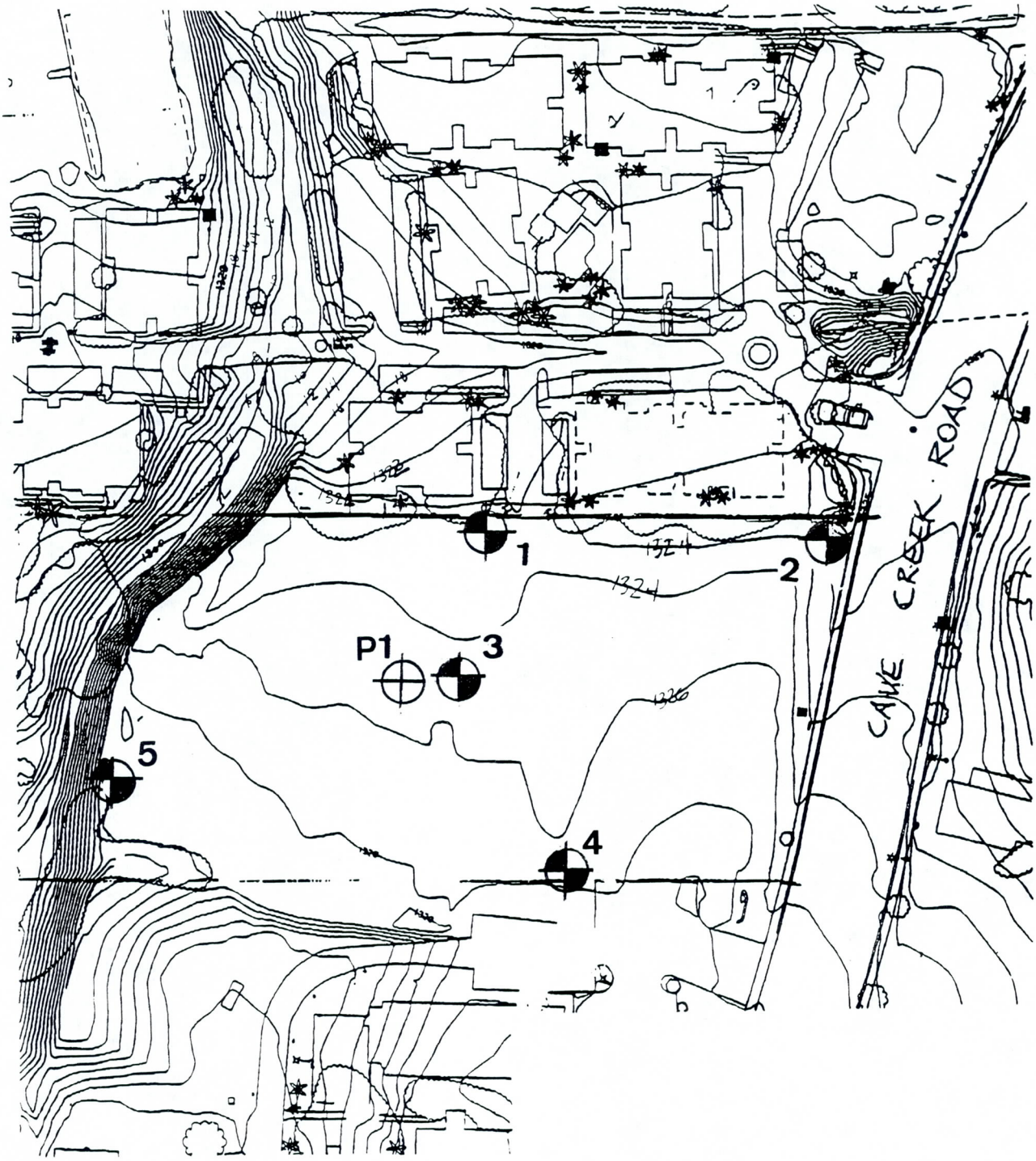
5. Compaction of cleaned exposed soil, and each lift of backfill, subbase fill, and base course materials should be accomplished to the following density criteria:

Material	Percent Compaction (ASTM D698)
Cleaned Exposed Soil, Backfill, and Subbase Fill:	
Below foundation level and in embankments	95 min.
*Miscellaneous Backfill	90 min.

*Utility trench and exterior fill or backfill not intended for utility line, floor slab, foundation or pavement support.

Compaction of site soils and imported fill soils with low expansive potentials should be accomplished at optimum moisture content ± 3 percent in areas beneath structures and exterior concrete slabs.

Natural undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced with materials compacted as specified above.



TEST BORING LOCATION

PERCOLATION TEST LOCATION

NOTE: Boring Elevations interpulated from site topo plan

Site Plan

Project No. 94-0337

HUNTINGDON ENGINEERING & ENVIRONMENTAL, INC.

LEGEND

SOIL CLASSIFICATION

COARSE-GRAINED SOIL

More than 50% larger than 200 sieve size

SYMBOL	LETTER	DESCRIPTION	MAJOR DIVISIONS
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES. LESS THAN 5% - #200 FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES. LESS THAN 5% - #200 FINES	
	GM	SILTY GRAVELS. GRAVEL-SAND-SILT MIXTURES. MORE THAN 12% - #200 FINES	
	GC	CLAYEY GRAVELS. GRAVEL-SAND-CLAY MIXTURES. MORE THAN 12% - #200 FINES	
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS. LESS THAN 5% - #200 FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS. LESS THAN 5% - #200 FINES	
	SM	SILTY SANDS. SAND-SILT MIXTURES MORE THAN 12% - #200 FINES	
	SC	CLAYEY SANDS. SAND-CLAY MIXTURES MORE THAN 12% - #200 FINES	

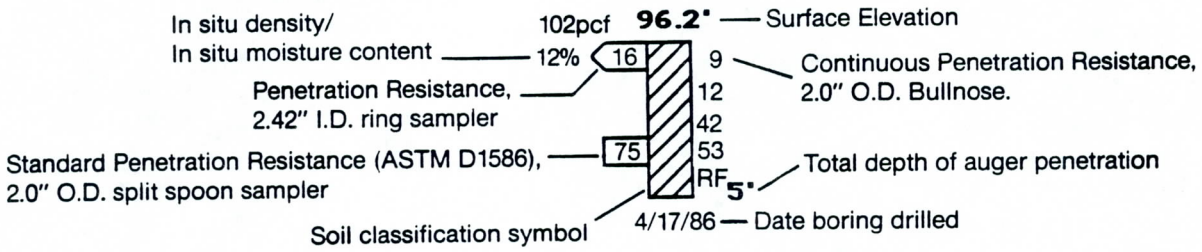
FINE-GRAINED SOIL

More than 50% smaller than 200 sieve size

SYMBOL	LETTER	DESCRIPTION	MAJOR DIVISIONS
	ML	INORGANIC SILTS, ROCK FLOUR, AND FINE SANDY OR CLAYEY SILTS OF LOW TO MEDIUM PLASTICITY	SILTS AND CLAYS Liquid limit less than 50
	CL	INORGANIC CLAYS, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, AND LEAN CLAYS OF LOW TO MEDIUM PLASTICITY	
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAY MIXTURES OF LOW TO MEDIUM PLASTICITY	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, AND FINE SANDY OR CLAYEY SILTS OF HIGH PLASTICITY	SILTS AND CLAYS Liquid limit greater than 50
	CH	INORGANIC CLAYS, FAT CLAYS, AND SILTY CLAYS OF HIGH PLASTICITY	
	OH	ORGANIC CLAYS AND ORGANIC SILTS OF MEDIUM TO HIGH PLASTICITY	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

LEGEND FOR GRAPHICAL BORING LOGS:

Log denotes visual approximation unless accompanied by mechanical analysis and Atterberg limits.



PENETRATION RESISTANCE: Blows per foot using 140 lb. hammer with 30" free-fall unless otherwise noted.

GRAIN SIZES								
U.S. STANDARD SERIES SIEVE	200	40	10	4	CLEAR SQUARE SIEVE OPENINGS 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 — WET (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).

LEGEND OF SOIL TYPES

CLAYEY GRAVELLY SAND (SC); brown, slightly damp to nearly dry, medium dense at the surface, dense to very dense below 3 to 4 feet into the deposit, medium plasticity fines, occasional zone of silty gravelly sand, moderate to heavy cementation below depths of 4 to 8 feet.

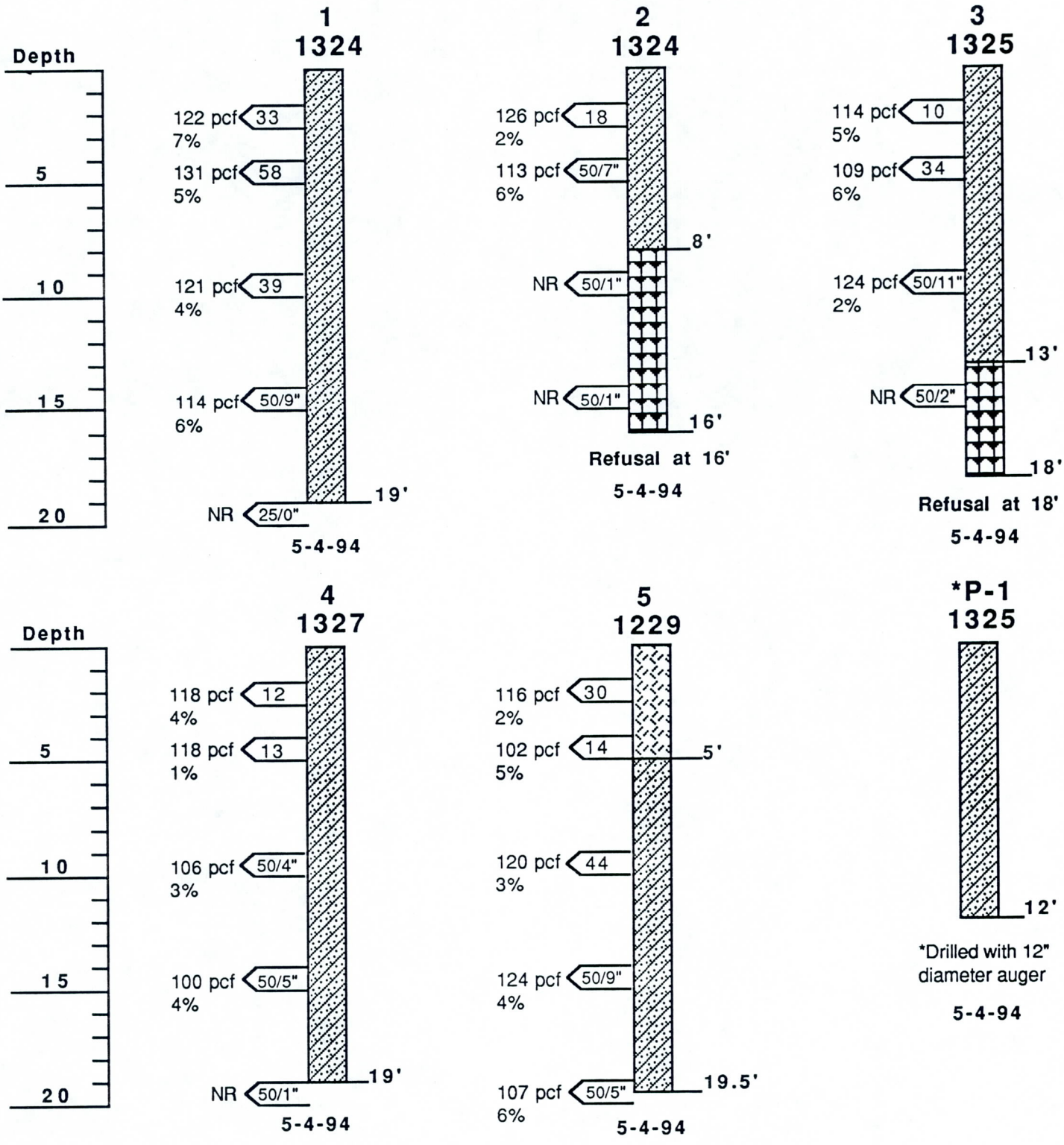
SCHIST; gray to brown, highly foliated, weathered, some recementation.

FILL MATERIAL - CLAYEY GRAVELLY SAND (SC); brown, nearly dry, loose to medium dense, medium plasticity fines, some debris and rubble.

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

Project No. 94-0337
Huntingdon Engineering & Environmental, Inc.

GRAPHICAL BORING LOGS



No free groundwater was encountered in any of the borings during drilling.
All borings drilled with 7" diameter hollow stem auger unless otherwise noted.

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

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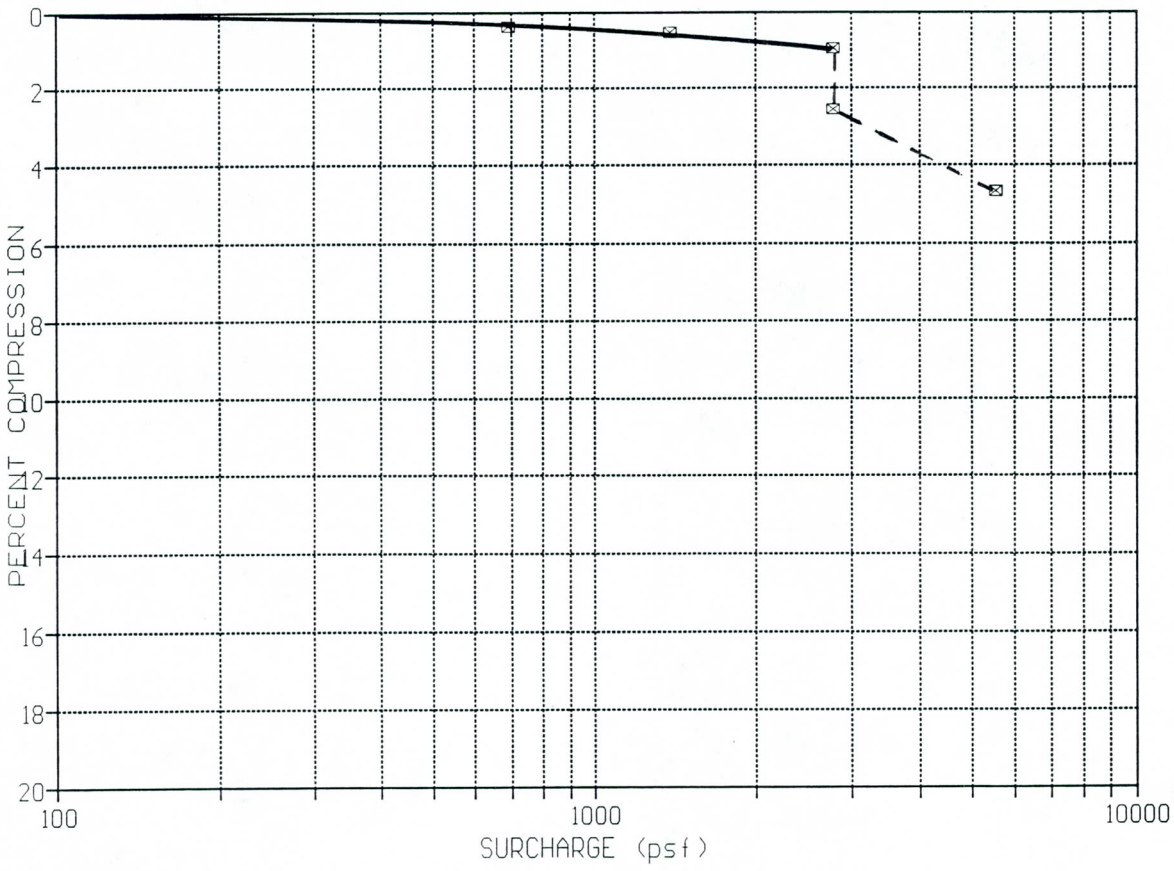
RESULTS OF CONSOLIDATION TESTS

SAMPLE: **Date:** 26-May-94

Source: 5 @ 4'-5'
Type: Driven Ring; 102 pcf Dry Density; 5% Field Moisture
Material: Silty Sand (SM)
Sampled By: H/Thompson

TESTED: ASTM D2435 : Sample soaked at 2770 psf.

RESULTS:



Project No.: 94-0337

RESULTS OF DIRECT SHEAR TESTS

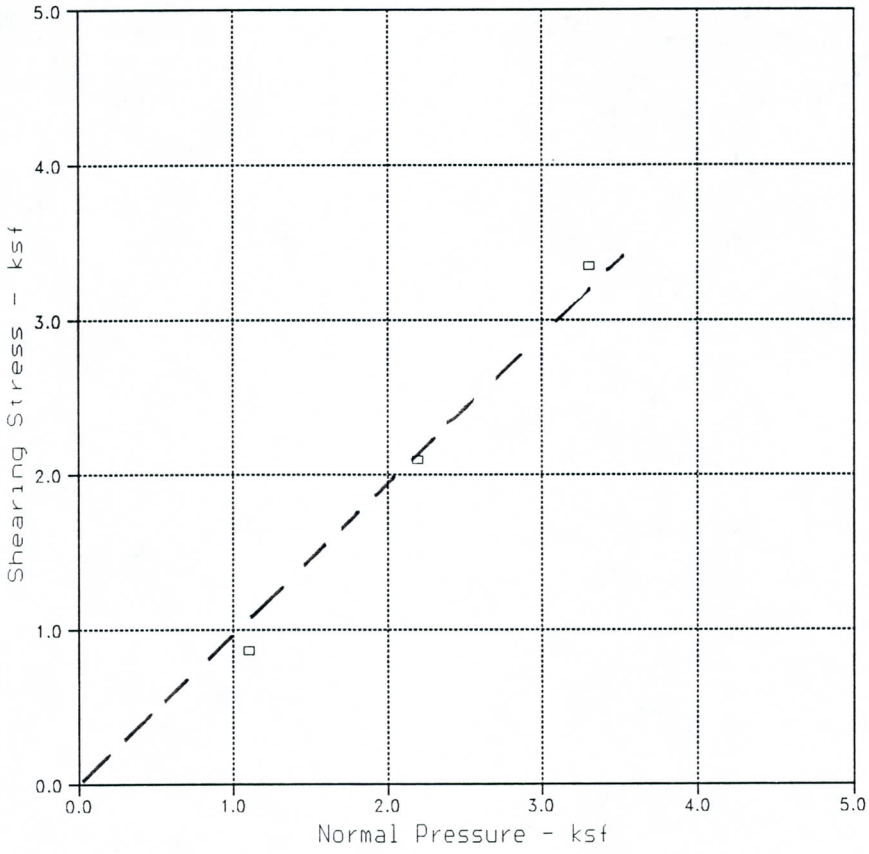
SAMPLE: **Date:** 26-May-94

Source: 2 @ 1.5'-2.5'
Type: Driven Ring; 126 pcf Dry Density; 2% Field Moisture
Material: Clayey Sand (SC)
Sampled By: H/Thompson

TESTED: ASTM D3080; Samples soaked.

RESULTS:

Friction Angle (phi) = 43 deg. Cohesion (c) = 0.00 ksf



Project No. 94-0337

RESULTS OF DIRECT SHEAR TESTS

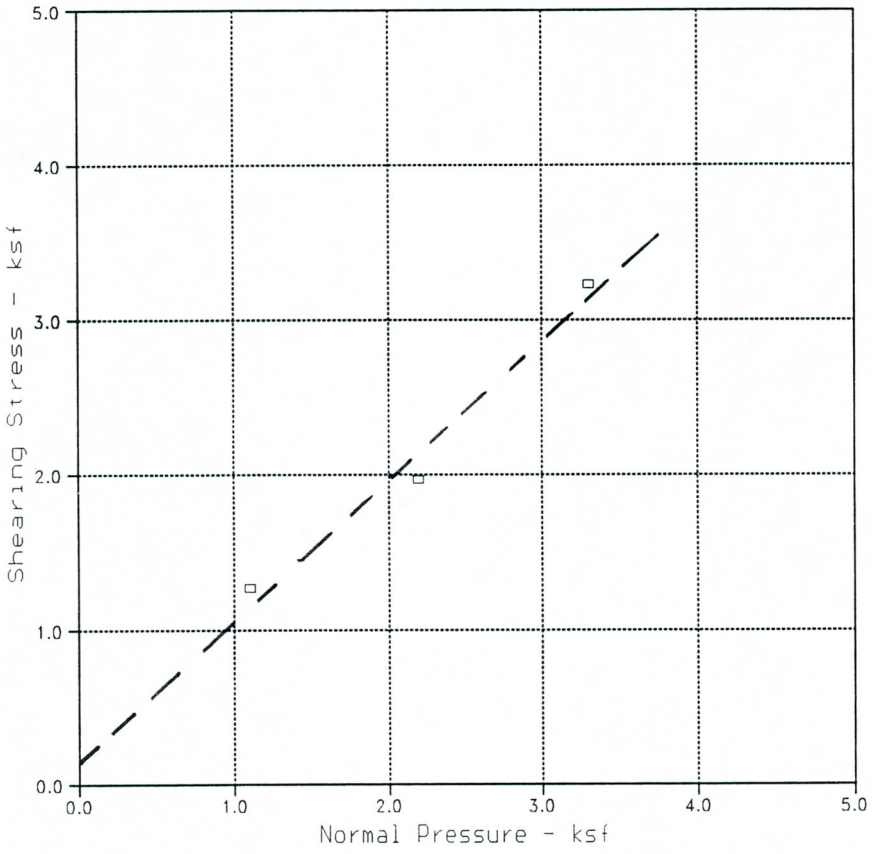
SAMPLE: **Date:** 26-May-94

Source: 4 @ 4'-5'
Type: Driven Ring; 118 pcf Dry Density; 1% Field Moisture
Material: Silty Sand (SM)
Sampled By: H/Thompson

TESTED: ASTM D3080; Samples soaked.

RESULTS:

Friction Angle (phi) = 41 deg. Cohesion (c) = 0.10 ksf



Project No. 94-0337

RESULTS OF DIRECT SHEAR TESTS

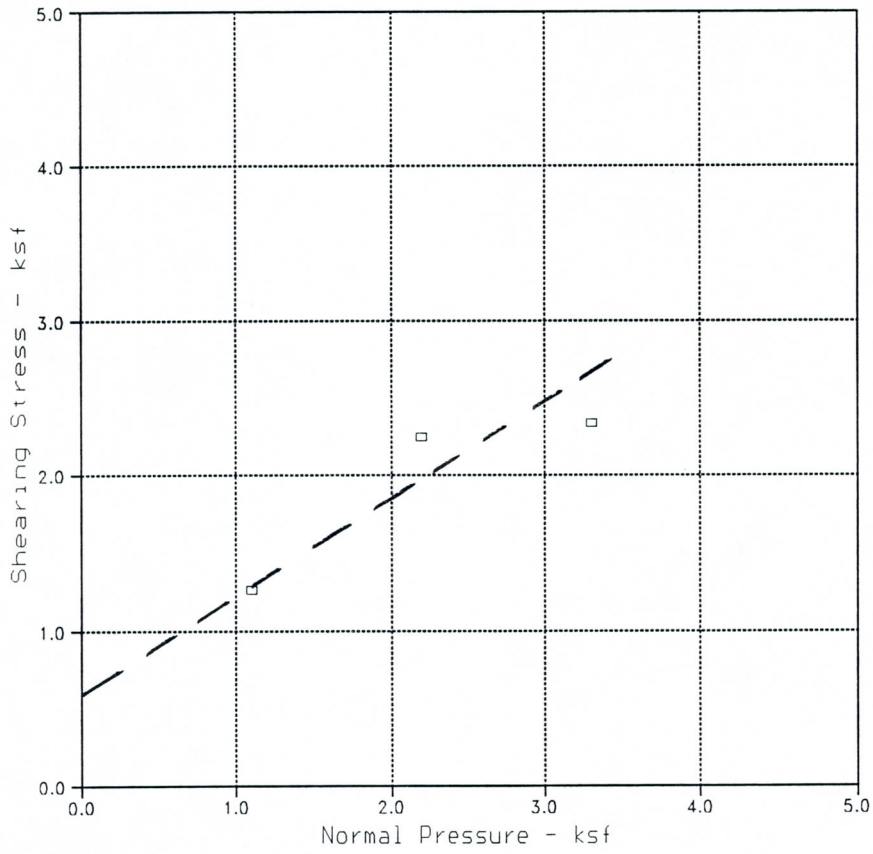
SAMPLE: **Date:** 26-May-94

Source: 4 @ 9'-10'
Type: Driven Ring; 106 pcf Dry Density; 3% Field Moisture
Material: Clayey Sand (SC)
Sampled By: H/Thompson

TESTED: ASTM D3080; Samples soaked.

RESULTS:

Friction Angle (phi) = 34 deg. Cohesion (c) = 0.65 ksf



Project No. 94-0337

REPORT ON FLEXIBLE - WALL PERMEABILITY TEST

SAMPLE: Source: Test Boring 5; 9-10′ DATE: 19-May-94
Type: Ring
Material: Subsoil
Sampled By: H/Thompson

TESTED: Flexible-Wall Permeability Test

TEST RESULTS

Dry Density	Moisture Content	Gradient	Coefficient of Permeability
120 pcf	3%	5.6 in/in	3.5×10^{-5} cm/sec

REPORT ON LABORATORY TESTS

SAMPLE: Date: 19-May-94

Source: As Noted Below

Type: Bulk

Material: Subsoil

Sampled By: H/Thompson

TESTED: Sieve analysis and Atterberg limits

Sample	Atterberg Limits		Sieve Size - Accum. % Passing											*
	LL	PI	200	100	50	30	16	8	4	3/4"	1"	2"	3"	Class
1; 5-10′	35	13	22	28	34	40	48	57	69	87	91	100		SC
2; 0-5′	29	6	29	35	41	47	55	64	75	960	97	100		SC/SM
3; 10-15′	35	12	20	24	28	34	43	57	74	95	96	100		SC
4; 15-19′	47	11	22	27	33	40	48	60	77	100				SC
5; 10-15′	37	14	21	24	29	35	44	56	72	100				SC
8; 0-3′	--	NP	19**											SM
9; 0-3′	--	NP	11**											SM/SP

NP = Non-Plastic

* Unified Soil Classification

Project No. 94-0337

Huntingdon Engineering & Environmental, Inc.

MAXIMUM DENSITY-OPTIMUM MOISTURE

(ASTM D698, METHOD A)

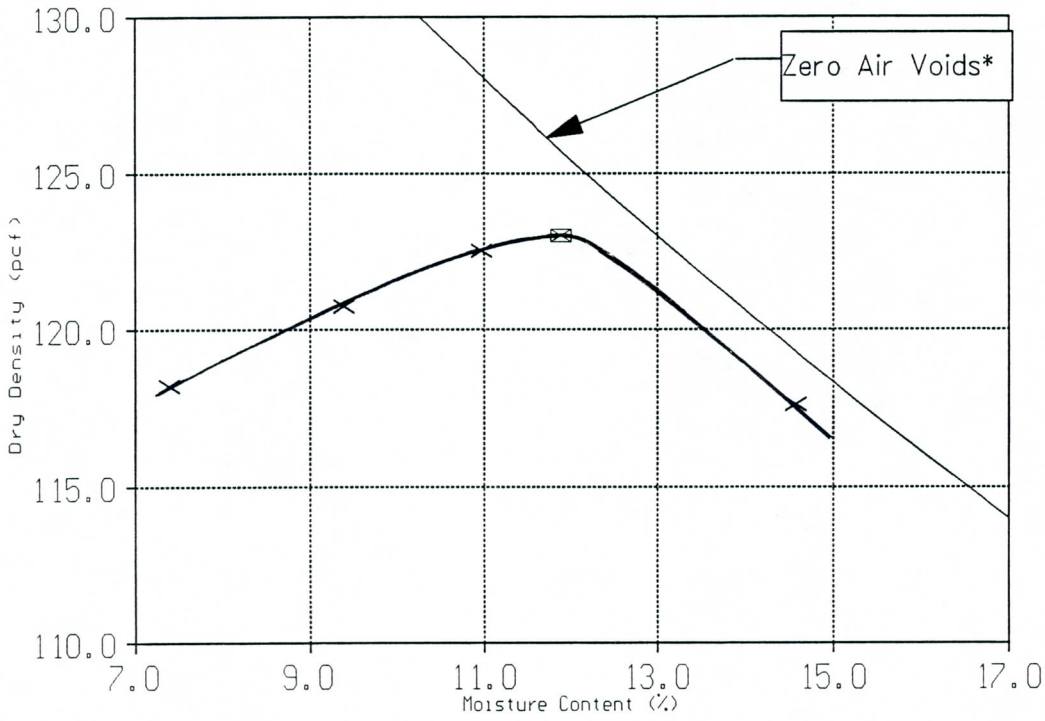
SAMPLE: **Date:** 19-May-94

Source: 5 @ 0'-5'
Type: Bulk
Material: Clayey Sand (SC)
Sampled By: H/Thompson

RESULTS:

Maximum Dry Density (pcf) = 123.0

Optimum Moisture Content (%) = 11.9



* Assumed Gs = 2.65

Project No.: 94-0337

KW 94-337

RBy

SEEPAGE

Maximum overall gradient:

$$i = \frac{1320.5 - 1298}{72} = 0.313 \frac{ft}{ft}$$

Darcy's law: $V = Ki$ $\quad K = 3.5 \times 10^{-5}$ cm/sec

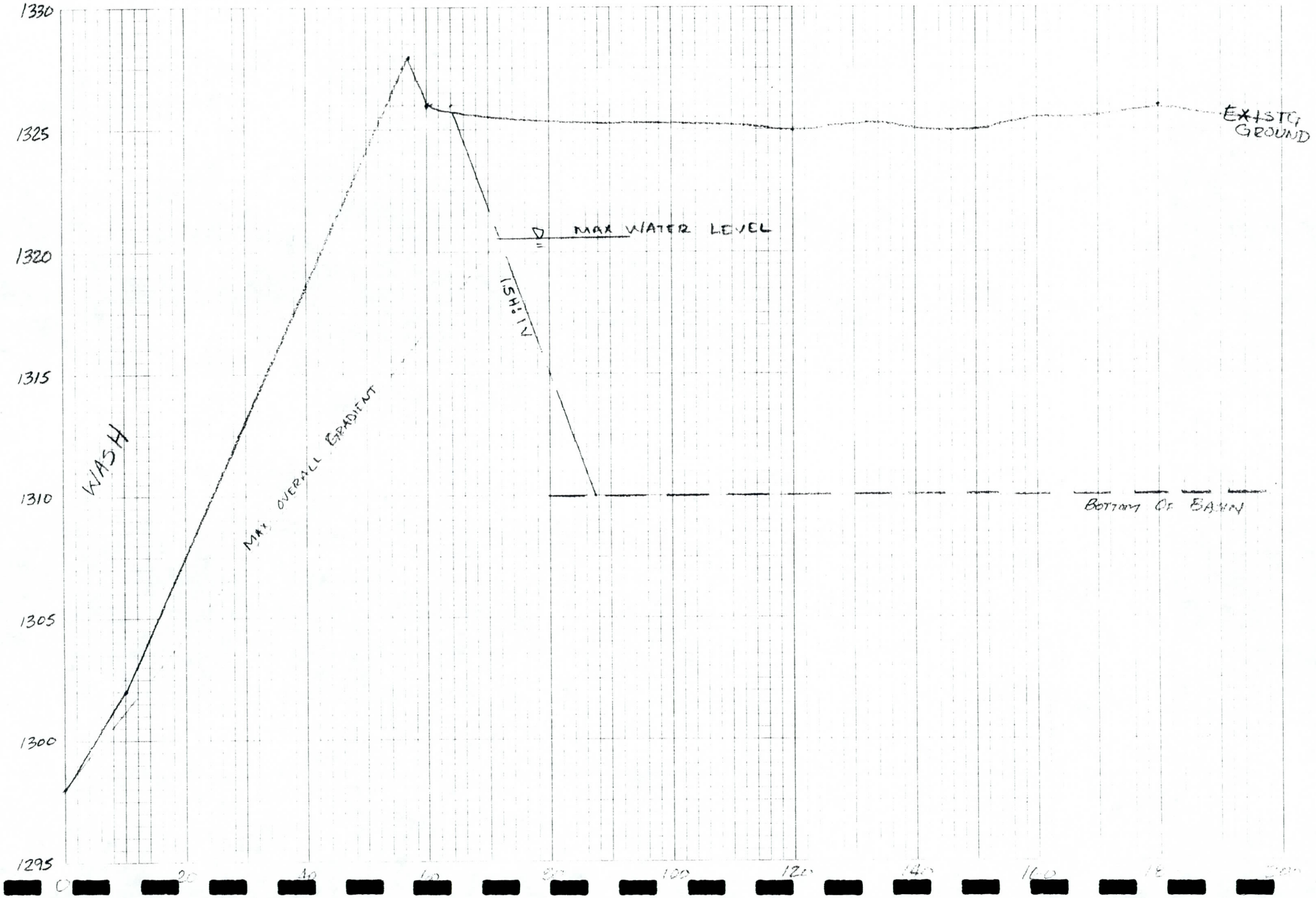
$$V = \left(3.5 \times 10^{-5} \frac{cm}{sec}\right)\left(0.313 \frac{ft}{ft}\right) = 0.000011 \text{ cm/sec}$$

$$= 0.00000036 \text{ ft/sec}$$

IN 36-HOURS, travel $= \left(0.00000036 \frac{ft}{sec}\right)\left(\frac{60 sec}{min}\right)\left(\frac{60 min}{hr}\right)(36 hr)$

$$= \underline{0.046 \text{ ft}}$$

No time available for interconnected seepage from basin to channel.


1330
1325
1320
1315
1310
1305
1300
1295
WASH
MAX OVERALL GRADIENT
MAX WATER LEVEL
15H:1V
EXISTG GROUND
BOTTOM OF BASIN

6/21
KW 94-337
RB, LLR

Slope Stability Evaluation

Below 8' cementation increases.

From Culman analysis, ignoring ϕ,

$$H_{max} = \frac{4c}{\gamma} = \frac{4\left(650 \frac{lb}{ft^2}\right)}{120\ lb/ft^3} = 22'$$

1.5H:1V is conservative, since 15' slope vertical would have $FS = \frac{22}{15} = 1.47$ ignoring ϕ.

Above 8' treat as 8' slope in materials with $\phi = 42°$, $C = 0$. Measured with samples submerged.

Granular - check controlling infinite slope condition

$$FS = \frac{\tan\phi}{\tan i} \qquad \tan i = \frac{\tan\phi}{1.5} = \frac{\tan(42°)}{1.5} = 0.60$$

$\therefore i = 31°$; approx. 1.67:1

SCALE BACK TO 1.75H:1V.

Dry condition controls; in 36 hrs expect no significant seepage & have only temporary stability issue.

REPORT ON LABORATORY TESTS

SAMPLE: Date _____

Source _____

Type _____

Material _____

Sampled By _____

TESTED: _____

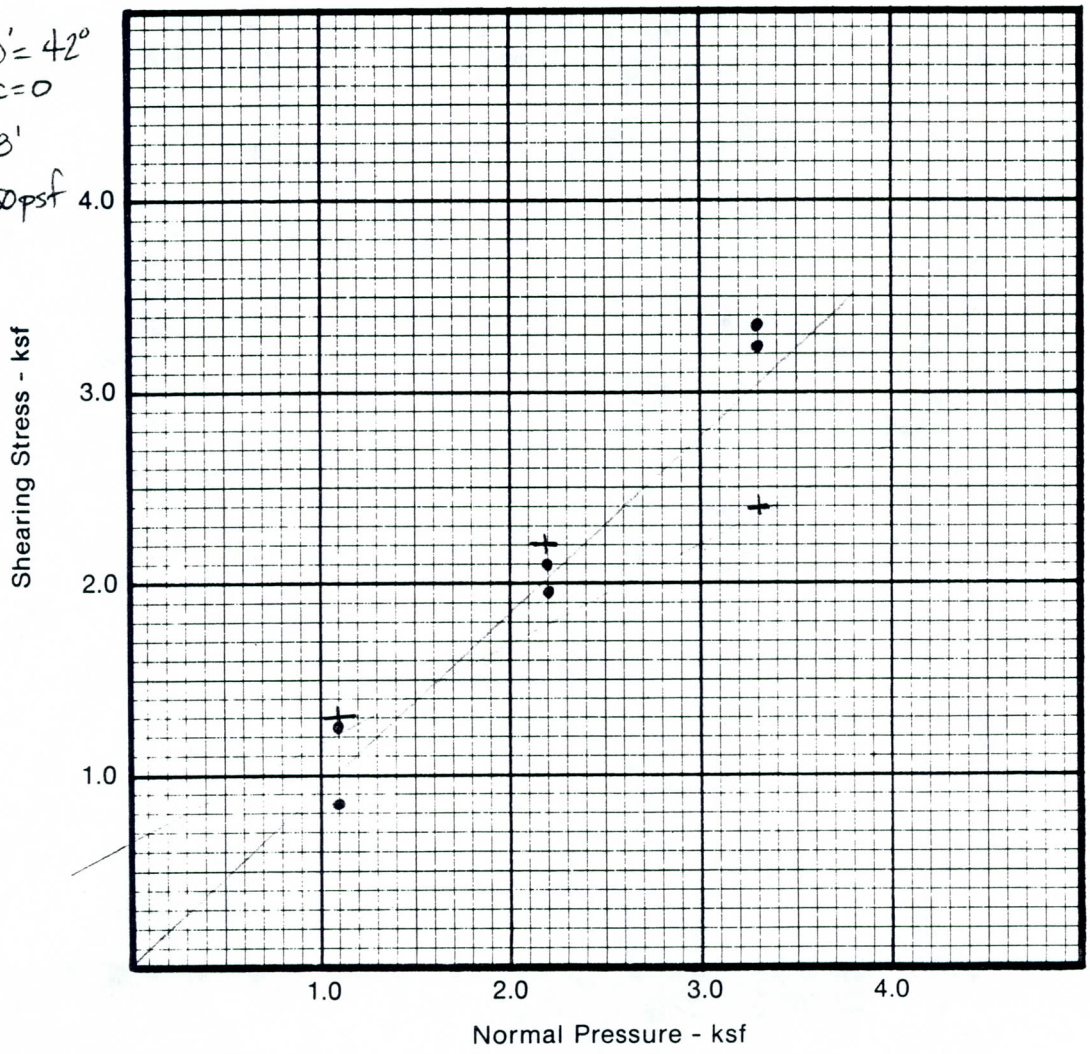
_____

RESULTS:

Friction Angle (Ø) = Cohesion (c) =

• Above 5' : $\phi' = 42°$
$c = 0$

+ 9-10' : $\phi' = 28'$
$c' = 650 psf$



Project No.

THOMAS-HARTIG & ASSOCIATES, INC.