UPPER EAST FORK CAVE CREEK DRAINAGE CHANNEL

Between Beardsley Road & Union Hills Road
Phoenix, Arizona

Registered Professional Engineer
CERTIFICATE NO. (Civil)
10971
KENNETH L.
RICKER
Date Signed 3-8-90
ARIZONA, U.S.A.

Prepared for

NBS/Lowry Engineers & Planners
2600 North 44th Street
Phoenix, Arizona 85008-1599

THOMAS-HARTIG & ASSOCIATES, INC.
GEOTECHNICAL, MATERIALS TESTING, AND ENVIRONMENTAL CONSULTANTS

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2600 North 44th Street
Phoenix, Arizona 85008-1599

8 March 1990

Attention: Brian Fry

Project: Upper Cave Creek Drainage Channel
Between Beardsley Road & Union Hills Road
Phoenix, Arizona

Project No. 90-0149

This report presents the results of the geotechnical engineering services authorized on the site for the proposed Upper Cave Creek Drainage Channel located between Beardsley Road & Union Hills Road 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, and ground subsidence/cracking potential due to groundwater withdrawal, 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,
THOMAS-HARTIG & ASSOCIATES, INC.

By: ______________________
Kenneth L. Ricker, P.E.

[Stamp: Registered Professional Engineer (Civil), Certificate No. 10971, Kenneth L. Ricker, Arizona, U.S.A., Date Signed 3-8-90]

Reviewed By: ______________________
Glen K. Copeland, P.E.

[Stamp: Registered Professional Engineer (Civil), Certificate No. 6858, Glen K. Copeland, Arizona, U.S.A., Date Signed 3-8-90]

/go
Copies to: Addressee (5)

TABLE OF CONTENTS

Registered Professional Engineer (Civil) CERTIFICATE NO. 10371 KENNETH L. RICKER Date Signed 3-8-90 ARIZONA, U.S.A.

PART I
REPORT

SCOPE

The proposed Upper East Fork Cave Creek Drainage Channel will extend from Beardsley Road south to Union Hills Road along an existing drainage channel located approximately 1800 feet east of Cave Creek Road in Phoenix, Arizona. The project will include:

1 A trapezoidal shaped open channel having a bottom width of 120 feet, 6 to 1 (horizontal to vertical) side slopes and a total depth of 6.4 to 6.6 feet.
2. Concrete box culverts at Utopia Road, Siesta Lane and Union Hills Drive.
3. Reinforced concrete pipe culverts at Beardsley Road.
4. Drop structures at various locations.
5. Reconstruction of street crossings.

The channel will be unlined with scope and erosion protection provided at the box and pipe culverts and at the drop structures.

PURPOSE

The purpose of these geotechnical services is to provide subsurface information, laboratory test data and geotechnical engineering information with respect to:

1. Recommendations for slope configuration.
2. Foundation recommendations for support of box and pipe culverts.
3. Site preparation and fill placement criteria.

SITE RECONNAISSANCE AND DESCRIPTION

The proposed Upper East Fork Cave Creek Drainage Channel will extend from Beardsley Road south to Union Hills Drive in Phoenix, Arizona. A field reconnaissance along the alignment revealed the following:

1. From Beardsley Road south approximately 1300 feet, the centerline of the alignment follows an existing drainage way. The existing channel is relatively narrow and contains a moderate to heavy growth of trees, bushes and grass. The drainage channel has also been used for the disposal of manure, grass and landscape cuttings, soil, some debris and occasional auto parts. The existing drainage way is bounded on both sides by relatively large single family residential lots all of which are occupied and many of which keep livestock and horses.

2. From approximately 1300 feet south of Beardsley to 1800 feet south, the proposed channel crosses a vacant lot and a trailer house lot west of the existing drainage way. The area contains a moderate growth of grass and weeds.

3. From 1800 feet south of Beardsley Road to Utopia Road, the alignment crosses the west side of an existing plant nursery. The area is occupied by gravel roads, several sheds, several canopies, and several open plant storage areas. Numerous underground utilities exist in the area. The site is relatively level.

4. From Utopia Road south to Siesta Lane, the alignment again follows an existing drainage way through a mobile home park. The existing drainage channel is 30 to 40 feet wide and contains a moderate growth of grass. The area is maintained and well kept. Mobile homes line both sides of the channel. An existing roadway crosses the channel with a box culvert approximately half way between Utopia Road and Siesta Lane.

5. From Siesta Lane south for 200 feet, the existing drainage way is fairly wide and grass lined. The centerline of the proposed channel is east of the existing drainage way and crosses a lot occupied by a church.

6. From 200 feet south of Siesta Lane to approximately 800 feet south of Siesta Lane, the centerline of the alignment crosses various sized residential lots with houses and mobile homes, many of which keep livestock and horses. The existing drainage way is west of the proposed channel, is relatively narrow, and contains numerous trees and bushes and some debris. Two small homemade bridges cross the existing drainage way in this area.

7. From 800 feet south of Siesta Lane to Union Hills Drive, the alignment crosses undeveloped land. The existing drainage way is very narrow and lined with trees and brush. The undeveloped land contains some fill

piles and scattered debris. The area is relatively level and sparsely vegetated with weeds.

INVESTIGATION

Test borings were drilled with a CME 55 drill rig using hollow stem auger at 6 locations along the proposed channel alignment and test pits were excavated with a Case 780 extend-a-hoe using a 24 inch wide bucket at 4 locations along the proposed channel alignment. The location of the various field explorations are shown on the attached site plan. During the field explorations the soils encountered were visually classified, and representative samples of the material obtained at selected depths. In-place field density tests were performed at Exploration Locations 2, 3, 5, 6, 8, and 10 using the sand cone method. The results of the field explorations are presented in Appendix A "Field Results". Two additional exploration locations were planned but not accomplished at this time due to access restrictions at the plant nursery site.

Representative samples obtained during the field exploration were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Sieve Analyses & Plasticity Index	Representative (10)	Classification and scour evaluation
Compression	Undisturbed (4)	Foundation settlement
Direct Shear	Undisturbed (2)	Shear strength, foundation bearing capacity and slope configuration
Permeability	Undisturbed (2)	Seepage characteristics
Soluble Salts/ Soluble Sulfates	Representative (3)	Corrosion Potential
Standard Proctor	Representative (3)	Compaction characteristics
*Dry Density and/or moisture content	Undisturbed (26)	In situ density and/or moisture determination

* Reported on Boring Logs

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

SOIL CONDITIONS

The soil profile encountered at the field exploration locations was relatively uniform. Detailed descriptions of the materials encountered are presented on the boring logs in Appendix A. The soils in the proposed channel area to the depth explored (14.5 to 20 feet) are clayey sands, stratified with layers or lenses of clayey sand and gravel, occasional sandy clay layers and various amounts of cobbles and occasional boulders. These materials were lightly to moderately cemented below 5 to 10 feet. Soil moisture contents are generally described as damp to very damp. The soils contained more gravel and cobble size material at the north part of the channel alignment. At the south end of the channel alignment (Exploration Locations 9 and 10), these soils were overlain by a 4 1/2 to 5 foot thick layer of sandy clay. The sandy clay was stiff and slightly damp. The moisture content of the other materials encountered was described as damp. No groundwater was encountered in the field exploration during this project. However, a perched water zone was encountered at Exploration Location 8 in a depth range of 9 to 10 feet. This condition may exist at other depths and locations throughout the length of the project.

DISCUSSION AND RECOMMENDATIONS

General: Geotechnical engineering recommendations for development of the channel, drop structures, and box and pipe culverts are presented in the following sections. These recommendations are based upon the results of the field and laboratory testing which are presented in Appendix A and B of this report.

Channel Section: A majority of the channel slopes will be constructed by cutting into the native soils and filling the existing drainage way which lies outside the planned channel configuration. We recommend that where embankment fills are required they be constructed with excavated material. The channel slope materials can be constructed of any of the materials encountered within the project area which are free of organic material, garbage, debris and rubble.

Slope stability analysis of the proposed embankment configurations described in "Scope" were performed. The following parameters were used in the evaluation:

1. Slope material
   ø = 24 degrees
   C = 300 psf
   In place density = 120 pcf
   Submerged = 55 pcf
2. Materials at submerged conditions
3. Rapid draw-down

The side slope configurations (as described in "Scope") have results in calculated factors of safety well over 2.0 for the various conditions and configuration . Therefore, it is our opinion that embankments may be satisfactorily constructed as planned.

<u>Channel Construction:</u> The proposed channel will be primarily in cut; however, some locals areas may require fill. Foundation preparation in the channel fill area should include, as a minimum, the complete removal of all soft soils and debris and rubble laden materials. After removal of the various materials, the foundation area should be scarified to a minimum depth of 8 inches and compacted. The fill materials should be compacted to at least 95 percent of a maximum dry density as determined by ASTM D698 at a moisture content in the range of 3 percent below to 3 percent above optimum.

<u>Foundations For Concrete Box Culverts:</u> Concrete box culverts will be used to support roads over the channel. These structures are generally cast-in-place and exhibit relative low bearing pressures. Cut off walls, which extend below potential scour depth or scour aprons will be constructed up and downstream of the box culverts. Spread and continuous footings founded on the compacted fill or undisturbed channel materials at shallow depths should be appropriate for support of box culverts. An allowable bearing pressure of 2000 psf at a depth of 1.0 feet below lowest adjacent grade or 1.5 feet below scour depth for unprotected footings may be used in design.

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. All spread column footings should have a minimum width of 2 feet and all continuous wall footings should be at least 1.33 feet wide.

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	30 psf/ft.
Restrained walls	50 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 (maximum 12-foot height). 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 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.

Drop Structure: The drop structures are planned at variable locations along the channel. The design and location of these structures has not been finalized. Each of the structures will drop the channel grade approximately 2 feet.

In order to provide uniform support of the drop structure, we recommend that foundation preparation below the entire structure include:

1. The complete removal of any soft soils and debris.
2. All areas should be scarified to a minimum depth of 8 inches and compacted.
3. All fill materials required below the drop structure should be placed in horizontal lifts, moisture conditioned to a uniform moisture content in the range of 3 percent below to 3 percent above optimum and compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D698.
4. Material obtained during excavation of the grade control structure or from other parts of the channelization project may be used as fill materials provided these materials are free of organic matter, debris, rubble and garbage.

Excavation Conditions: The field exploration and sampling at the site was performed for design purposes. It is not possible to accurately correlate results of the various methods of field explorations 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 designer's information with the understanding that they ar approximations based only on field exploration data. More accurate information regarding excavatability should be evaluated by contractors or other interested parties from test excavations using the intended equipment.

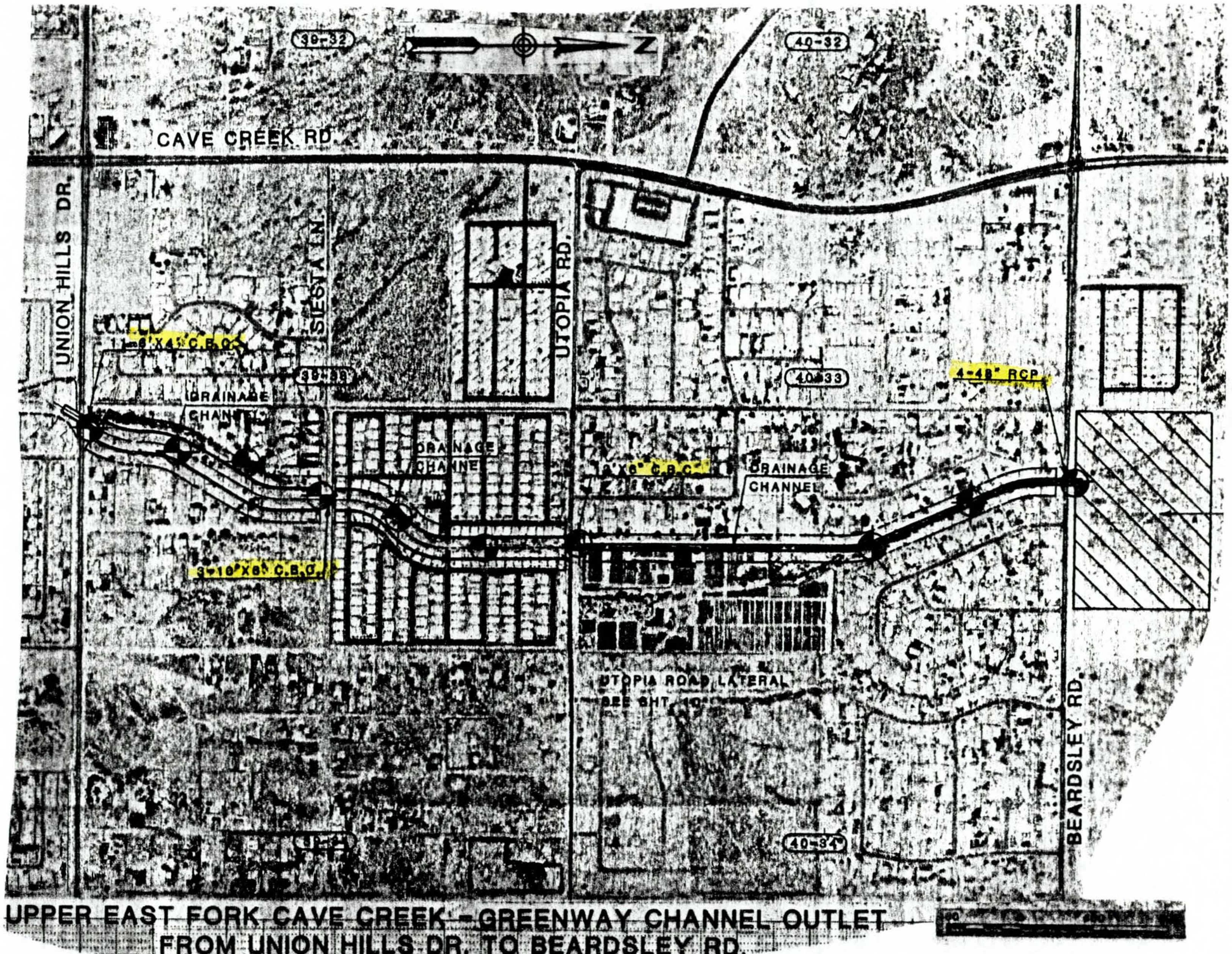
Excavations into the site soils to the proposed depth of the channel should be possible with conventional excavating equipment. Due to the granular nature of these soils; the possible presence of relatively shallow perched water; and the presence of cobble and boulder sized material, excavations may be slow and difficult to accomplish.

Temporary Construction Slopes: Temporary slopes required for the construction of various aspects of the project will be dependent of the materials encountered, groundwater conditions, seepage conditions and location, type, extent and weight of surcharge loads. In general, the following temporary slopes may be used in design but flatter or steeper slopes may be accomplished or required in the field as dictated by specific conditions .

Material	Configuration (Horizontal to Vertical)
Clayey sand, gravel & cobbles	1 to 1
Sand, silty sand	1.5 to 1
Sandy clay	0.5 to 1

*These slopes are for soils at relatively low water contents not subjected to seepage forces or submerged. Flatter slopes will be required for these conditions.

PART II
FIELD RESULTS



Field Exploration Location

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Project No. 90-0149

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	

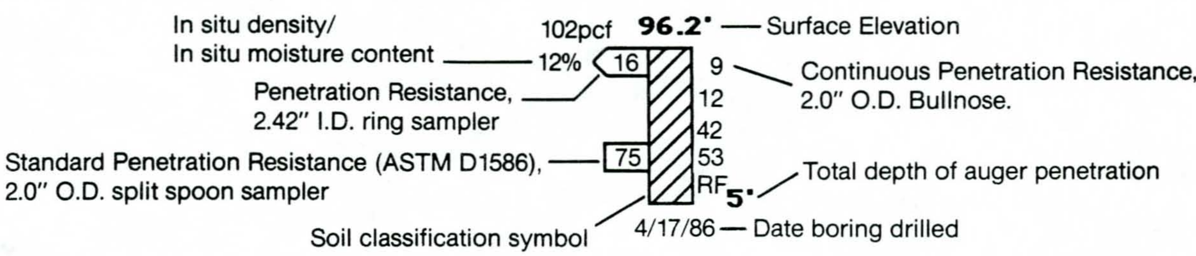
FINE-GRAINED SOIL

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

CLAYEY SAND (CL); brown; medium dense, damp; medium to high plasticity fines; traces to some gravel.

CLAYEY SAND AND GRAVEL SOME COBBLES (GC); brown; dense to very dense; damp; medium to high plasticity fines; occasional layers of clayey sand and sandy clay; light cementation.

CLAYEY SAND WITH GRAVEL (SC-GC); brown; medium dense, damp, medium to high plasticity fines; occasional cobbles; light to moderate cementation.

SANDY CLAY (CL); brown; stiff; slightly damp, medium plasticity.

No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight auger unless other wise 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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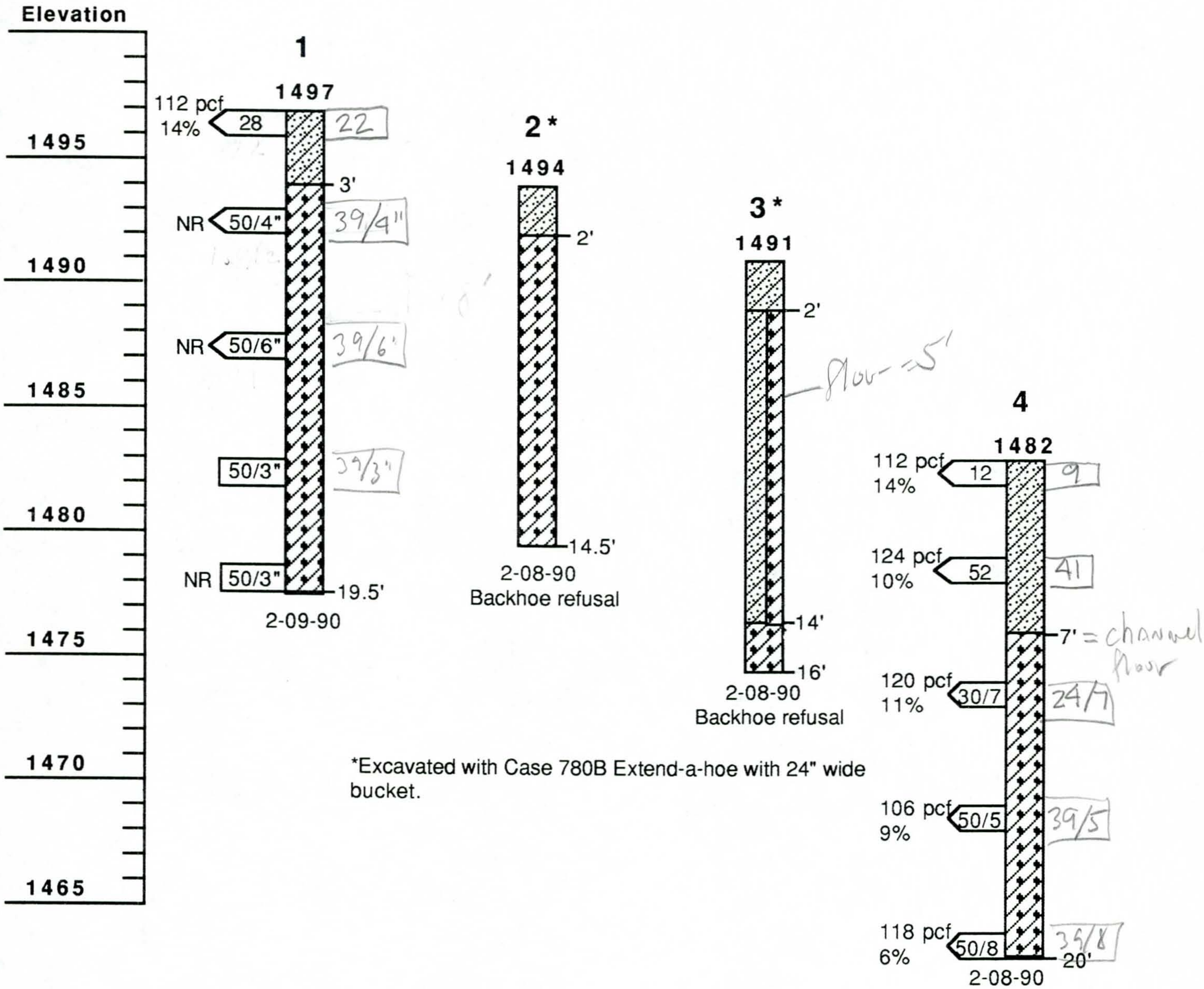

No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 7" diameter hollow stem auger unless other wise noted.

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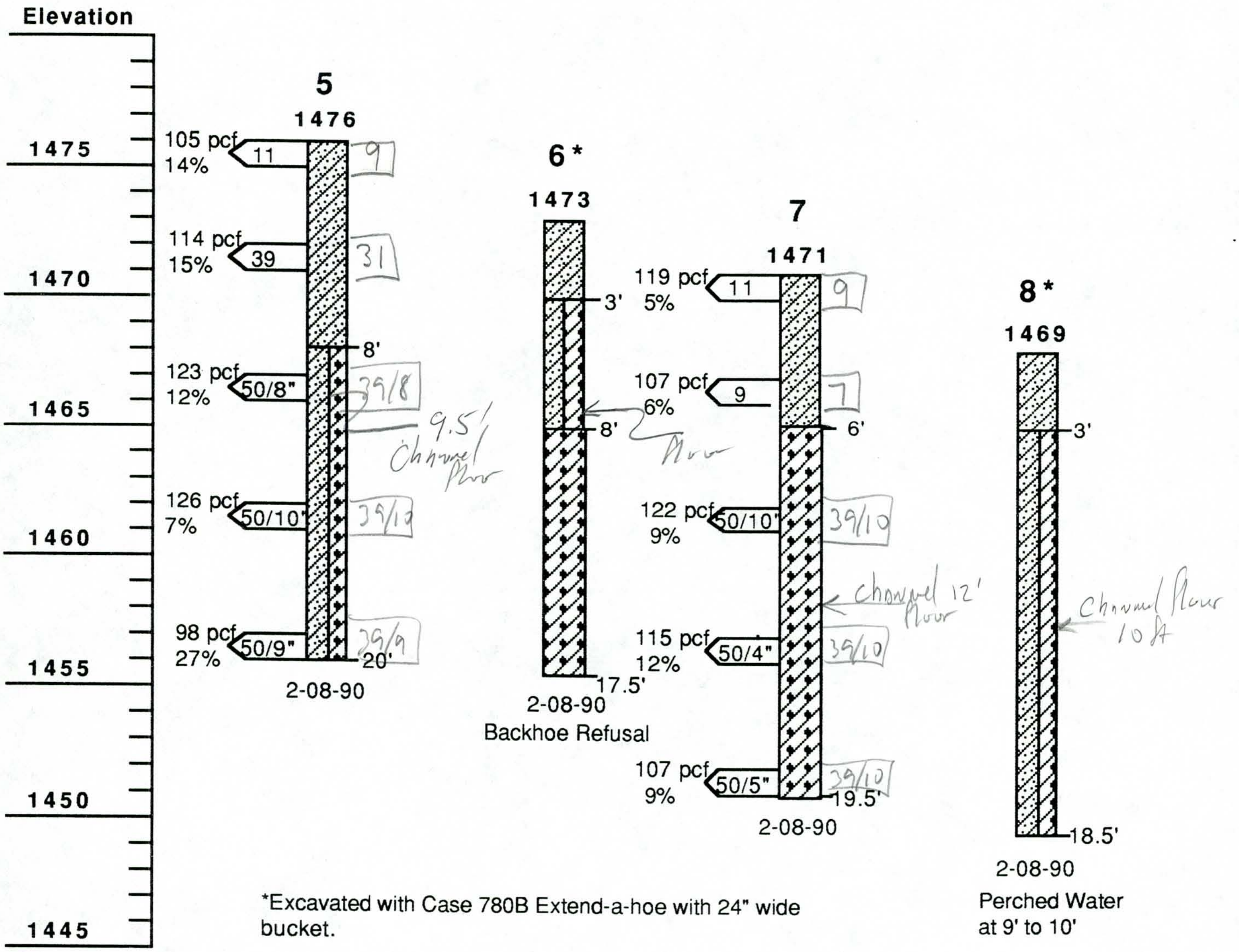

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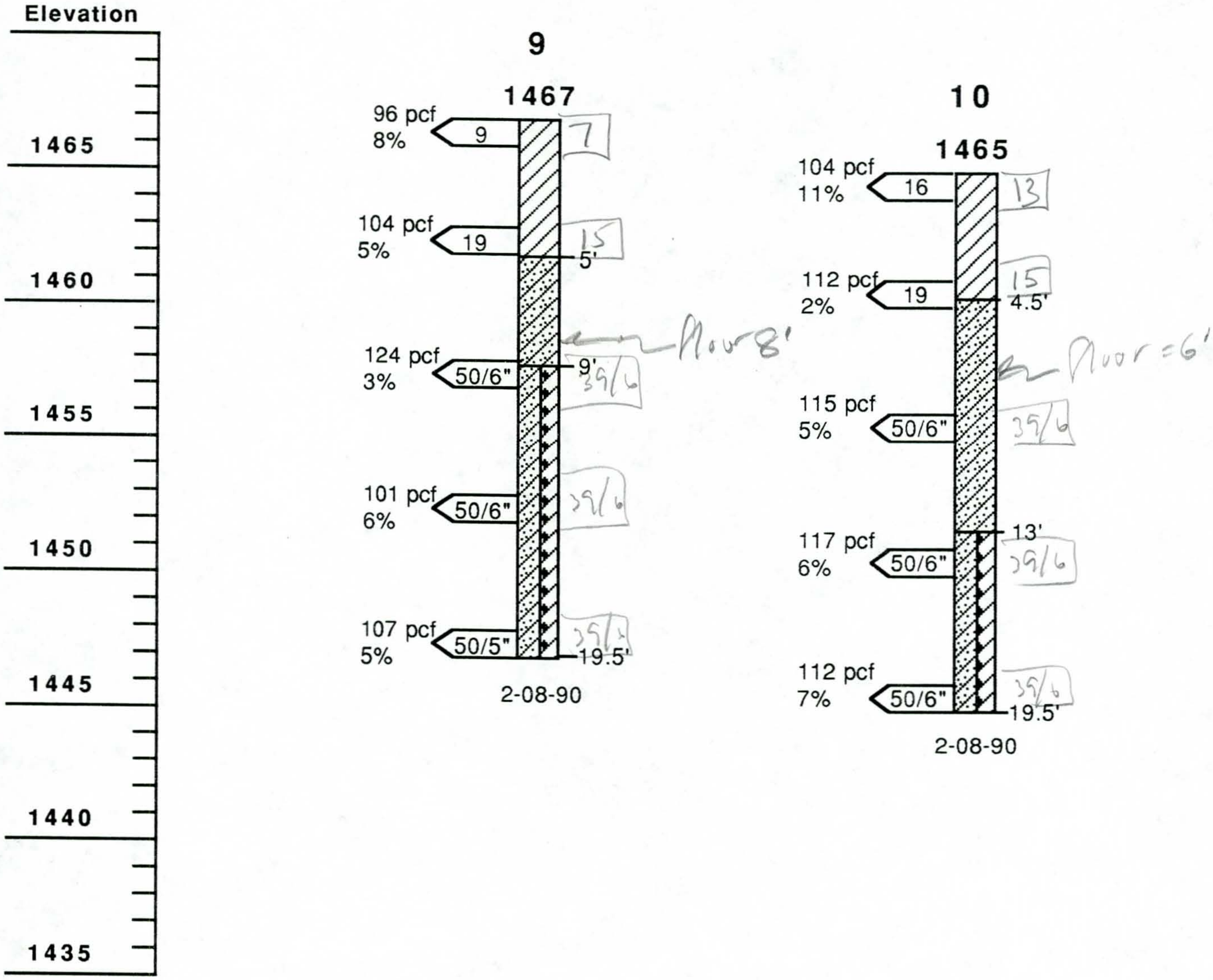

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PART III
LABORATORY RESULTS

REPORT ON FIELD TESTS

DESCRIPTION: Date: 2-23-90

Location: As Noted Below

Material: Soil

Performed By: TH/Wennes

TESTED: In-Place Field Density Tests by Sand Cone Method

RESULTS:

Location	Dry Density		e	Moisture Content
2; 1.5'	110.8 pcf	max=121pcf	.39	10.6%
3; 1.0'	95.8 pcf			8.1%
5; 1.5'	114.4 pcf			8.7%
6; 1.5'	96.8 pcf	max=121pcf	.39	17.4%
8; 2.0'	95.5 pcf	max=128pcf	.32	14.3%
10; 1.0'	108.9 pcf			3.7%

Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source: As Noted Below

Type: Bulk

Material: Soil

Sampled By: TH/Thompson-Wennes

TESTED: Sieve Analysis and Plasticity Index

RESULTS:

Sample	LL	PI	Sieve Size - 200	100	50	30	16	Accum. 8	% 4	Passing 3/4"	1"	2"	3"	* Class
1; 0 - 5'	51	27	28	32	36	41	48	60	76	94	100			SC
2; 1.5 - 5'	56	27	7	8	10	14	21	31	46	69	71	77	81**	GP-GC
3; 0 - 1.5'	55	30	22	24	27	34	46	65	85	96	100			SC
4; 5 - 10'	57	32	27	31	35	40	49	63	80	100				SC
5; 0 - 5'	36	17	32	37	42	50	61	74	91	100				SC
6; 0 - 3'	27	9	50	57	62	68	78	89	97	100				CL-SC
7; 5 - 10'	50	29	35	39	44	50	58	72	88	96	100			SC
8; 0 - 3'	27	10	30	35	39	47	59	73	90	100				SC
9; 5 - 10'	31	11	23	27	30	35	49	69	91	100				SC
10; 5 - 10'	38	22	19	21	24	30	43	62	82	94	96	100		SC

* Unified Soil Classification

**100 Percent Passing
6 Inch Sieve

Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

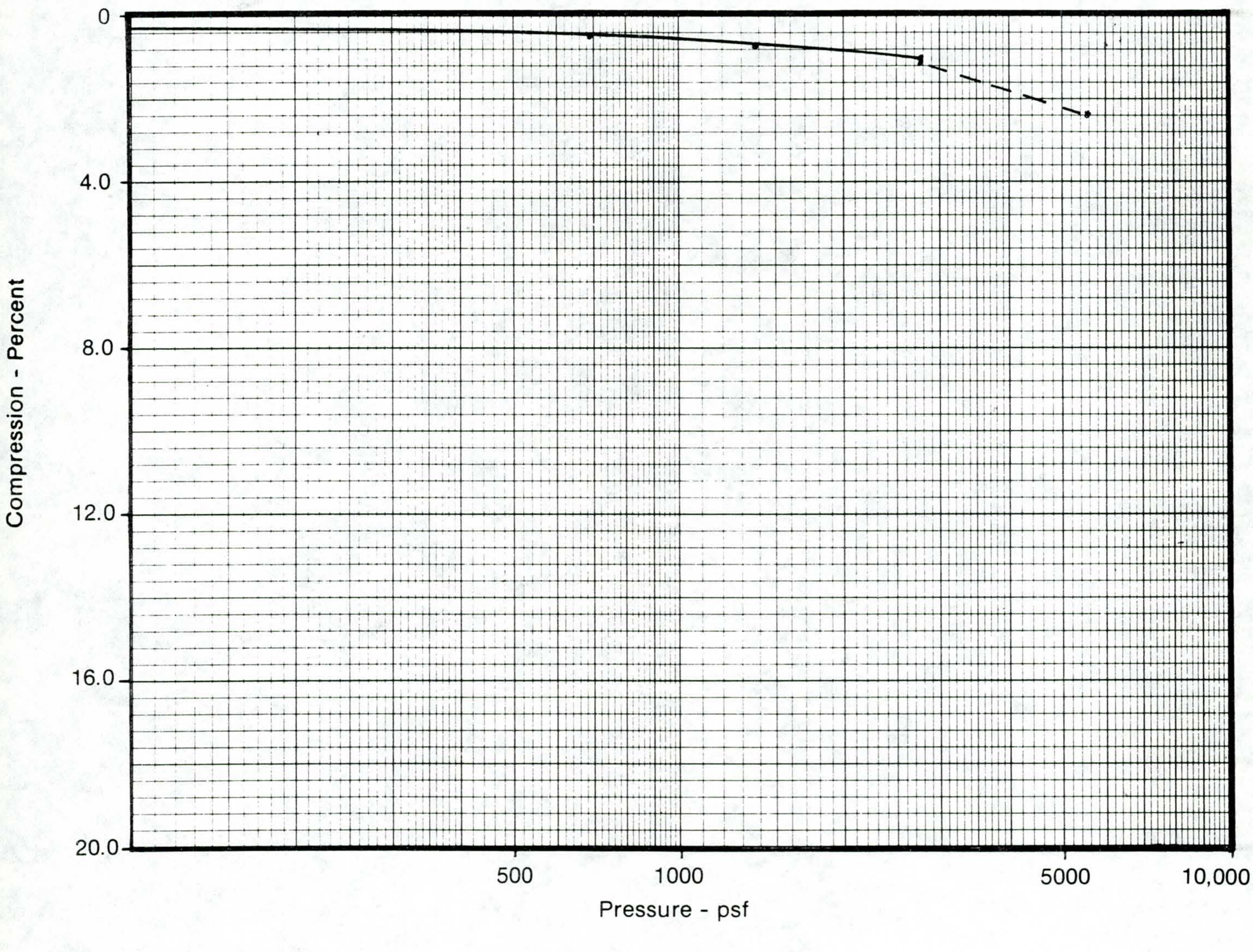
Source Test Boring 1; 0 - 1'

Type Driven ring sample; 112 pcf dry density; 14% field moisture

Material Clayey Sand (SC)

Sampled By TH/Thompson

TESTED: Compression; test sample soaked at 2770 psf



REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

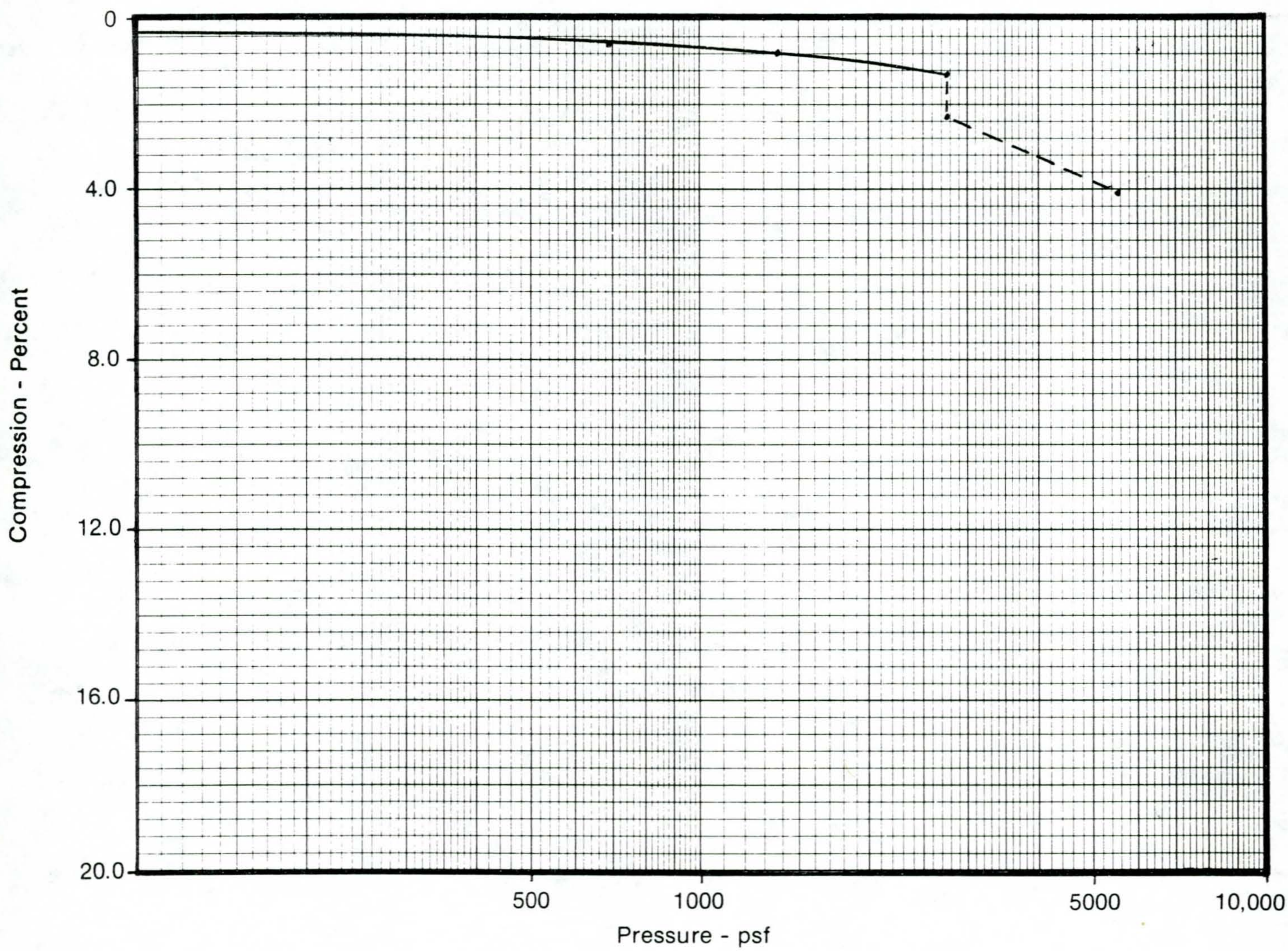
Source Test Boring 4; 9 - 10'

Type Driven ring sample; 120 pcf dry density; 11% field moisture

Material Clayey Sand & Gravel (GC)

Sampled By TH/Thompson

TESTED: Compression; test sample soaked at 2770 psf



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REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

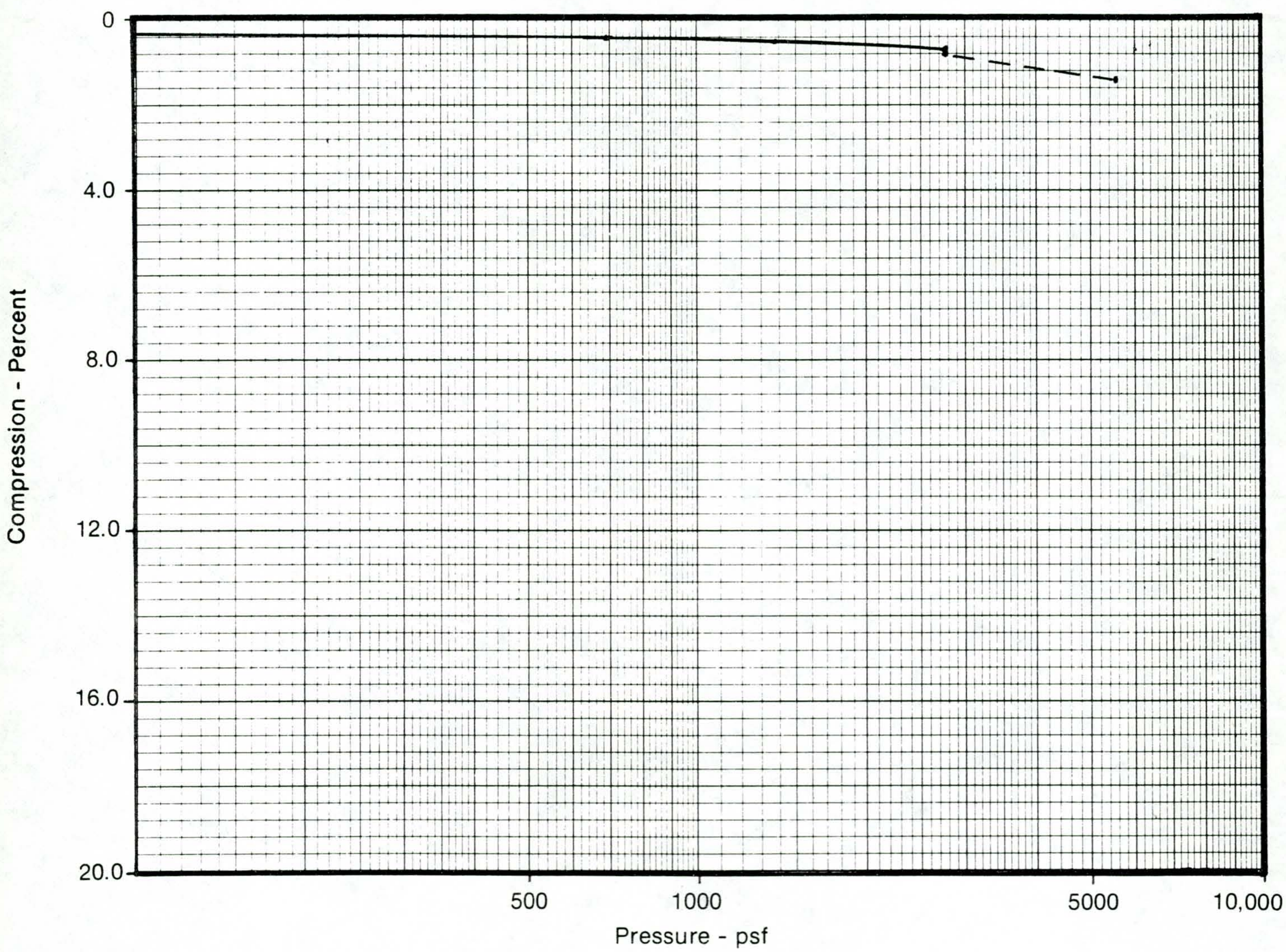
Source Test Boring 7; 4 - 5'

Type Driven ring sample; 107 pcf dry density; 6% field moisture

Material Clayey Sand (SC)

Sampled By TH/Thompson

TESTED: Compression; test sample soaked at 2770 psf



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THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

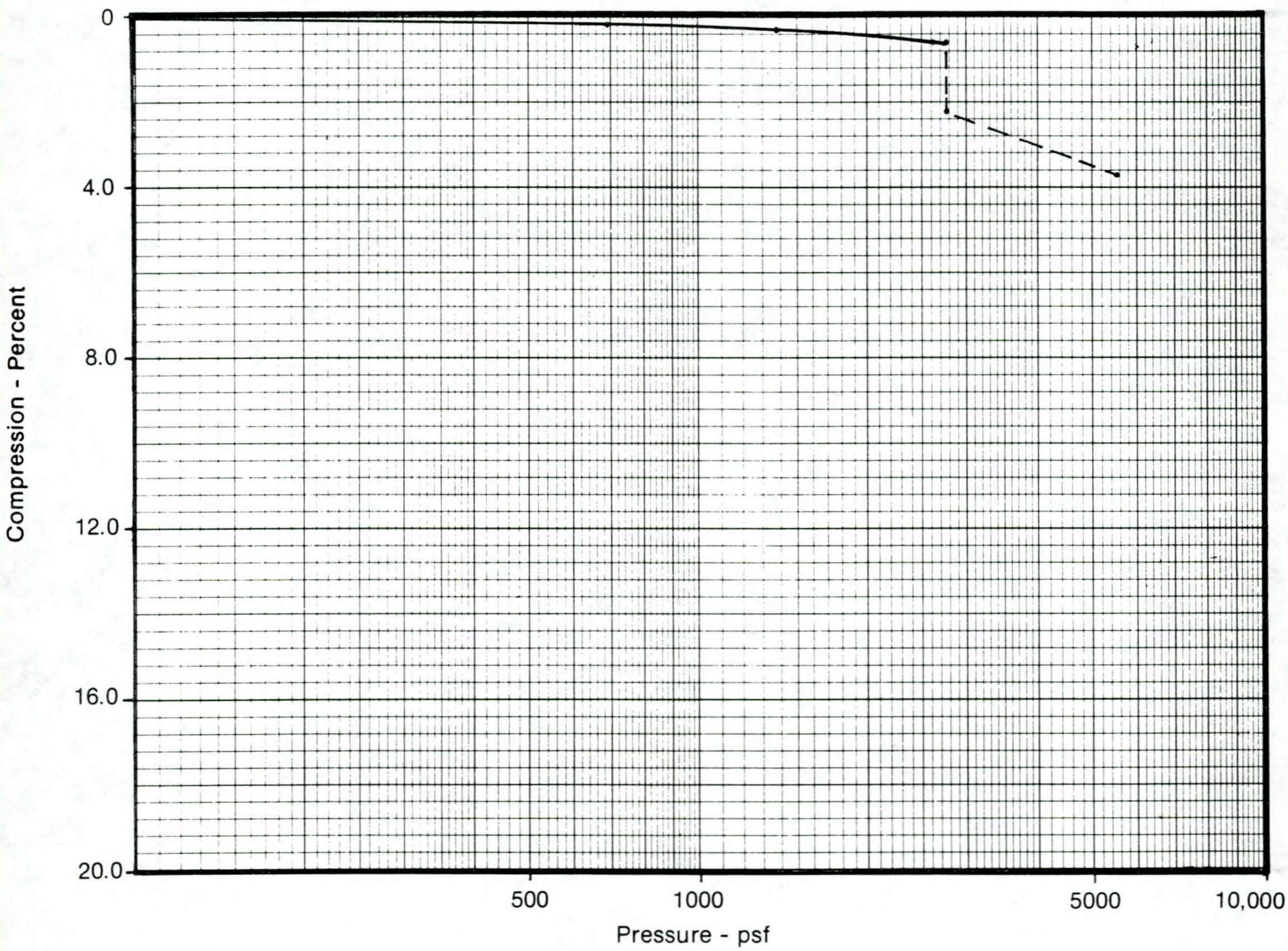
Source Test Boring 10; 4 - 5'

Type Driven ring sample; 112 pcf dry density; 2% field moisture

Material Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: Compression; test sample soaked at 2770 psf



Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source Test Boring 5; 0 - 1'

Type Driven ring sample; 105 pcf dry density; 15% field moisture

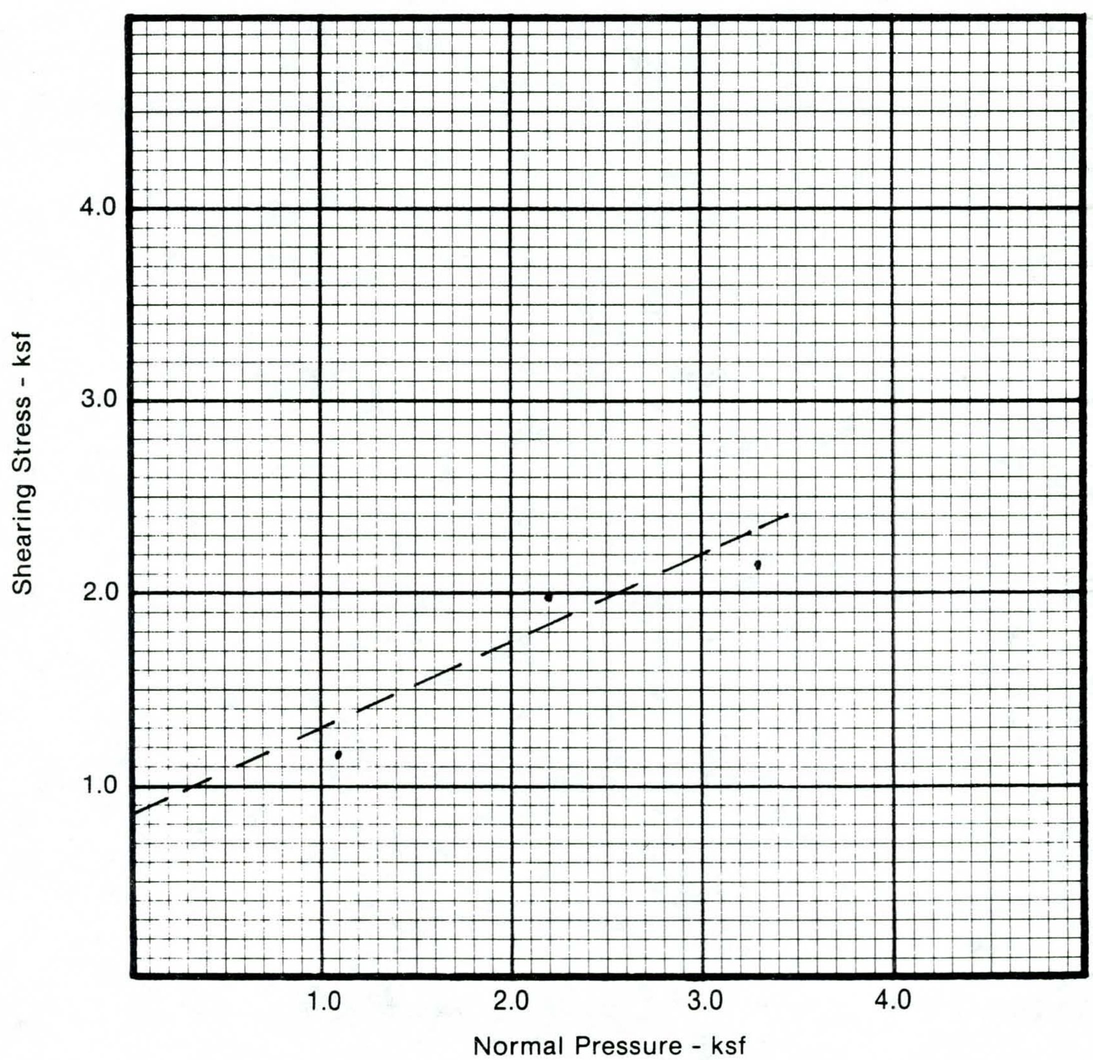
Material Clayey Sand (SC)

Sampled By TH/Thompson

TESTED: Direct shear with sample immersed

RESULTS:

Friction Angle (Ø) = 24° Cohesion (c) = 86°



Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source: Test Boring 9; 4 - 5'

Type: Driven ring sample; 104 pcf dry density; 5% field moisture

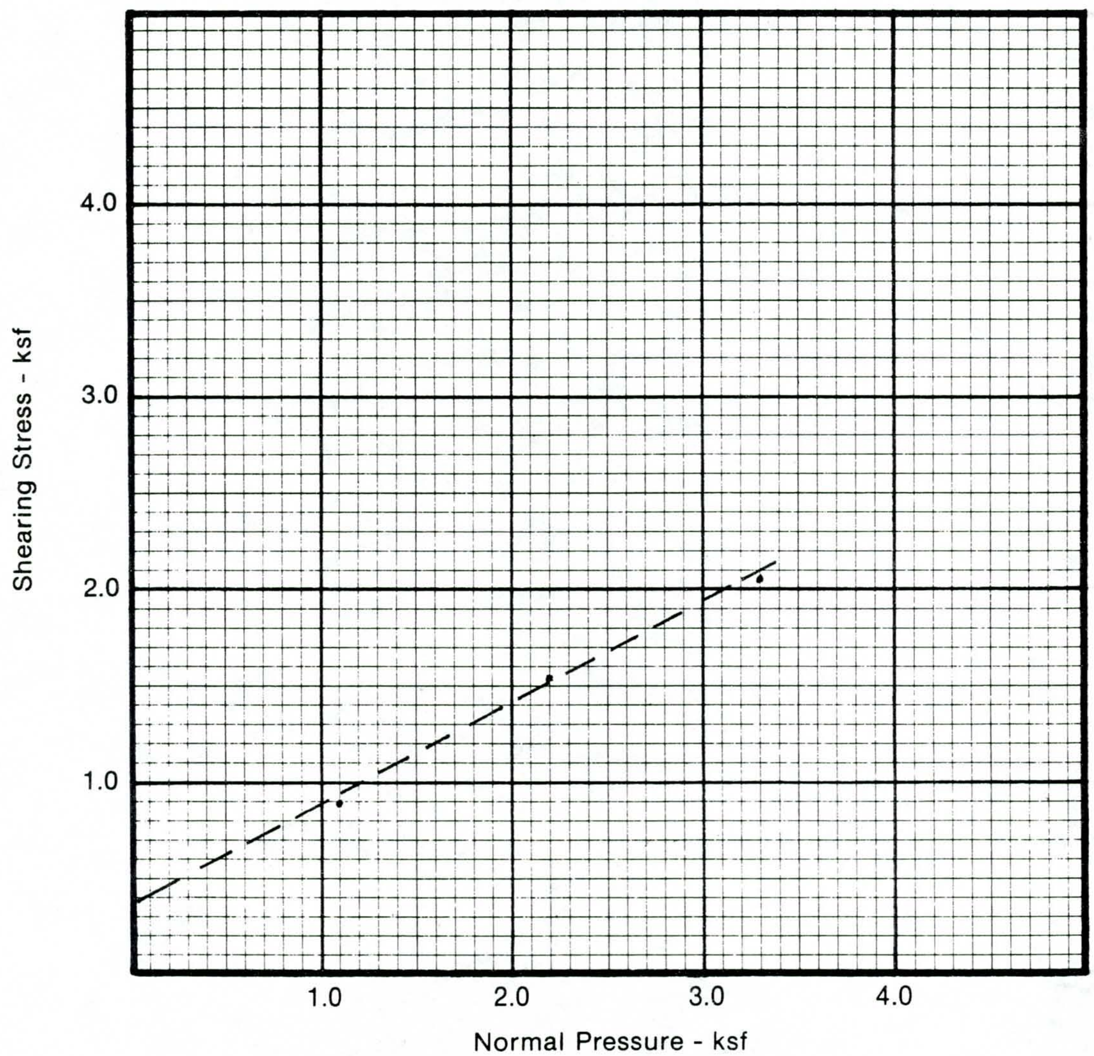
Material: Sandy Clay (CL)

Sampled By: TH/Thompson

TESTED: Direct shear with sample immersed

RESULTS:

Friction Angle (Ø) = 28° Cohesion (c) = 38°



Project No. 90-0149

TH-105

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source As Noted Below

Type Ring

Material Soil

Sampled By TH/Thompson

TESTED: Constant Head Permeability on Ring Sample

RESULTS:

Location	Dry Density	Moisture Content	Coefficient or Permeability
5; 4-5'	113.9 pcf	15.4%	1.3×10^{-8} cm/sec
7; 9-10'	122.1 pcf	9.3%	1.1×10^{-6} cm/sec

Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source Test Boring 2; 1.5 - 5'

Type Grab sample

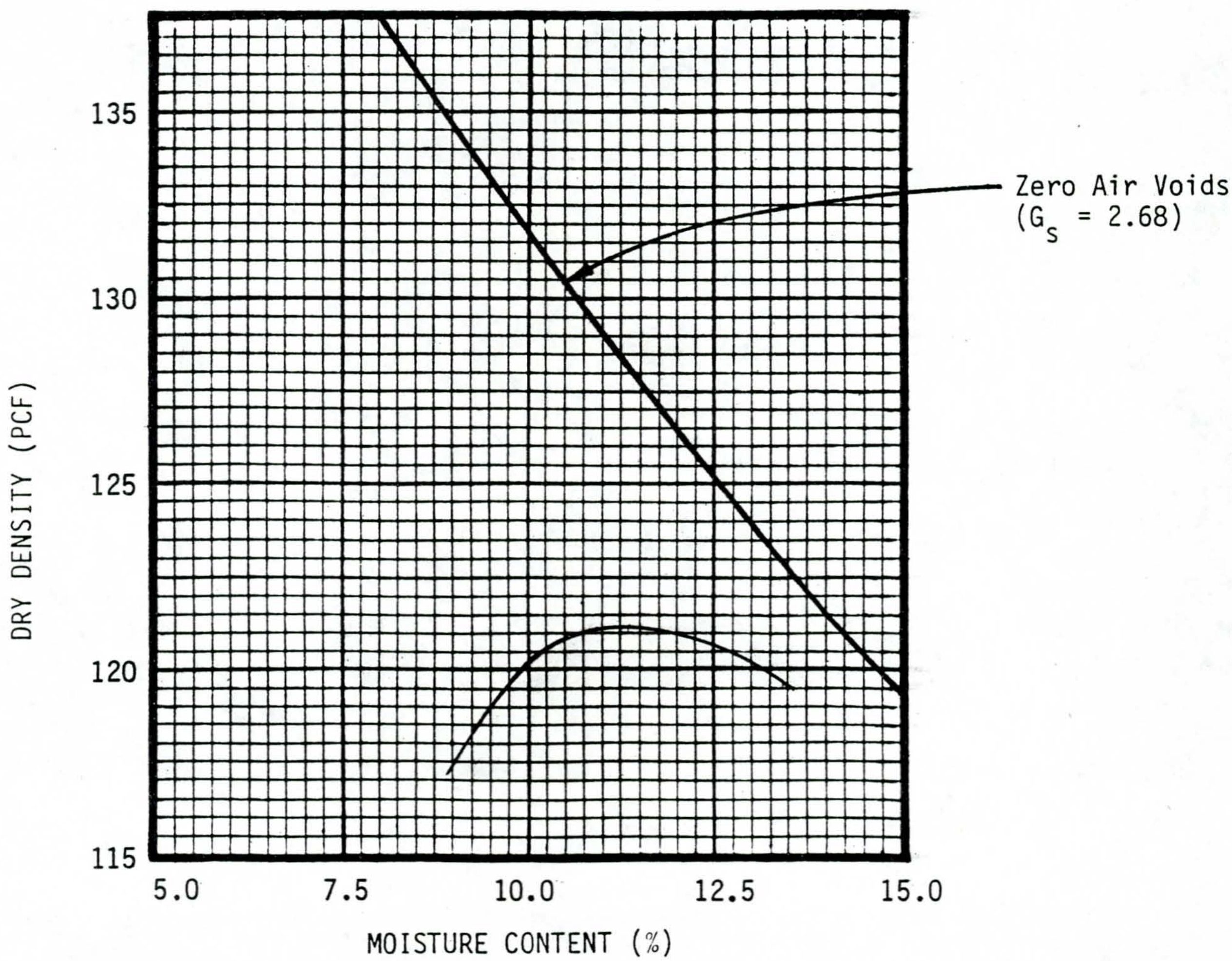
Material Clayey Sand & Gravel (GC)

Sampled By TH/Thompson

TESTED: Moisture-Density Relationship Curve; ASTM D698, Method A

RESULTS:

Max. Dry Density (pcf) 121.2 Optimum Moisture Content (%) 11.3



Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source Test Boring 6; 0 - 3'

Type Grab sample

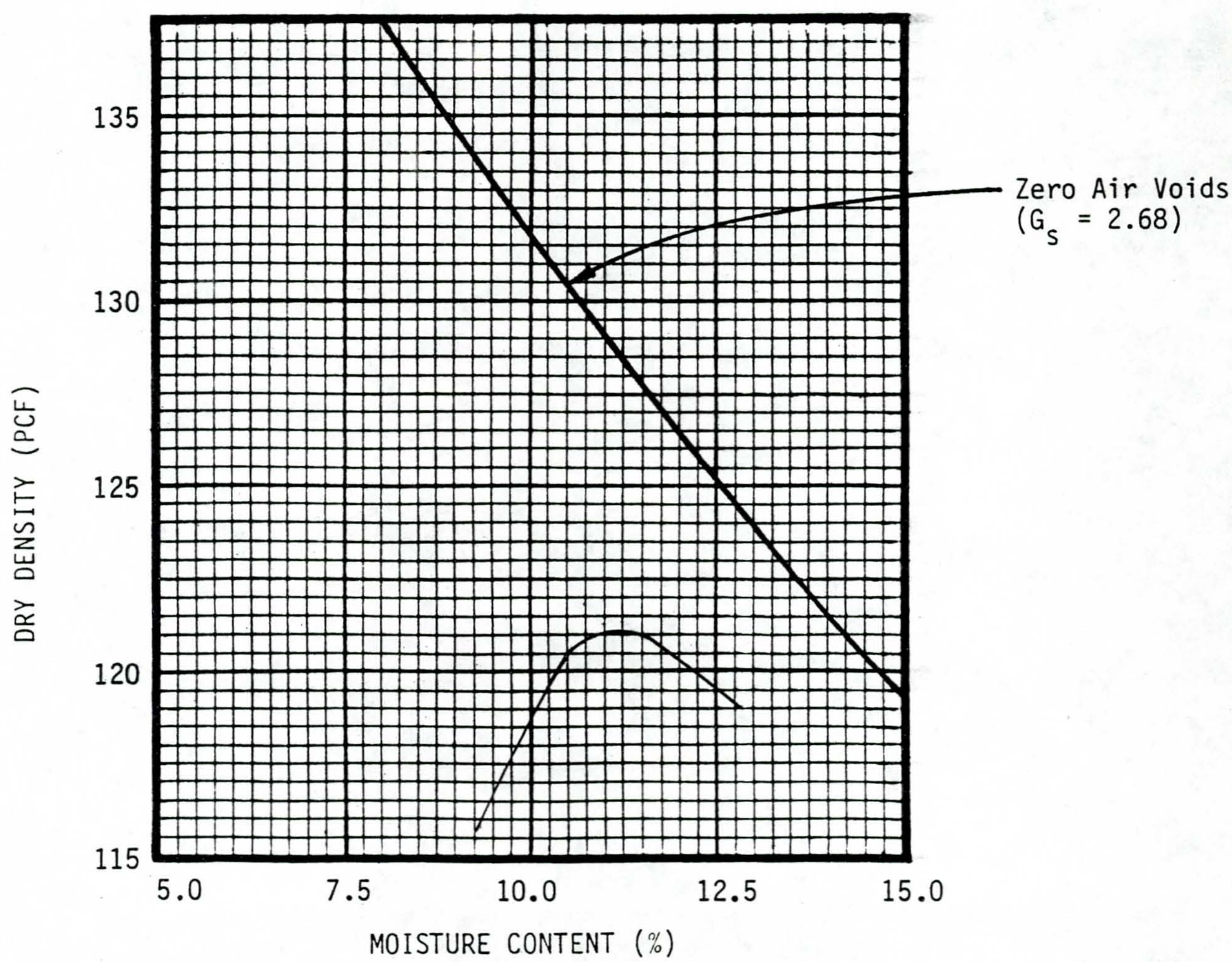
Material Clayey Sand (SC)

Sampled By TH/Thompson

TESTED: Moisture-Density Relationship Curve, ASTM D698, Method A

RESULTS:

Max. Dry Density (pcf) 121.1 Optimum Moisture Content (%) 11.2



REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source Test Boring 8; 0 - 3'

Type Grab Sample

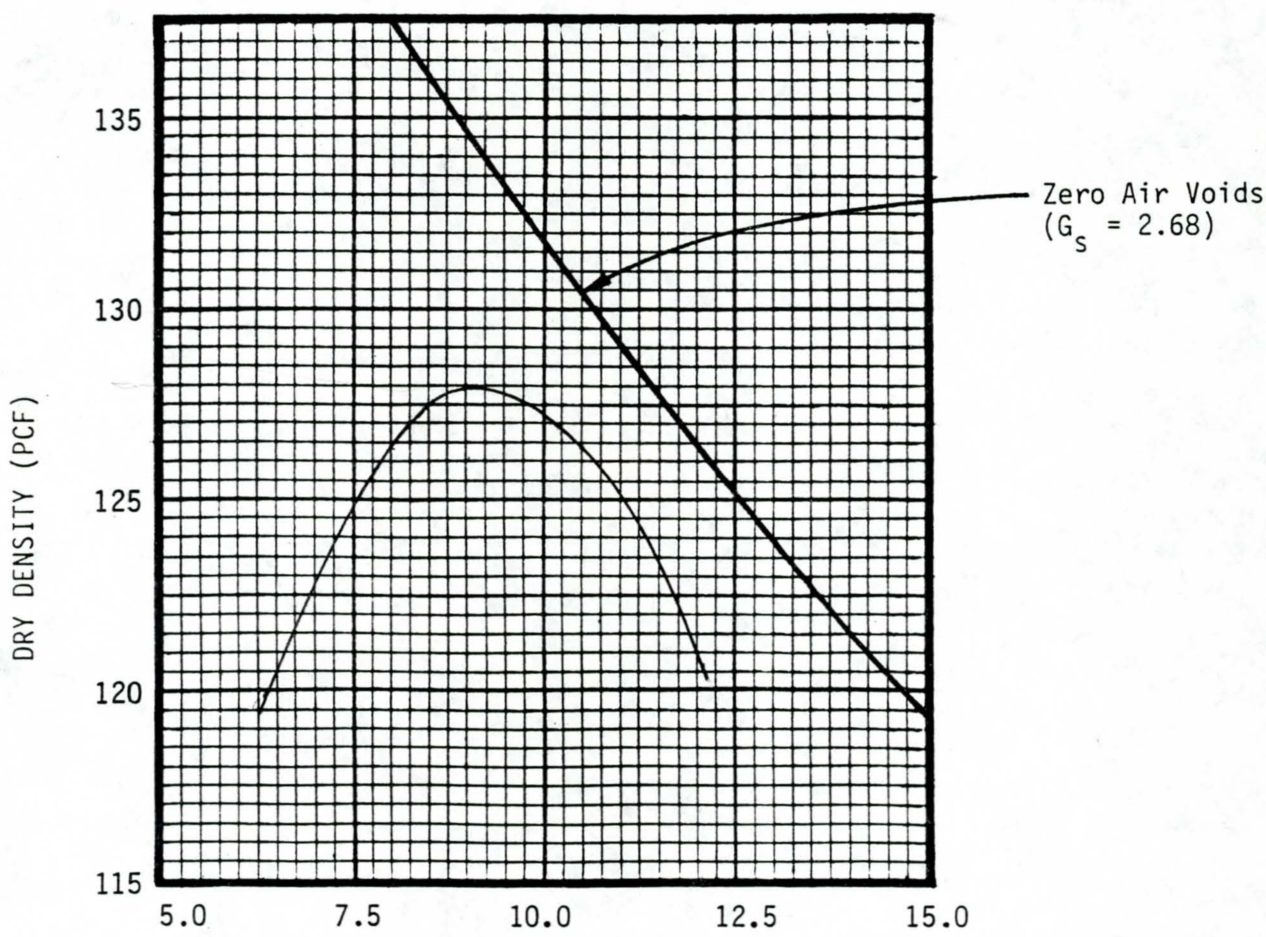
Material Clayey Sand (SC)

Sampled By TH/Thompson

TESTED: Moisture-Density Relationship Curve, ASTM D698, Method A

RESULTS:

Max. Dry Density (pcf) 127.9 Optimum Moisture Content (%) 9.2



Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 2-23-90

Source As Noted Below

Type Bulk

Material Soil

Sampled By TH/Thompson/Perry

TESTED: Solule Salts and Soluble Sulfates

RESULTS:

Location	Percent Soluble Salts	Percent Soluble Sulfates
1; 0-5'	0.07	0.009
5; 0-5'	0.07	0.024
10; 5-10'	0.05	0.021

THOMAS-HARTIG & ASSOCIATES, INC.

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Phoenix, Arizona 85008-1599

10 April 1990

Attention: Brian Fry

Project: Upper Cave Creek Drainage Channel
Between Beardsley Road & Union Hills Road
Phoenix, Arizona

Project No. 90-0149
Supplement No. 1

This supplement presents the results of the two test borings drilled in the Desert Trees Farm Nursery and the laboratory testing associated with these test borings. The test borings are similar to the other test borings. Therefore, the recommendations presented in the original report are applicable to the nursery area.

This supplement shall be attached to the original report and shall become a part thereof. Please call if you have any questions or if we may be of further assistance.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: ______________________ Kenneth L. Ricker, P.E.

Registered Professional Engineer (Civil) Certificate No. 10971 KENNETH L. RICKER Date Signed 4-10-90 ARIZONA, U.S.A.

Reviewed by: ______________________ Glen K. Copeland, P.E.

Registered Professional Engineer (Civil) Certificate No. 6858 GLEN K. COPELAND Date Signed 4-10-90 ARIZONA, U.S.A.

/go
Copies to: Addressee (3)

Chandler: Phone (602) 961-1169, Fax (602) 940-0952 • Phoenix Phone (602) 437-5450

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	

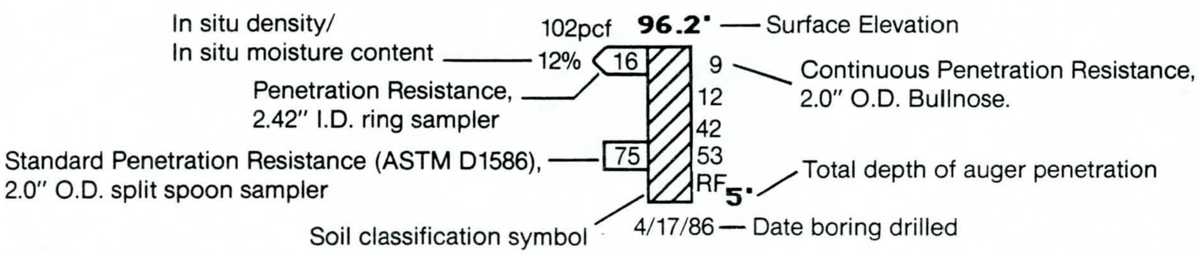
FINE-GRAINED SOIL

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	MOIST	VERY MOIST	WET (SATURATED)
		(Plastic Limit)			(Liquid Limit)

CONSISTENCY CORRELATION

CLAYS & SILTS	BLOWS/FOOT*
VERY SOFT	0-2
SOFT	2-4
FIRM	4-8
STIFF	8-16
VERY STIFF	16-32
HARD	OVER 32

RELATIVE DENSITY CORRELATION

SANDS & GRAVELS	BLOWS/FOOT*
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

*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).

Project No. 90-0149

THOMAS-HARTIG & ASSOCIATES, INC.

LEGEND OF SOIL TYPES

CLAYEY SAND (CL); brown; medium dense; damp; medium to high plasticity fines; traces to some gravel.

CLAYEY SAND AND GRAVEL-SOME COBBLES (GC); brown; dense to very dense; damp; medium to high plasticity fines; occasional layers of clayey sand and sandy clay; light cementation.

CLAYEY SAND WITH GRAVEL (SC-GC); brown; medium dense; damp; medium to high plasticity fines; occasional cobbles; light to moderate cementation.

SANDY CLAY (CL); brown; stiff; slightly damp; medium plasticity.

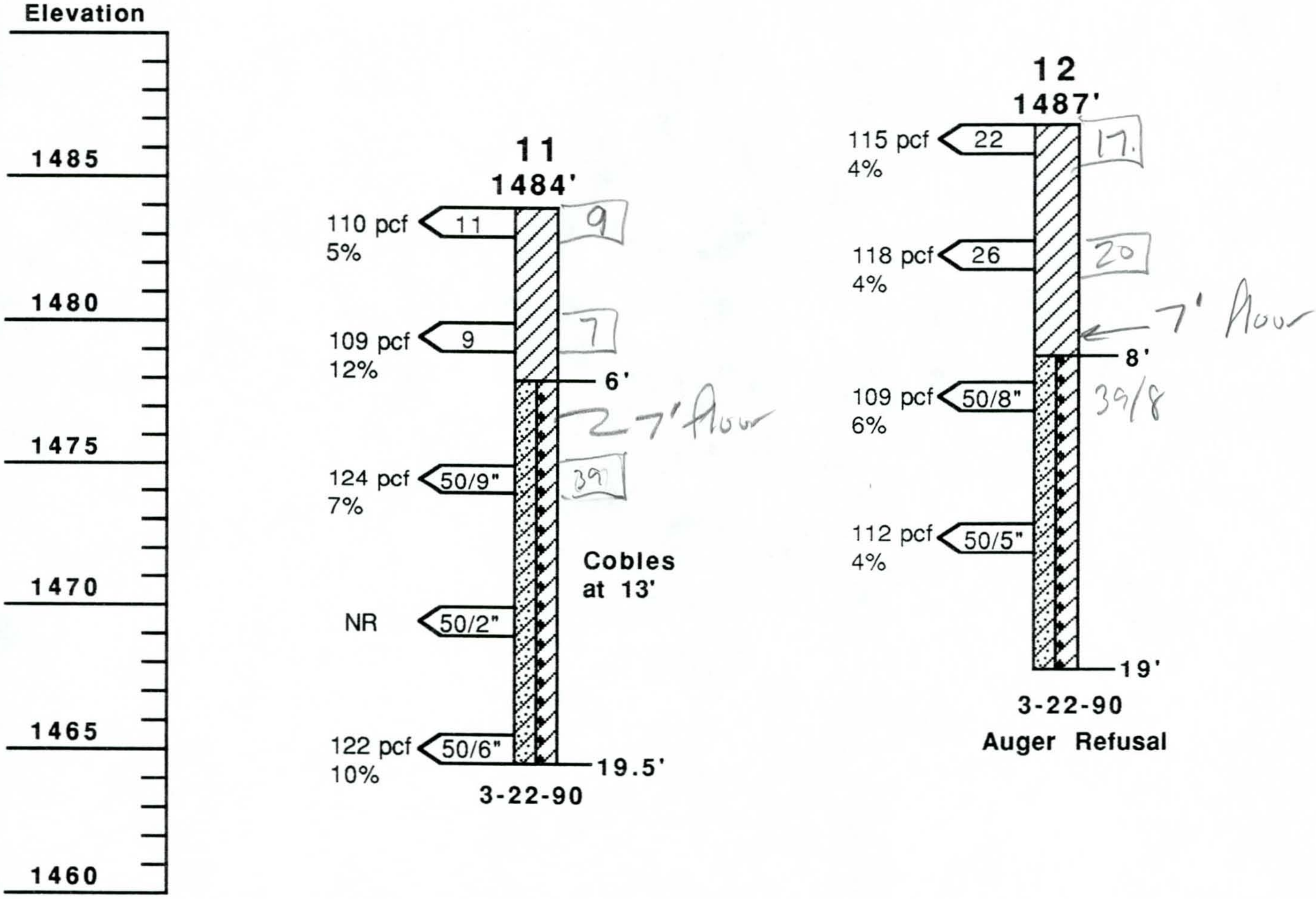
No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight 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.

Project No. 90-0149
Thomas-Hartig & Associates

GRAPHICAL BORING LOGS



NR=No Recovery

No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight 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.

Project No. 90-0149
Thomas-Hartig & Associates

REPORT ON GRADATION AND PLASTICITY INDEX

SAMPLE: Date: 10 April 1990

Source: As Noted Below

Type: Bulk

Material: Soil

Sampled By: TH/Thompson

TESTED: Sieve Analysis and Plasticity Index

Is this PL?

RESULTS

			Sieve Size -					Accumulative % Passing						*
Sample	LL	PL	200	100	50	30	16	8	4	3/4"	1"	2"	3"	Class.
11; 0 - 5' X	32	14	59	66	70	75	80	89	96	100				CL
12; 10' - 15' X	52	27	16	19	23	30	39	57	64	92	96	100		SC-GC

*Unified Soil Classification

Project No. 90-0149

Thomas-Hartig & Associates, Inc.