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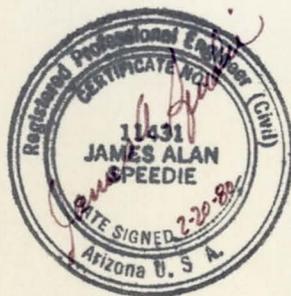
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REPORT ON SOIL EXPLORATION

PROJECT NO: 88902
DESIGNATION: MCFCD/RWCD Floodway Bridges
LOCATION: Baseline Road at RWCD Canal
and Elliot Road at RWCD Canal
Maricopa County, Arizona
CLIENT: Sverdrup & Parcel & Associates, Inc.
DATE: February 20, 1980



A121.914

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Maricopa County, Arizona

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FLOOD CONTROL DISTRICT
RECEIVED

FEB 26 '80



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CONSULTING SITE AND GEOTECHNICAL ENGINEERS
11029 NORTH 24TH AVENUE, SUITE 805 • PHOENIX, ARIZONA 85029 • (602) 944-9668

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INTRODUCTION

This report presents the results of a subsoil exploration made at the sites of two proposed bridges in Southeastern Maricopa County, Arizona. The bridges are to span a new floodway to be constructed by the Maricopa County Flood Control District (MCFCD) adjacent to an existing irrigation canal which is part of the Roosevelt Water Conservation District (RWCD). The bridges are to be located at the intersections of the RWCD Canal with Baseline Road and Elliot Road, as shown on the attached Vicinity Map which is appended hereto as Plate 1.

SCOPE OF WORK

The purpose of this study is to obtain and analyze such data as is necessary to define subsurface conditions at the proposed bridge sites and to evaluate this data with respect to the foundation and earthwork requirements of the proposed facilities. Design details for each bridge were provided by Sverdrup and Parcel, Inc. and are presented under Proposed Development. Use of spread footings as a foundation was not to be considered. The analysis carried out in connection with this project provides design data and criteria for recommendations regarding:

1. Design load capacities for various diameter straight-shaft drilled caissons.
2. Design load capacities for various sections of driven steel piles.
3. Allowable lateral loads for each element considered.
4. Earthwork control data, and properties of soil materials (to be used in approach fills) for pavement design.

PROPOSED DEVELOPMENT

It is proposed to construct a floodway channel adjacent on the east to the existing RWCD irrigation canal. The channel section will be trapezoidal with a 150-foot base and 2 (horizontal) to 1 (vertical) side slopes. The channel will be excavated in the immediate vicinity of the road crossing to permit installation of foundation elements at channel bottom grade. Material from the excavation will be used to build the bridge approach fills.

At both sites existing roadways are 2-lane (24-foot wide) asphalt sections with graded shoulders and roadside drainage. Bridges over canals are 2-lane width and are to remain. The new bridges will be provided with an approach on the east end approximately 200 feet in length; the west ends will be connected with the existing bridges.

The proposed bridges are identical in concept, and differ only in length. The Elliot Road Bridge is to be a 6-span structure approximately 200 feet in length. As a result of a 30 degree skew at the Baseline Road site, that bridge is to be a 7-span structure approximately 230 feet in length. Both are to be 76 feet wide. Abutment design loads are 370 kips dead load plus 260 kips live load; intermediate piers will support 1100 kips dead load, plus 480 kips live load. Design lateral loads will be on the order of 90 kips per pier. Design grades for proposed channel floor are Elevation 1327.3 at Baseline Road and Elevation 1320.8 at Elliot Road.

FIELD AND LABORATORY STUDIES

Field Investigation - During the period from January 22, 1980 through January 25, 1980, eleven soil test borings were drilled at the two bridge sites, BR-1 through BR-6 at Baseline Road and ER-1 through ER-5 at Elliot Road. Specific locations were as selected by Sverdrup and Parcel, Inc. and are shown on the Test Boring Location Plan, Plate 2. These borings were drilled and sampled by Arizona Custom Drilling under the full-time supervision of our field engineer. The drilling was carried out with a CME-55 rotary drill rig utilizing 6-inch hollow stem augers to advance the holes.

Drilling depths ranged from 31.0 feet to 46.5 feet at the Baseline Road Bridge and 36.0 feet to 46.5 feet at the Elliot Road Bridge. A continuous record of subsoils encountered, sampling procedures and groundwater conditions was kept by our engineer. This data is presented on an individual Log of Test Boring for each hole which are appended hereto as Figures 1 through 11.

Sampling was carried out in each boring as follows: BR-1, 3, 5 and 6 on Baseline Road and ER-1, 3 and 5 on Elliot Road were sampled at 5 foot intervals beginning at a depth of 15.0 feet to obtain specimens of foundation support materials; BR-2 and 4, and ER-2 and 4 were sampled at 10 foot intervals beginning at 20.0 feet and 25.0 feet deep, respectively. Additional samples were obtained of the various upper materials as encountered to provide specimens of proposed embankment material. Three types of samples were taken:

Log Designation

Sample Type

LS-

Standard Penetration Test (ASTM D-1586). 2-inch O.D. split tube sampler equipped with two 3-inch long, 1.375-inch I.D. brass liners.

SL-

Ring Sampler. 3-inch O.D. split tube sampler equipped with a series of 1-inch long, 2.42-inch I.D. brass rings.

Log DesignationSample Type

AS-

Bag samples of various sizes taken directly from the auger cuttings.

All samples were sealed and transported to our laboratory for further examination and testing. All holes were dry upon completion, and were backfilled with excavated material.

Laboratory Testing - Laboratory testing consisted of grain size and Atterberg Limit determinations for classification purposes, and unconfined compression tests for strength evaluation. This data, together with natural moisture content and in-place dry density values are presented on Tabulation of Test Data Sheets, Figure 12 (Baseline Road) and Figure 13 (Elliot Road).

Moisture-Density Relations (ASTM D-698) were also determined for near surface materials which would be used for approach fills. This data is presented on Figure 14 (Baseline Road) and Figure 15 (Elliot Road).

ANALYSES AND RECOMMENDATIONS

Subsoil Conditions - Baseline Road - Two general strata were identified. Below minor surface fills and rip-rap materials, a stratum of brown fine sandy silt was encountered. This material contains a substantial degree of fines, on the order of 60 percent passing a No. 200 Sieve. These fines, however, are of low plasticity, with a Plasticity Index of 3. This stratum extends to a depth of approximately 10 feet, although higher clay contents were noted in some borings below 5 feet.

This stratum is underlain by a massive deposit of hard mottled brown silty clay which contains a moderate amount of sand, gravel and cemented nodules. This material is more plastic than the upper material, and has very high shear strength properties, with cohesion values generally ranging from 6,000 to 10,000 psf. Based upon blow count data and drilling difficulty, a strength increase was noted at a depth of approximately 27 feet (Elevation 1308). Accordingly, this is considered a preferred depth for support of caisson foundations.

Subsoil Conditions - Elliot Road - Subsurface conditions at this site are quite variable. Materials within the upper 5 feet are predominately granular, but vary sufficiently to be considered partially fills. These materials are generally non-plastic, with only 20 percent passing the No. 200 Sieve.

Immediately underlying the surface sands and silts, a stratum of stiff to hard mottled brown silty clay is encountered. This material is of high plasticity, with plasticity index values ranging from 25 to 35. It has very high shear strength

properties, with cohesion values generally ranging from 5,000 to 10,000 psf. This stratum, however, is not uniform. In Test Boring ER-2 for example, a deposit of sand and gravel was noted from depths of 11 feet to 36 feet. Granular materials were also found in other borings, although generally at greater depths, 25 to 30 feet.

While no pattern of stratification can be established, an overall condition of stability is evident on the basis of laboratory testing, high penetration resistance and difficult drilling. Thus, while proper support for foundation elements appears certain, the non-uniformity of subsurface conditions must be considered in design and installation of the Elliot Road Bridge foundation.

Ground Water - All borings at both sites were completely dry upon completion of drilling. Accordingly, groundwater will not be a factor in design or construction of either bridge.

Foundation Analysis - Field and laboratory data has been evaluated for each bridge site on an individual basis. In each case, the top of the permanent support material for deep foundations was established at least 5 feet below proposed channel floor. This would represent top of caisson (or pile cap): Elevation 1322 for Baseline Road and Elevation 1315 for Elliot Road. A 2-foot thick pile cap was assumed for pile-embedment analyses.

Design charts and tables for each bridge site have been prepared for a variety of caisson diameters and driven H-pile sections. "Allowable (Design) Caisson Capacities" are presented as Figure 16. Considering the increase in strength noted at a depth of 27 feet for the Baseline Road site, the allowable vertical and lateral loads have been computed assuming bearing at this depth (Elevation 1308). For the Elliot Road site variable conditions precluded such a bearing depth recommendation, and Figure 17 was prepared on the basis of generalized subsoil properties; a minimum embedment depth of 10 feet (Elevation 1305) is recommended. Note that the allowable loads presented on Figures 16 and 17 are based on dead load plus design live load, with a full factor of safety of 3.0. A one-third increase may be employed for wind or seismic forces. Pier settlements should not exceed one-half inch. Lateral loads have been computed according to the Broms Method ("Lateral Resistance of Piles in Cohesive Soils", Journal of the Soil Mechanics and Foundation Division, ASCE, March, 1964), utilizing a maximum lateral deflection of 0.25 inch at top of caisson, assuming moment restraint.

Due to the presence of variable granular deposits at the Elliot Road site, installation of drilled piers may be impeded by some sloughing and caving of the

drill holes. Thus, a contingency for casing should be included if caissons are to be used. Slurry-assisted drilling is not recommended, since shaft friction (which has been included in capacity computations) would be reduced.

The presence of granular materials at Elliot Road should also be considered with regard to scour. Erosion of granular materials present at channel floor level will cause unevenness and corresponding turbulent flow which is undesirable and could produce additional erosion to depths of 5 feet where design foundation support begins. Such erosion may be minimized by replacement of granular materials with compacted clay (at least 95 percent of maximum dry density as per ASTM D-698) to a depth of not less than 3 feet below the channel floor. The excavation should be examined by a qualified soil engineer to detect granular pockets within a distance of 200 feet both upstream and downstream of the bridge. It is also pointed as a general note that any earthen channels which carry flows with velocity in excess of 3 feet per second should be periodically examined to detect progressive erosion and provide protection.

Estimated pile capacities for various depths have been developed for 10, 12 and 14-inch steel H-Piles. These values are presented graphically on Figures 18 (Baseline Road) and 19 (Elliot Road). Piles should be driven with a hammer capable of developing a minimum rated energy of 15,000 foot-pounds, and should be driven until the design capacity is indicated by the Arizona Highway Department Dynamic Driving Formula. It is recommended that piles be driven to minimum depths corresponding to Elevation 1308 for Baseline Road and Elevation 1300 for Elliot Road. No reduction in capacity for group action will be required if piles are spaced on centers in excess of 3 times the width of the section. Settlement of piles driven in this manner should not exceed one-half inch. Allowable lateral loads for the various pile sizes are presented on Figure 20, "Allowable Lateral Loads - Driven Piles". These have been computed in the basis of a lateral displacement of the pile cap of 0.25 inches.

Pavement Design - Approach embankments are to be minor and will be constructed utilizing materials from channel excavations. At both bridge sites predominately granular materials are encountered within the upper 5 to 10 feet below existing ground surface. It is recommended that these upper materials be utilized for fills to provide proper pavement support and economical design. This will require attention in selectively excavating the surface materials of low plasticity.

While these upper materials are of very low plasticity, some mixing with more plastic materials will likely occur during excavation and placement. This should be avoided insofar as possible if the Moisture-Density Relations, Figure 14

and Figure 15 are to apply. Since some mixing is certain, however, the following parameters have been estimated to be representative of such a mixture:

	Percent Passing No. 200 Sieve	Plasticity Index
Baseline Road	65	8
Elliot Road	40	6

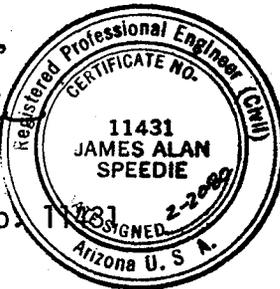
It is pointed out that plastic clays underlie surface granular materials at shallow depths (4 to 5 feet) at the Elliot Road site and special care will be necessary to prevent use of this material in roadway fill.

General - This exploration has been performed, and this report prepared, for the use of Sverdrup and Parcel, Inc., for specific application to foundation design for floodway canal bridges at Baseline Road and Elliot Road in Maricopa County, Arizona, in accordance with generally accepted soil and foundation engineering practices. In the event that changes in the nature, design or location of the proposed facilities are planned, the recommendations presented herein shall not be considered valid unless the changes are reviewed and the recommendations set forth herein revised or verified.

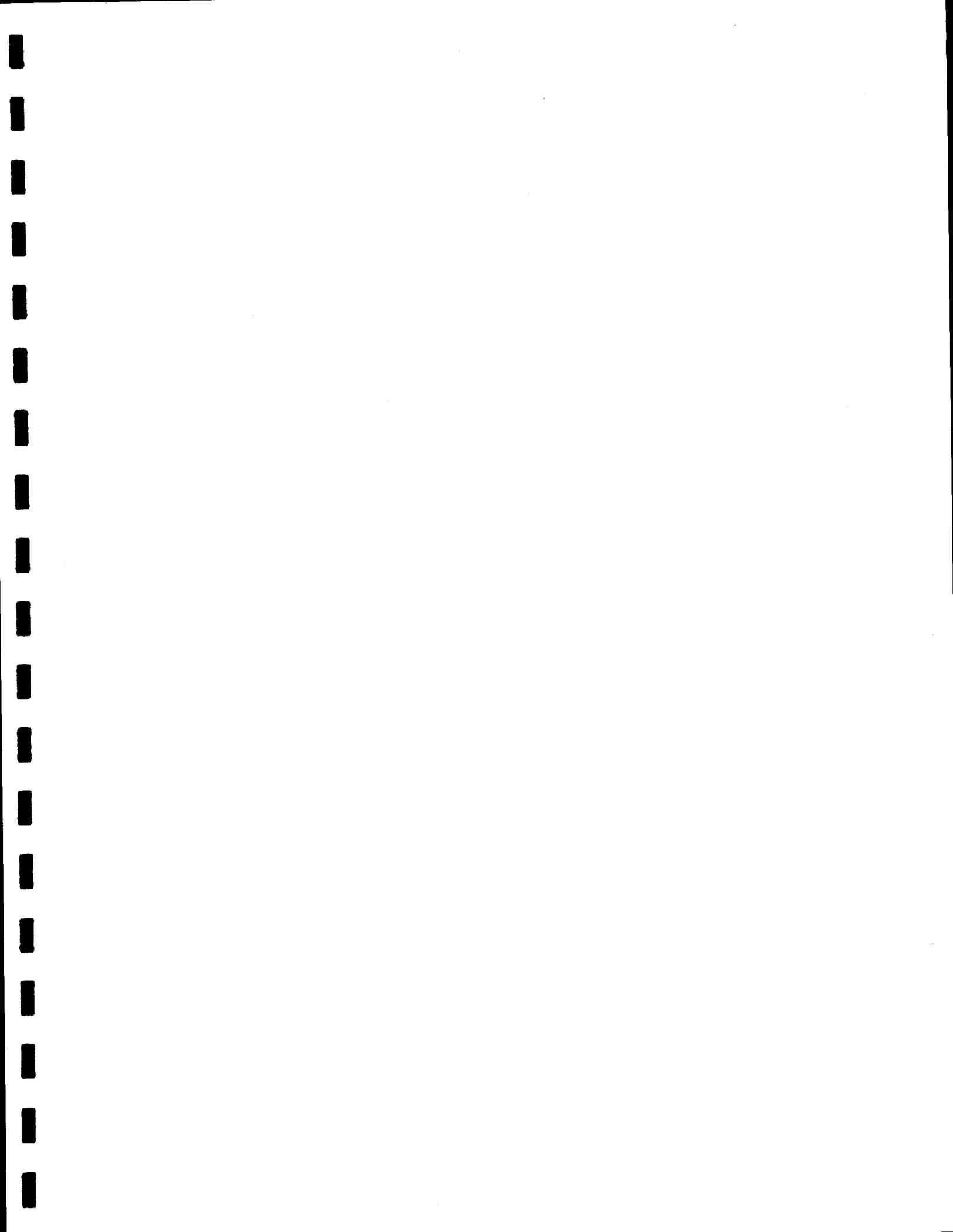
Respectfully submitted,

James A. Speedie

James A. Speedie, P.E.
Arizona Registration No. 11431



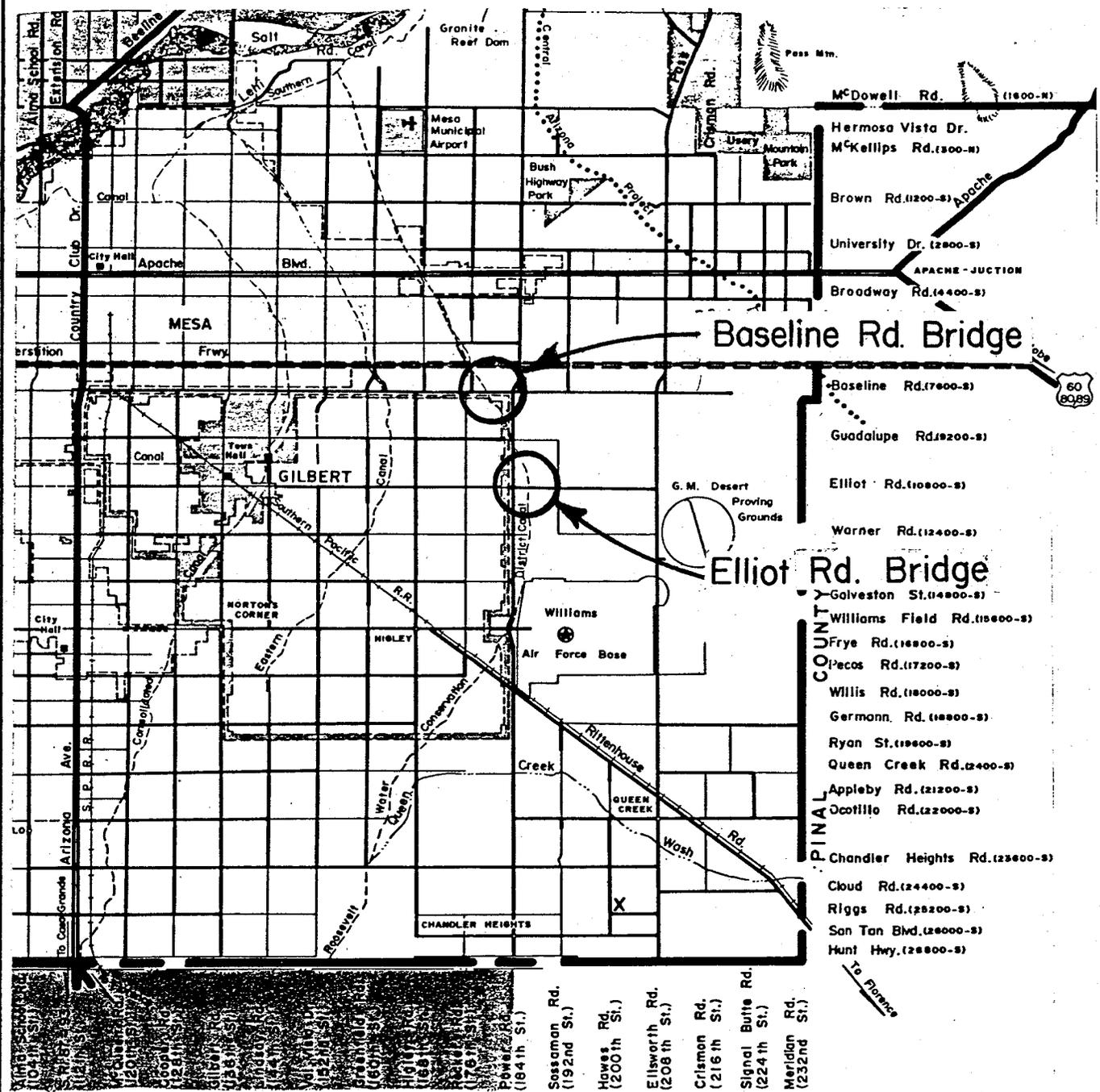
February 20, 1980



APPENDIX

VICINITY MAP	PLATE NO. 1
TEST BORING LOCATION PLAN	PLATE NO. 2
LOG OF TEST BORING NOS. BR-1 thru BR-6 (Baseline Road Bridge)	Figures 1 thru 6
LOG OF TEST BORING NOS. ER-1 thru ER-5 (Elliot Road Bridge)	Figures 7 thru 11
TABULATION OF TEST DATA (Sheet 1 of 1) (Baseline Road Bridge)	Figure 12
TABULATION OF TEST DATA (Sheet 1 of 1) (Elliot Road Bridge)	Figure 13
MOISTURE-DENSITY RELATIONS (Baseline Road Bridge)	Figure 14
MOISTURE-DENSITY RELATIONS (Elliot Road Bridge)	Figure 15
ALLOWABLE (DESIGN) CAISSON CAPACITIES	Figure 16
ALLOWABLE CAISSON CAPACITY (TONS) (Elliot Road Bridge)	Figure 17
ALLOWABLE PILE CAPACITY (TONS) (Baseline Road Bridge)	Figure 18
ALLOWABLE PILE CAPACITY (TONS) (Elliot Road Bridge)	Figure 19
ALLOWABLE LATERAL LOADS - DRIVEN PILES	Figure 20





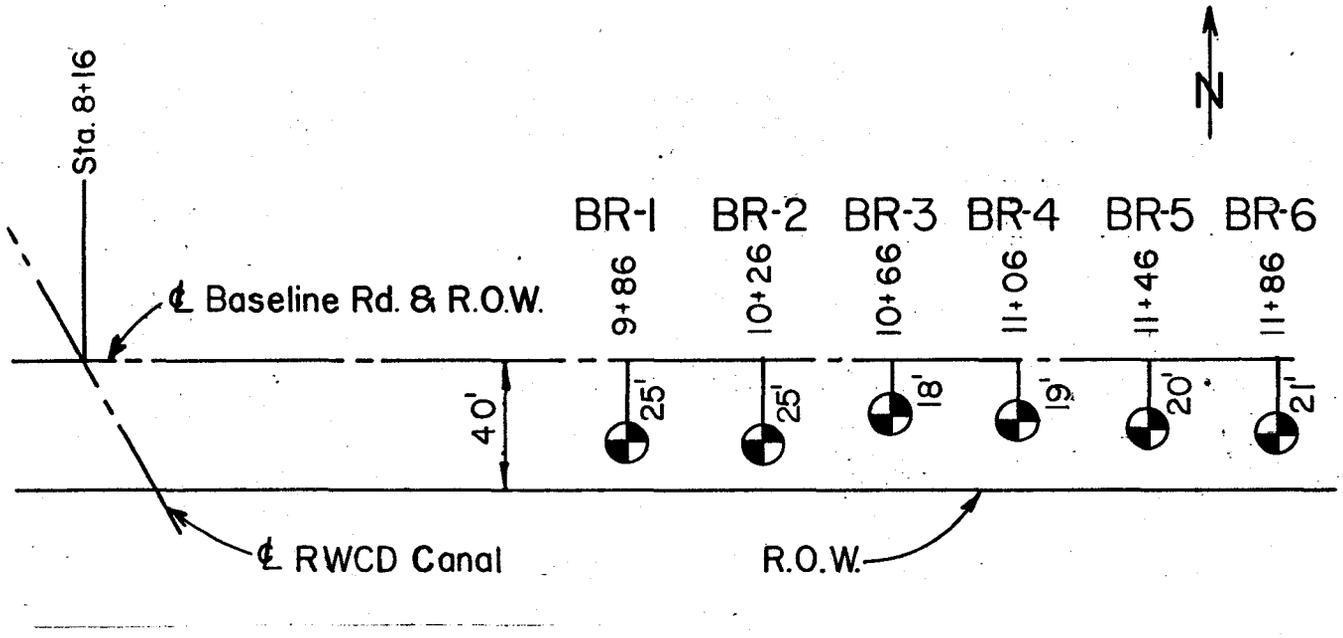
REV.
REV.
REV.
REV.

VICINITY MAP
PROPOSED MCFC D BRIDGES
RWCD FLOODWAY CHANNEL
MARICOPA COUNTY, ARIZONA

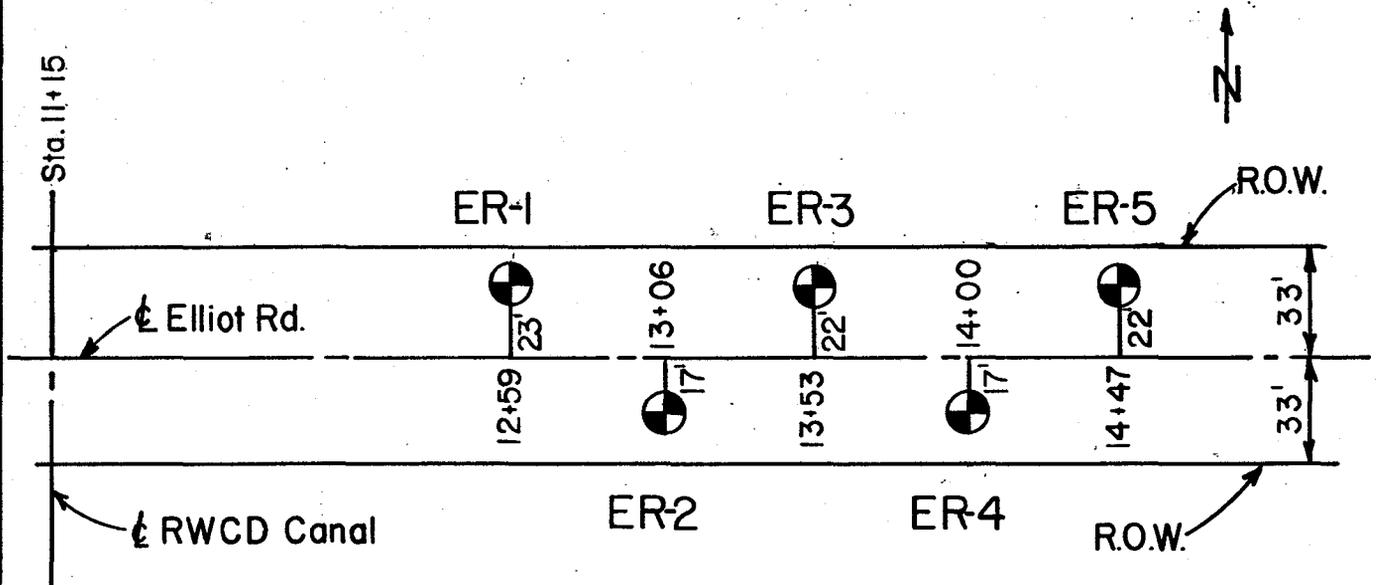
HALPERT ASSOCIATES, INC.
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS
 11029 N. 24th AVENUE SUITE 805 PHOENIX, ARIZONA 85029

PROJECT NO. 8890Z	DRAWN BY: PFC	DATE 2-4-80
SCALE NONE	CHECKED BY JAS	SHEET 7 OF 2

Baseline Rd.



Elliot Rd.




 Test Boring By Arizona
 Custom Drilling Under
 Supervision Of
 Halpert Associates
 (Jan.22-25,1980)

REV.	
REV.	
REV.	
REV.	

TEST BORING LOCATION PLAN PROPOSED MCFCD BRIDGES RWCD FLOODWAY CHANNEL MARICOPA COUNTY, ARIZONA		
HALPERT ASSOCIATES, INC. CONSULTING SITE AND GEOTECHNICAL ENGINEERS 11029 N. 24th AVENUE SUITE 805 PHOENIX, ARIZONA 85029		
PROJECT NO. 8890Z.	DRAWN BY J.P.C.	DATE 2-1-80
SCALE 1"=60'	CHECKED BY JAS	SHEET 2 OF 2

LOG OF SUBSURFACE PROFILE

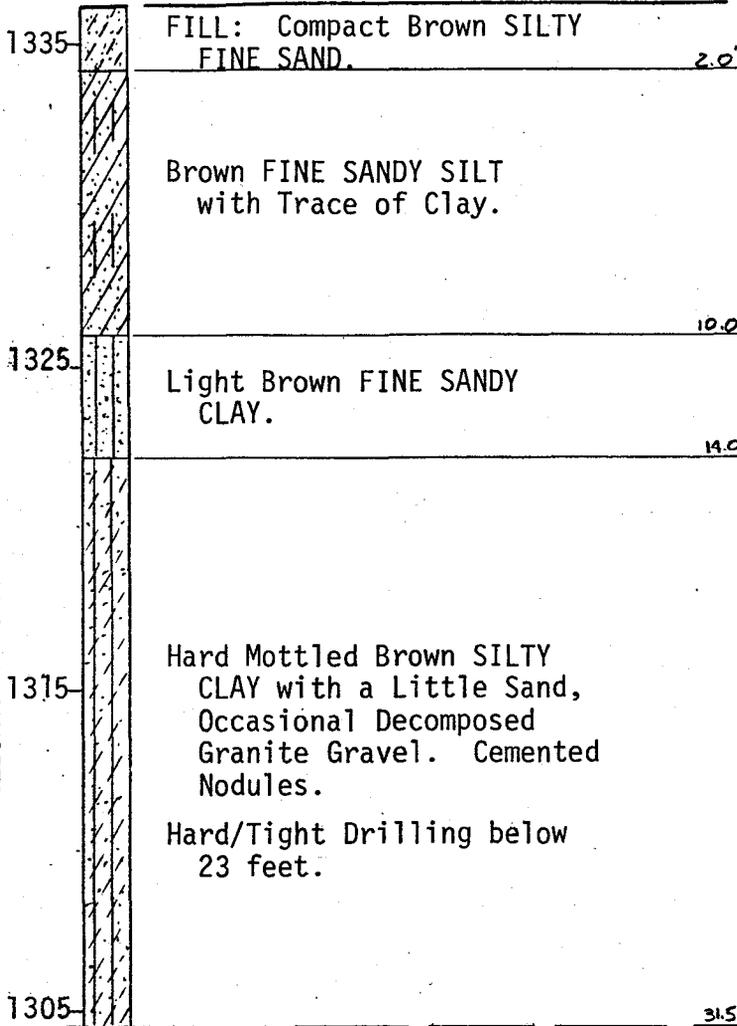
CLASSIFICATIONS BY:
HALPERT ASSOCIATES

GROUND SURFACE ELEVATION:

1336.1

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *		
				0	50	100
AS-1	1328.1	-	-			
LS-1	1319.6	-	-			
LS-2	1314.6	-	-			
LS-3	1309.6	-	-			
LS-4	1304.6	-	-			



TOTAL DEPTH: 31.5 feet
 BORING STARTED: January 24, 1980
 BORING COMPLETED: January 24, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling

WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.

* **PENETRATION RESISTANCE:**
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O. D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS

LOG OF TEST BORING NUMBER BR-1

PROPOSED MCFCD FLOODWAY BRIDGE
 BASELINE ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: JAS

DATE: 2/04/80

PROJECT No. 88902

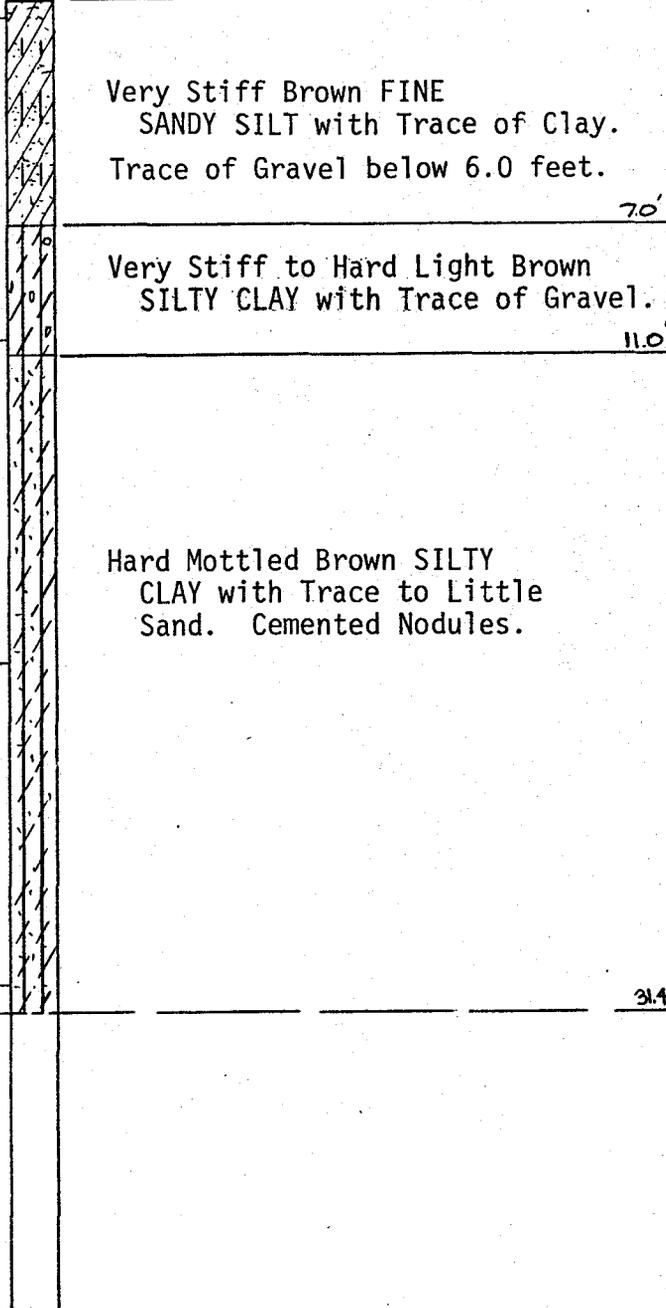
FIGURE No. 1

LOG OF SUBSURFACE PROFILE
CLASSIFICATIONS BY:
HALPERT ASSOCIATES
GROUND SURFACE ELEVATION:

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *		
				0	50	100

ELEVATION - FEET
 1335
 1325
 1315
 1305

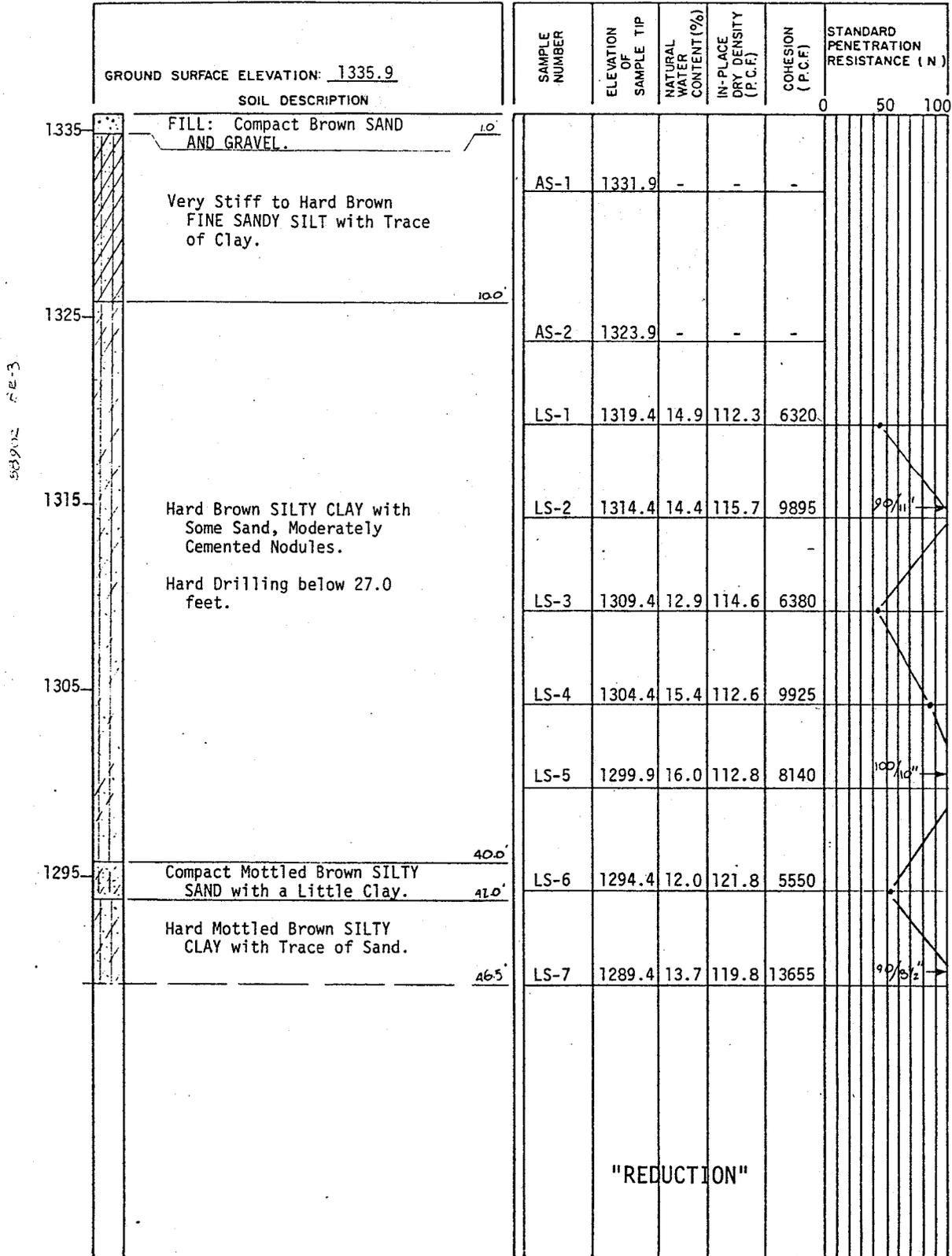


LS-1	1314.0	-	-							
LS-2	1304.1	-	-							90/10 1/2"

TOTAL DEPTH: 31.4 feet
BORING STARTED: January 24, 1980
BORING COMPLETED: January 24, 1980
INSPECTOR: Gregg Creaser
DRILLER: Joe Thompson, Jr.
CONTRACTOR: Arizona Custom Drilling
WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.
*** PENETRATION RESISTANCE:**
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS
LOG OF TEST BORING NUMBER BR-2
 PROPOSED MCFCD FLOODWAY BRIDGE
 BASELINE ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: <i>JAS</i>	DATE: 2/04/80
PROJECT No. 88902	FIGURE No. 2



GROUND SURFACE ELEVATION: 1335.9
SOIL DESCRIPTION

SAMPLE NUMBER	ELEVATION OF SAMPLE TIP	NATURAL WATER CONTENT (%)	IN-PLACE DRY DENSITY (P.C.F.)	COHESION (P.C.F.)	STANDARD PENETRATION RESISTANCE (N)		
					0	50	100
AS-1	1331.9	-	-	-			
AS-2	1323.9	-	-	-			
LS-1	1319.4	14.9	112.3	6320			
LS-2	1314.4	14.4	115.7	9895			99/11"
LS-3	1309.4	12.9	114.6	6380			
LS-4	1304.4	15.4	112.6	9925			
LS-5	1299.9	16.0	112.8	8140			100/14"
LS-6	1294.4	12.0	121.8	5550			
LS-7	1289.4	13.7	119.8	13655			99/12"

"REDUCTION"

BORING STARTED: January 22, 1980
 BORING COMPLETED: January 23, 1980
 FIELD ENGINEER/TECHNICIAN: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling
 WATER LEVEL OBSERVATION N/A
 FIRST ENCOUNTERED:
 AT COMPLETION:
 AFTER HOURS:
 WATER LEVEL IN HOLE AT INDICATED DRY
 NUMBER OF HOURS AFTER COMPLETION OF BORING

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. THE ACTUAL TRANSITION IN THE FIELD MAY BE GRADUAL.

 HALPERT ASSOCIATES CONSULTING SITE AND GEOTECHNICAL ENGINEERS	
LOG OF TEST BORING NUMBER BR-3	
PROPOSED MCFCD FLOODWAY BRIDGE BASELINE ROAD AT RWCD CHANNEL MARICOPA COUNTY, ARIZONA	
APPROVED: <i>JAS</i>	DATE: 2/04/80
PROJECT NO: 88902	FIGURE NO: 3

LOG OF SUBSURFACE PROFILE

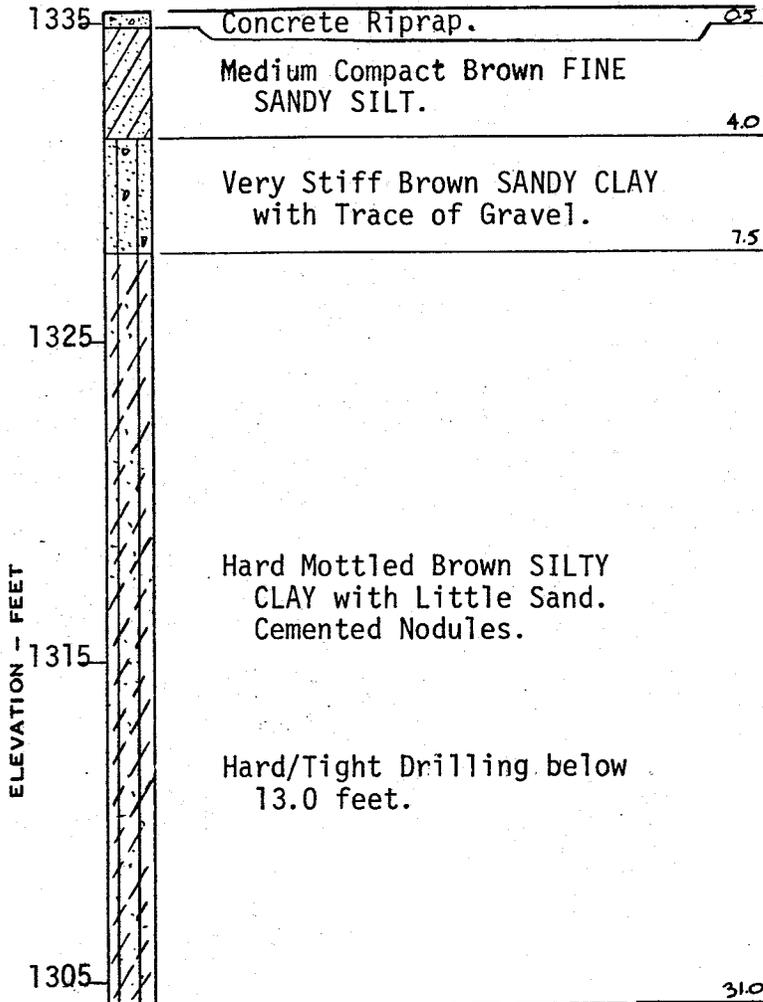
CLASSIFICATIONS BY:
HALPERT ASSOCIATES

GROUND SURFACE ELEVATION:

1335.4

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *					
				0	50	100			
SL-1	1314.4	-	-						115
SL-2	1304.4	-	-						

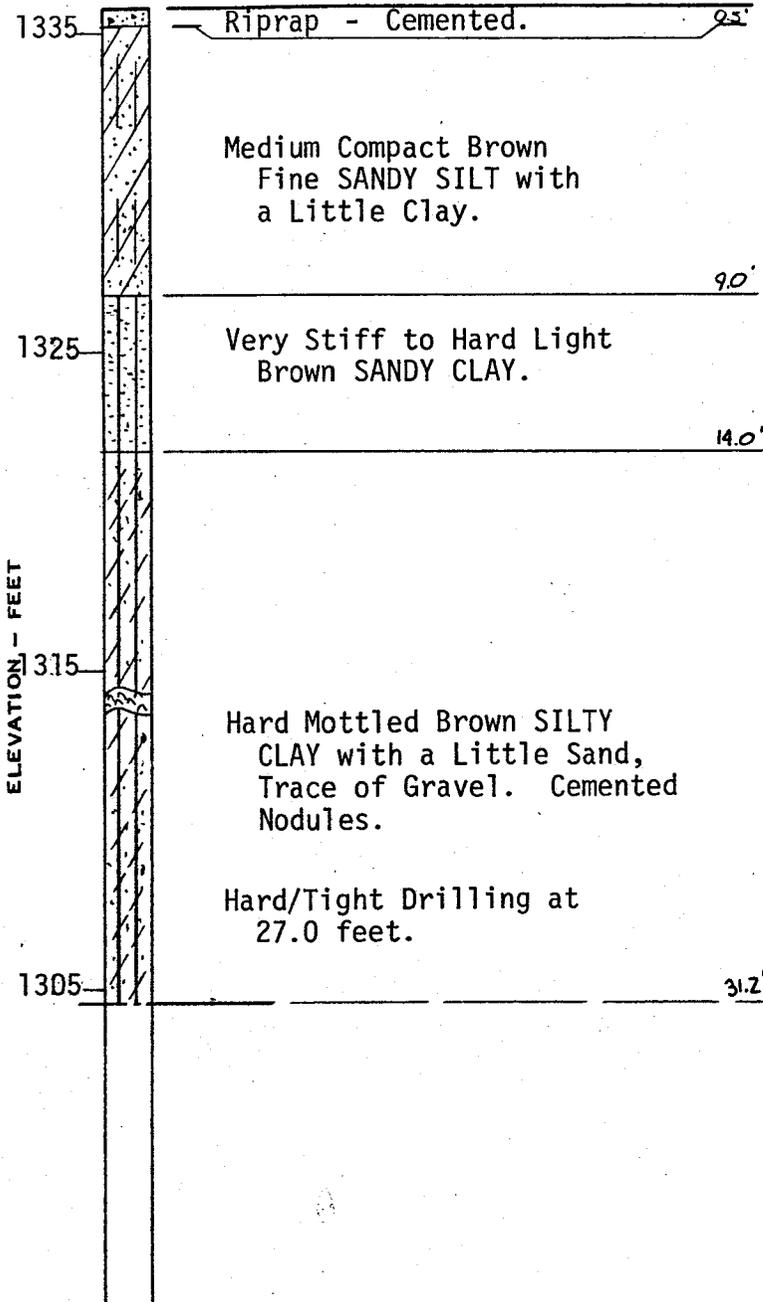


TOTAL DEPTH: 31.0 feet
 BORING STARTED: January 23, 1980
 BORING COMPLETED: January 23, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling
 WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.
 * PENETRATION RESISTANCE:
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES CONSULTING SITE AND GEOTECHNICAL ENGINEERS	
LOG OF TEST BORING NUMBER <u>BR-4</u>	
PROPOSED MCFCD FLOODWAY BRIDGE BASELINE ROAD AT RWCD CHANNEL MARICOPA COUNTY, ARIZONA	
APPROVED BY: <i>JAS</i>	DATE: 2/04/80
PROJECT No. 88902	FIGURE No. 4

LOG OF SUBSURFACE PROFILE
 CLASSIFICATIONS BY:
 HALPERT ASSOCIATES
 GROUND SURFACE ELEVATION:
 1335.8

SOIL SAMPLE DATA						
SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *		
				0	50	100
AS-1	1330.8	-	-			
AS-2	1325.8	-	-			
LS-1	1319.3	-	-			
LS-2	1314.3	-	-			
LS-3	1309.3	-	-			
LS-4	1304.6	-	-			



TOTAL DEPTH: 31.2 feet
 BORING STARTED: January 23, 1980
 BORING COMPLETED: January 23, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling
 WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.
 * PENETRATION RESISTANCE:
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS
LOG OF TEST BORING NUMBER BR-5

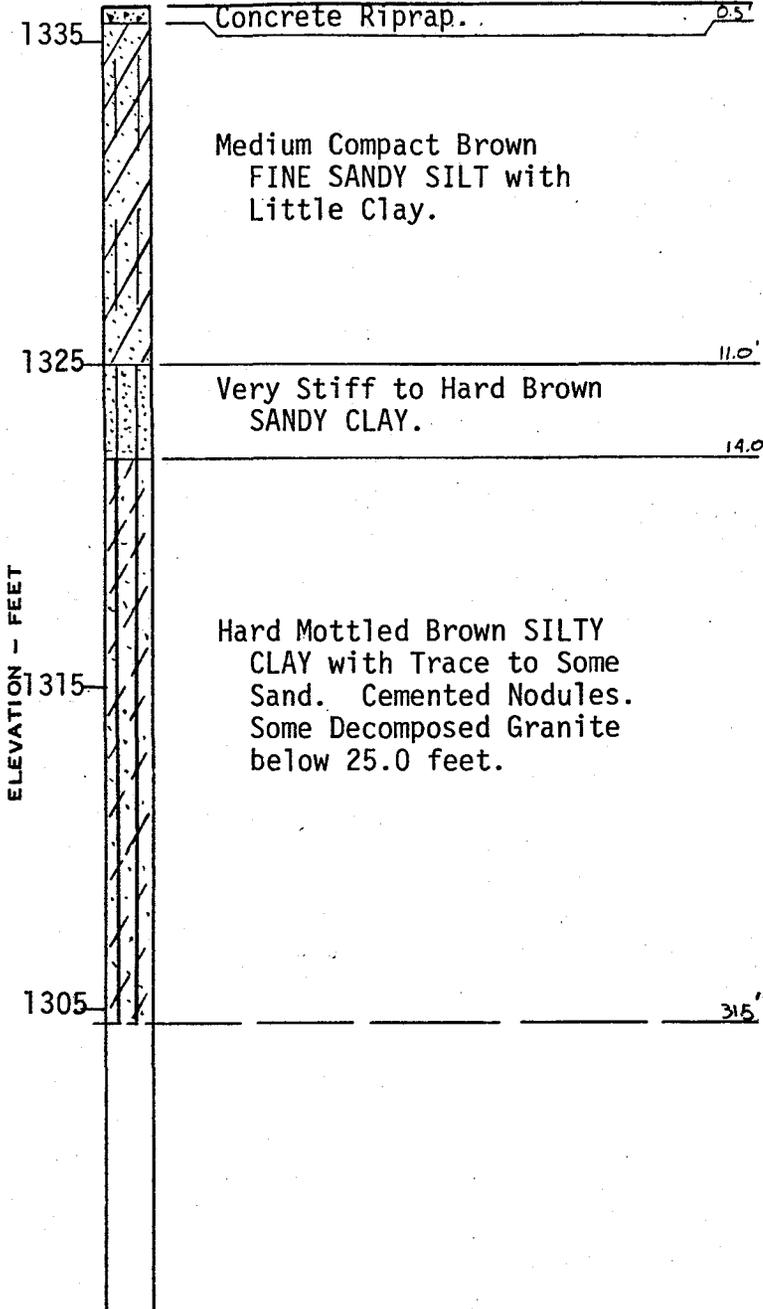
PROPOSED MCFCD FLOODWAY BRIDGE
 BASELINE ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: <i>JAS</i>	DATE: 2/04/80
PROJECT No. 88902	FIGURE No. 5

LOG OF SUBSURFACE PROFILE
CLASSIFICATIONS BY:
HALPERT ASSOCIATES
GROUND SURFACE ELEVATION:
 1336.1

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *		
				0	50	100
AS-1	1328.6	-	-			
LS-1	1319.6	14.1	116.0			
LS-2	1314.6	14.4	117.9			
LS-3	1310.1	10.7	121.0			
LS-4	1304.6	11.5	117.1			



TOTAL DEPTH: 31.5 feet
BORING STARTED: January 23, 1980
BORING COMPLETED: January 23, 1980
INSPECTOR: Gregg Creaser
DRILLER: Joe Thompson, Jr.
CONTRACTOR: Arizona Custom Drilling
WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.
*** PENETRATION RESISTANCE:**
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS
LOG OF TEST BORING NUMBER BR-6

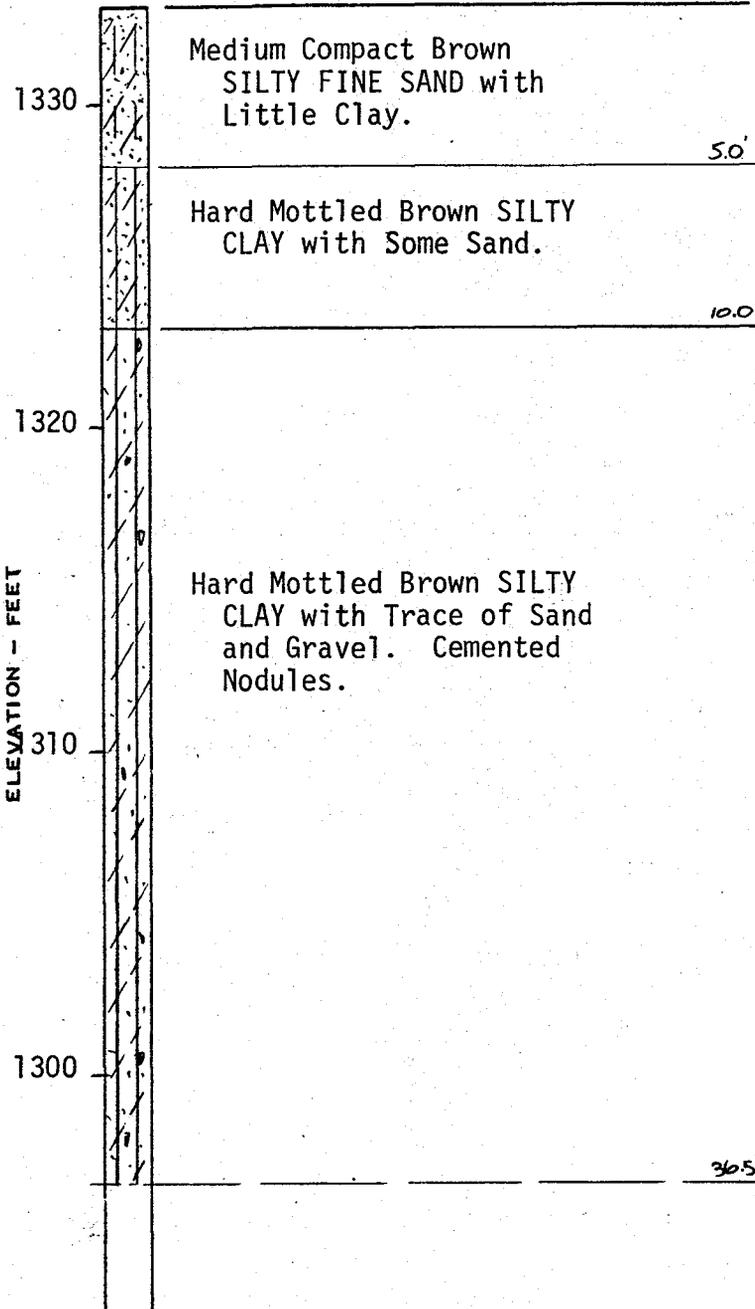
PROPOSED MCFCD FLOODWAY BRIDGE
 BASELINE ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: <i>JAS</i>	DATE: 2/04/80
PROJECT No. 88902	FIGURE No. 6

LOG OF SUBSURFACE PROFILE
CLASSIFICATIONS BY:
HALPERT ASSOCIATES
GROUND SURFACE ELEVATION:
 1333⁺

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *		
				0	50	100



AS-1	1329.5	-	-																
AS-2	1325.0	-	-																
LS-1	1316.5	-	-																
LS-2	1311.5	-	-																
LS-3	1306.5	-	-																
LS-4	1301.6	-	-																9 1/4" →
LS-5	1296.5	-	-																

TOTAL DEPTH: 36.5 feet
 BORING STARTED: January 25, 1980
 BORING COMPLETED: January 25, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling
 WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.
 * PENETRATION RESISTANCE:
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS

LOG OF TEST BORING NUMBER ER-1

PROPOSED MCFCD FLOODWAY BRIDGE
 ELLIOT ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: <i>JAS</i>	DATE: 2/11/80
PROJECT No. 88902	FIGURE No. 7

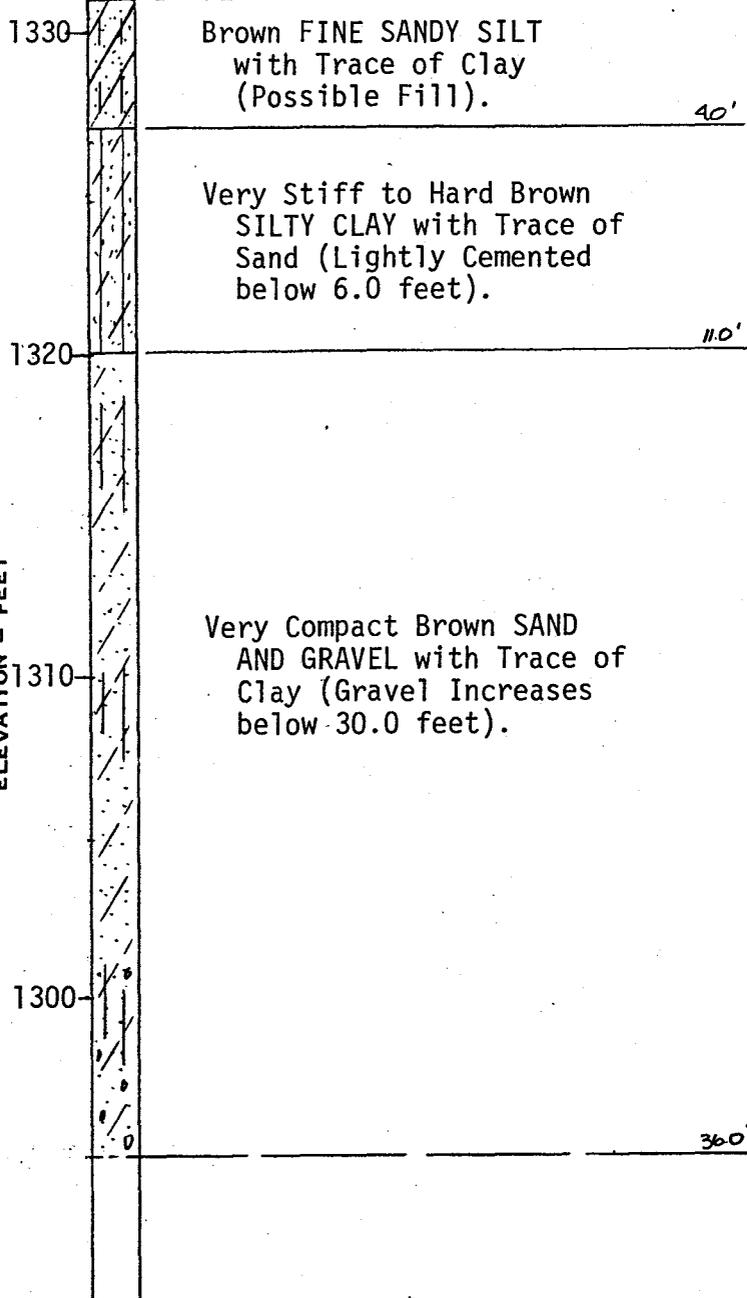
LOG OF SUBSURFACE PROFILE

CLASSIFICATIONS BY:
HALPERT ASSOCIATES

GROUND SURFACE ELEVATION:
1331[±]

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *	
				0	50
SL-1	1305.0	-	-		
SL-2	1295.0	-	-		



TOTAL DEPTH: 36.0 feet
 BORING STARTED: January 25, 1980
 BORING COMPLETED: January 25, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling

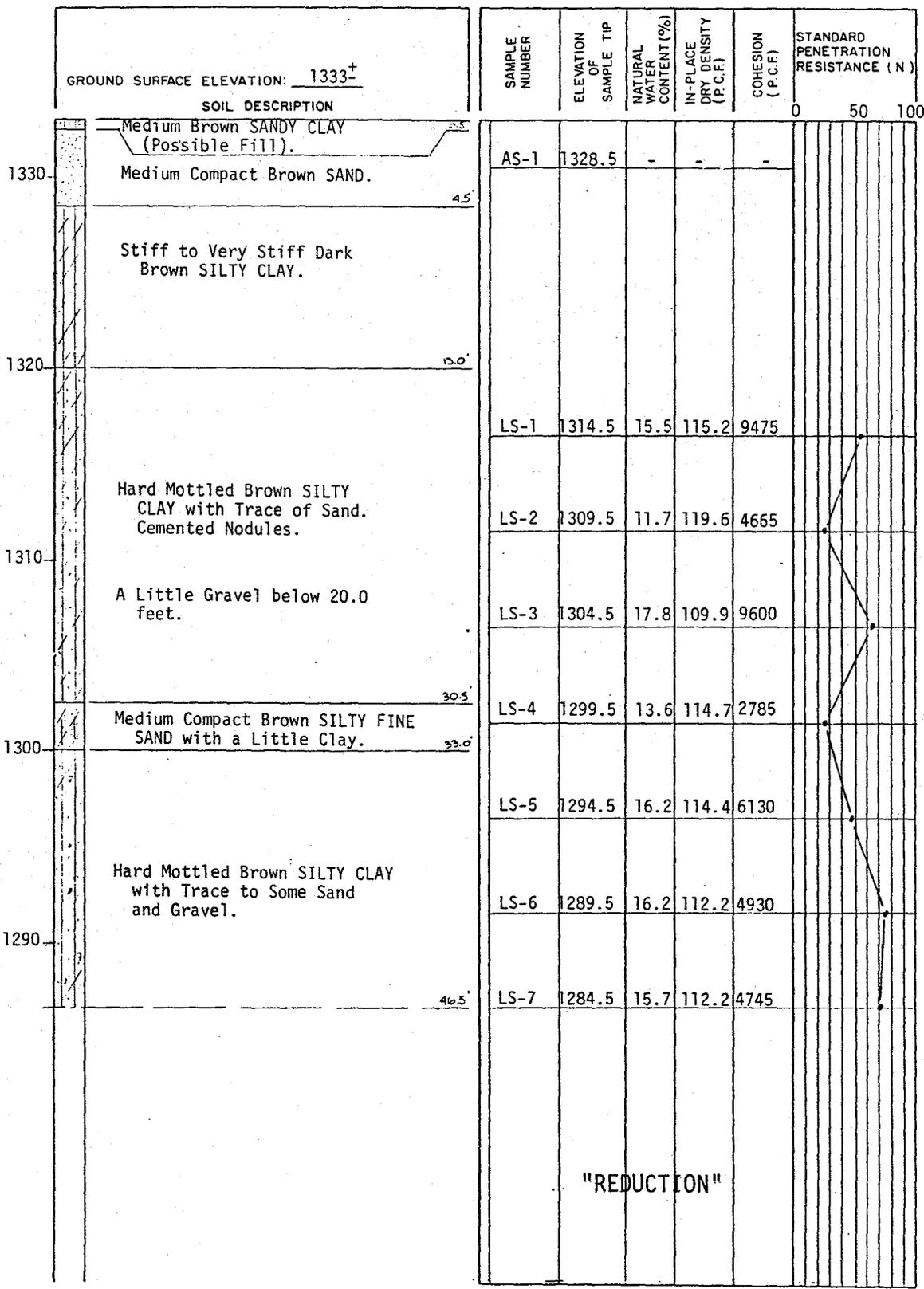
WATER LEVEL IN HOLE AT INDICATED DRY
 NUMBER OF HOURS AFTER COMPLETION OF BORING
 WITH 0 FEET OF CASING IN PLACE.

* PENETRATION RESISTANCE:
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH
 O. D. SOIL SAMPLER 12 INCHES, USING 140
 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS
 LOG OF TEST BORING NUMBER ER-2

PROPOSED MCFCD FLOODWAY BRIDGE
 ELLIOT ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: JAS DATE: 2/11/80
 PROJECT No. 88902 FIGURE No. 8



BORING STARTED: January 24, 1980
 BORING COMPLETED: January 24, 1980
 FIELD ENGINEER/TECHNICIAN: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling
 WATER LEVEL OBSERVATION N/A
 FIRST ENCOUNTERED:
 AT COMPLETION:
 AFTER HOURS:
 WATER LEVEL IN HOLE AT INDICATED
 NUMBER OF HOURS AFTER COMPLETION OF BORING

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. THE ACTUAL TRANSITION IN THE FIELD MAY BE GRADUAL.

HALPERT ASSOCIATES CONSULTING SITE AND GEOTECHNICAL ENGINEERS	
LOG OF TEST BORING NUMBER <u>ER-3</u>	
PROPOSED MCFCD FLOODWAY BRIDGE ELLIOT ROAD AT RWCD CHANNEL MARICOPA COUNTY, ARIZONA	
APPROVED: <i>JAS</i>	DATE: 2/11/80
PROJECT NO: 88902	FIGURE NO: 9

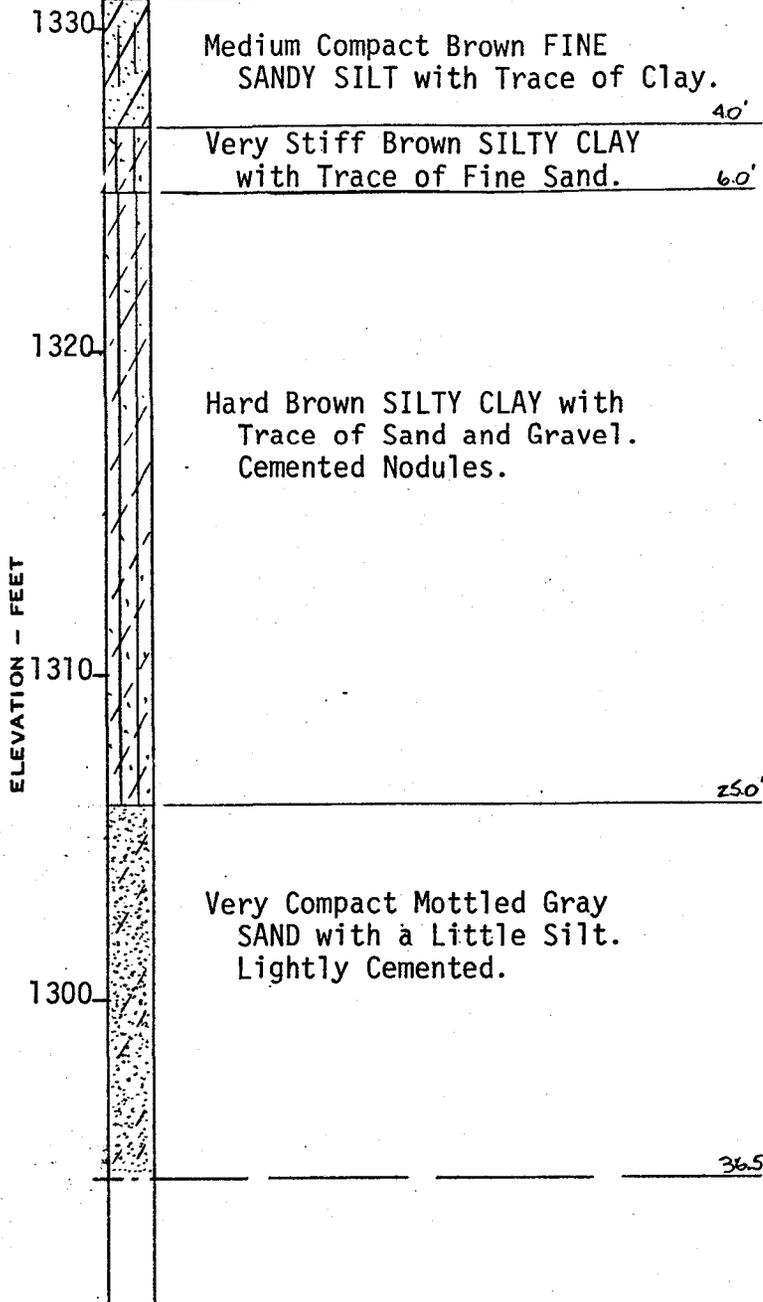
LOG OF SUBSURFACE PROFILE

CLASSIFICATIONS BY:
HALPERT ASSOCIATES

GROUND SURFACE ELEVATION:
1331⁺

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *	
				0	100
LS-1	1304.5	-	-		
AS-1	1301.0	-	-		
LS-2	1294.5	-	-		



TOTAL DEPTH: 36.5 feet
 BORING STARTED: January 25, 1980
 BORING COMPLETED: January 25, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling

WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.

* PENETRATION RESISTANCE:
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS

LOG OF TEST BORING NUMBER ER-4

PROPOSED MCFCD FLOODWAY BRIDGE
 ELLIOT ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: *JAS* DATE: 2/11/80
 PROJECT No. 88902 FIGURE No. 10

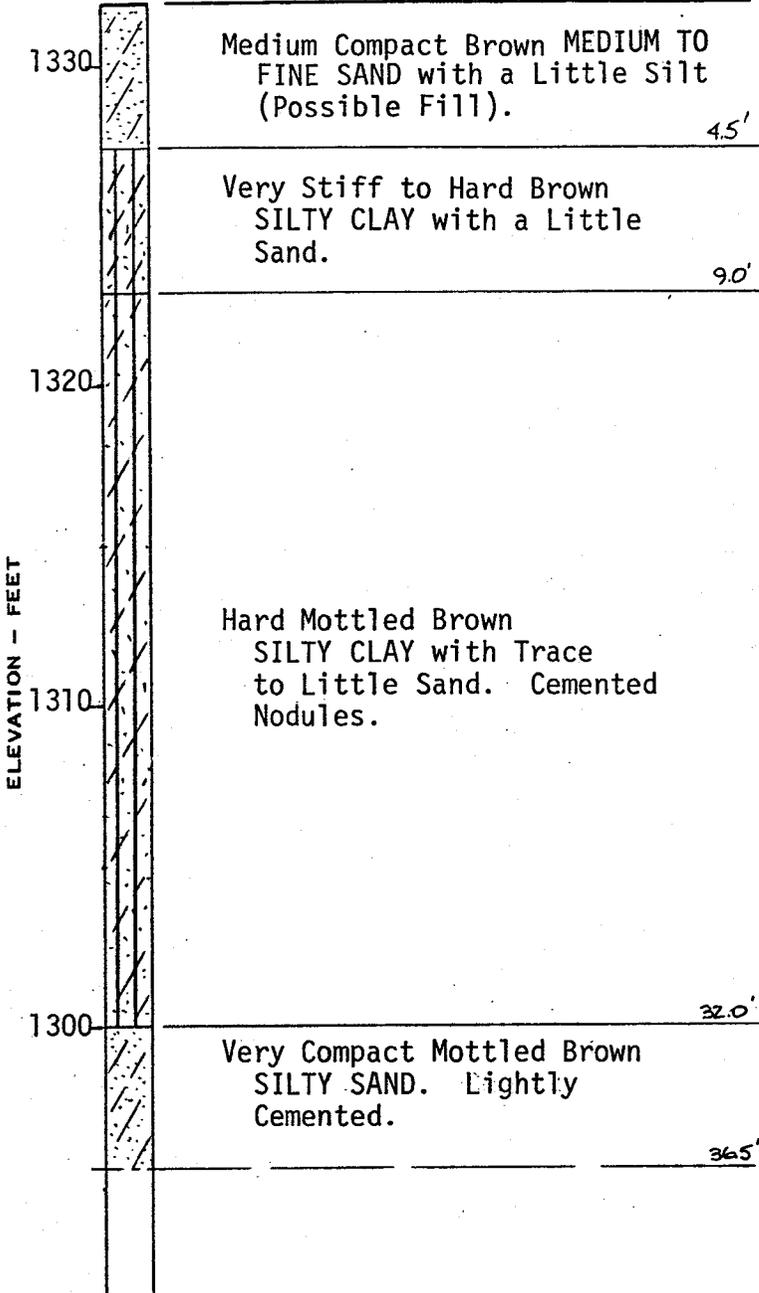
LOG OF SUBSURFACE PROFILE

CLASSIFICATIONS BY:
HALPERT ASSOCIATES

GROUND SURFACE ELEVATION:
1333⁺₋

SOIL SAMPLE DATA

SAMPLE NUMBER	ELEV. (FEET)	NATURAL MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	PENETRATION RESISTANCE *		
				0	50	100
AS-1	1329.0	-	-			
LS-1	1316.5	-	-			
LS-2	1311.5	-	-			
LS-3	1306.5	-	-			
LS-4	1301.5	-	-			
LS-5	1296.5	-	-			



TOTAL DEPTH: 36.5 feet
 BORING STARTED: January 25, 1980
 BORING COMPLETED: January 25, 1980
 INSPECTOR: Gregg Creaser
 DRILLER: Joe Thompson, Jr.
 CONTRACTOR: Arizona Custom Drilling

WATER LEVEL IN HOLE AT INDICATED DRY NUMBER OF HOURS AFTER COMPLETION OF BORING WITH 0 FEET OF CASING IN PLACE.

* **PENETRATION RESISTANCE:**
 NUMBER OF BLOWS REQUIRED TO DRIVE 2 INCH O.D. SOIL SAMPLER 12 INCHES, USING 140 POUND WEIGHT WITH 30 INCH FREE FALL.

HALPERT ASSOCIATES
 CONSULTING SITE AND GEOTECHNICAL ENGINEERS

LOG OF TEST BORING NUMBER ER-5

PROPOSED MCFCD FLOODWAY BRIDGE
 ELLIOT ROAD AT RWCD CHANNEL
 MARICOPA COUNTY, ARIZONA

APPROVED BY: <i>JAB</i>	DATE: 2/11/80
PROJECT No. 88902	FIGURE No. 11

TABULATION OF TEST DATA

TEST BORING OR TEST PIT NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE TIP	ELEVATION OF SAMPLE TIP	COHESION - ONE-HALF OF UNCONFINED COMPRESSIVE STRENGTH (PSF)		NATURAL WATER CONTENT (PERCENT OF DRY WEIGHT)	IN-PLACE DRY DENSITY (POUNDS PER CUBIC FOOT)	VOLUMETRIC ANALYSIS			PARTICLE SIZE DISTRIBUTION						ATTERBERG LIMITS			APPARENT SPECIFIC GRAVITY			
								SOLIDS (PERCENT)	LIQUIDS (PERCENT)	AIR (PERCENT)	COLLOIDS (PERCENT)	CLAY (PERCENT)	SILT (PERCENT)	FINE SAND (PERCENT)	MEDIUM SAND (PERCENT)	COARSE SAND (PERCENT)	GRAVEL (PERCENT)	LIQUID LIMIT (PERCENT)	PLASTIC LIMIT (PERCENT)		PLASTICITY INDEX (PERCENT)		
BR-1	LS-4	31.5	1319.6	-		-	-					-	-	-	-	-	48	24	24				
BR-3	AS-1	4.0	1331.9	-		-	-					←	63	→	16	14	05	02	22	19	3		
BR-3	LS-1	16.5	1319.4	6320		14.9	112.3					-	-	-	-	-	-	-	-	-	-	-	
BR-3	LS-2	21.5	1314.4	9895		14.4	115.7					←	68	→	18	09	03	02	40	19	21		
BR-3	LS-3	26.5	1309.4	6380		12.9	114.6					-	-	-	-	-	-	-	-	-	-	-	
BR-3	LS-4	31.5	1304.4	9925		15.4	112.6					←	67	→	18	10	04	01	39	20	19		
BR-3	LS-5	36.0	1299.9	8140		16.0	112.8					-	-	-	-	-	-	-	-	-	-	-	
BR-3	LS-6	41.5	1294.4	5550		12.0	121.8					-	-	-	-	-	-	-	-	-	-	-	
BR-3	LS-7	46.5	1289.4	13655		13.7	119.8					-	-	-	-	-	-	-	-	-	-	-	
BR-6	LS-1	16.5	1319.6	6200		14.1	116.0					-	-	-	-	-	-	-	-	-	-	-	
BR-6	LS-2	21.5	1314.6	6870		14.4	117.9					-	-	-	-	-	-	-	-	-	-	-	
BR-6	LS-3	26.0	1310.1	3965		10.7	121.0					←	54	→	23	15	06	02	43	19	24		
BR-6	LS-4	31.5	1304.6	-		11.5	117.1					-	-	-	-	-	-	-	-	-	-	-	

TABULATION OF TEST DATA

TEST BORING OR TEST PIT NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE TIP	ELEVATION OF SAMPLE TIP	COHESION - ONE-HALF OF UNCONFINED COMPRESSIVE STRENGTH (PSF)		NATURAL WATER CONTENT (PERCENT OF DRY WEIGHT)	IN-PLACE DRY DENSITY (POUNDS PER CUBIC FOOT)	VOLUMETRIC ANALYSIS			PARTICLE SIZE DISTRIBUTION						ATTERBERG LIMITS			APPARENT SPECIFIC GRAVITY	
								SOLIDS (PERCENT)	LIQUIDS (PERCENT)	AIR (PERCENT)	COLLOIDS (PERCENT)	CLAY (PERCENT)	SILT (PERCENT)	FINE SAND (PERCENT)	MEDIUM SAND (PERCENT)	COARSE SAND (PERCENT)	GRAVEL (PERCENT)	LIQUID LIMIT (PERCENT)	PLASTIC LIMIT (PERCENT)		PLASTICITY INDEX (PERCENT)
ER-1	AS-2	8.0	1325.0	-		-	-				↑	64	→	27	07	02	00	54	19	35	
ER-2	SL-1	26.0	1305.0	-		-	-				↑	06	→	16	22	16	40	-	-	-	
ER-3	LS-1	16.5	1314.5	9475		15.5	115.2				-	-	-	-	-	-	-	-	-	-	
ER-3	LS-2	21.5	1309.5	4665		11.7	119.6				-	-	-	-	-	-	-	-	-	-	
ER-3	LS-3	26.5	1304.5	9600		17.8	109.9				↑	71	→	15	09	02	03	56	24	32	
ER-3	LS-4	31.5	1299.5	2785		13.6	114.7				-	-	-	-	-	-	-	-	-	-	
ER-3	LS-5	36.5	1294.5	6130		16.2	114.4				-	-	-	-	-	-	-	-	-	-	
ER-3	LS-6	41.5	1289.5	4930		16.2	112.2				-	-	-	-	-	-	-	-	-	-	
ER-3	LS-7	46.5	1284.5	4745		15.7	112.2				-	-	-	-	-	-	-	-	-	-	
ER-5	AS-1	4.0	1329.0	-		-	-				↑	20	→	30	40	10	00	-	-	NP	
ER-5	LS-3	26.5	1306.5	-		-	-				↑	71	→	19	07	02	01	44	20	24	
ER-5	LS-5	36.5	1296.5	-		-	-				↑	35	→	27	36	02	00	-	-	-	

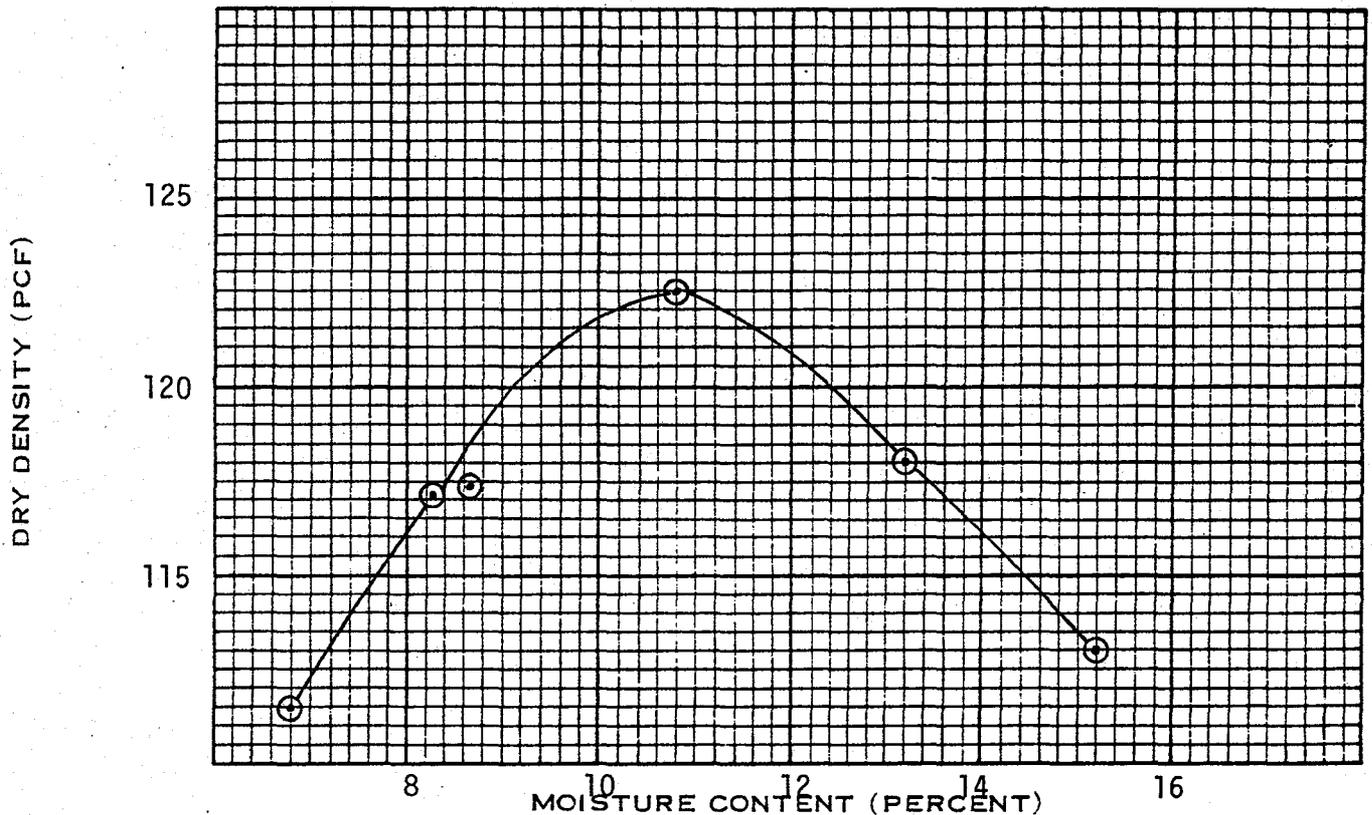
HALPERT ASSOCIATES

CONSULTING SITE AND GEOTECHNICAL ENGINEERS

MOISTURE - DENSITY RELATIONS

LAB. SA. No. 14270 PROJECT No. 88902 FOR Baseline Bridge
 PROJECT LOCATION Mesa, Arizona
 BORING No. BR-3 FIELD SA. No. AS-1 SA. DEPTH 4.0 SA. ELEV. (TIP) -
 SAMPLE DESCRIPTION Brown SANDY SILT with Little Clay, Trace Gravel
 METHOD OF COMPACTION ASTM 698 Method A
 MOLD: No. 6, DIA. 4.00 IN., HT. 4.58 IN., VOLUME 1/30 CU. FT., WT. 9.48 LBS.
 TESTED BY: M. Palermo 1/30/80 CHECKED BY: B. Creaser DATE: 1/31/80

DETERMINATION NUMBER	1	2	3	4	5	6
WT. OF WET SOIL + MOLD, LBS.	13.45	13.71	13.73	14.00	13.93	13.82
WT. OF MOLD, LBS.	9.48	9.48	9.48	9.48	9.48	9.48
WT. OF WET SOIL, LBS.	3.97	4.23	4.25	4.52	4.45	4.34
WET DENSITY, PCF	119.1	126.9	127.5	135.6	133.5	130.2
TARE NUMBER	P-51	P-30	L-11	P-7	P-19	P-24
WT. OF WET SOIL + TARE, GR.	486.4	469.6	469.0	569.0	510.0	583.3
WT. OF DRY SOIL + TARE, GR.	459.3	438.4	436.8	519.6	457.9	514.6
WT. OF MOISTURE, GR.	27.1	31.2	32.2	49.4	52.1	68.7
WT. OF TARE, GR.	62.3	64.6	65.1	63.0	64.0	63.0
WT. OF DRY SOIL, GR.	397.0	374.4	371.7	456.6	393.9	451.6
MOISTURE CONTENT, %	6.8	8.3	8.7	10.8	13.2	15.2
DRY DENSITY, PCF	111.5	117.1	117.3	122.4	117.9	113.0



MAXIMUM DRY DENSITY 122.4 PCF OPTIMUM MOISTURE CONTENT 10.8 %
 LIQUID LIMIT 22 % PLASTIC LIMIT 19 % SPECIFIC GRAVITY -
 PERCENT PASSING: 3/4" 100, No. 4 98, No. 10 93, No. 40 79, No. 200 63

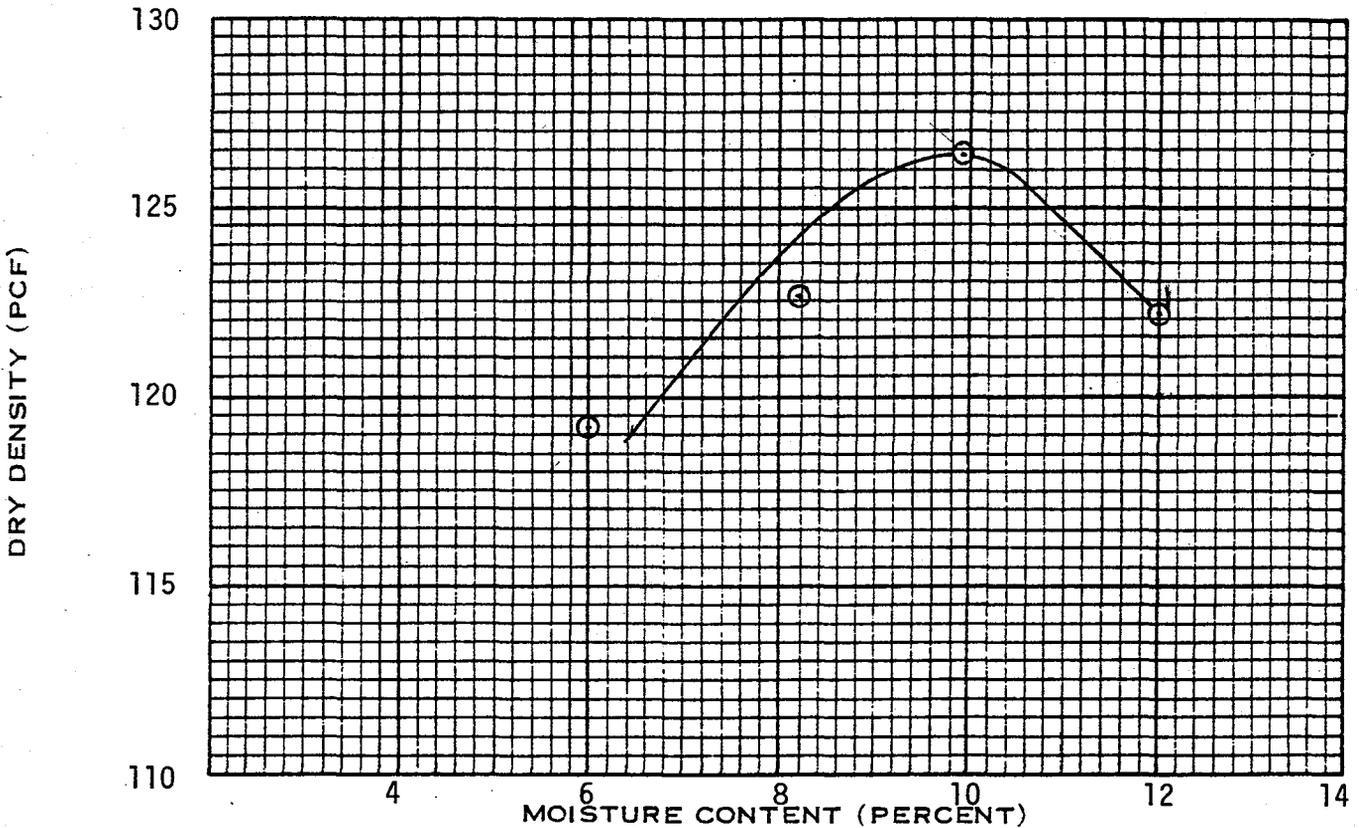
HALPERT ASSOCIATES

CONSULTING SITE AND GEOTECHNICAL ENGINEERS

MOISTURE - DENSITY RELATIONS

LAB. SA. No. 14342 PROJECT No. 88902 FOR Elliot Road Bridge
 PROJECT LOCATION Maricopa County, Arizona
 BORING No. ER-5 FIELD SA. No. AS-1 SA. DEPTH 4.0 SA. ELEV. (TIP) 1329.0
 SAMPLE DESCRIPTION Brown MEDIUM TO FINE SAND with a Little Silt
 METHOD OF COMPACTION ASTM 698 Method A
 MOLD: No. 6, DIA. 4.00 IN., HT. 4.58 IN., VOLUME 1/30 CU. FT., WT. 9.48 LBS.
 TESTED BY: M. Palermo/J. Kennedy CHECKED BY: G. Creaser DATE: 2/14/80

DETERMINATION NUMBER	1	2	3	4	5	6
WT. OF WET SOIL + MOLD, LBS.	13.69	13.90	14.11	14.04		
WT. OF MOLD, LBS.	9.48	9.48	9.48	9.48		
WT. OF WET SOIL, LBS.	4.21	4.42	4.63	4.56		
WET DENSITY, PCF	126.3	132.6	138.9	136.8		
TARE NUMBER	P-54	P-34	P-10	P-12		
WT. OF WET SOIL + TARE, GR.	533.7	489.0	567.0	608.5		
WT. OF DRY SOIL + TARE, GR.	506.9	456.9	521.7	550.0		
WT. OF MOISTURE, GR.	26.8	32.1	45.3	58.5		
WT. OF TARE, GR.	63.4	63.5	64.6	63.2		
WT. OF DRY SOIL, GR.	433.5	393.4	457.1	486.8		
MOISTURE CONTENT, %	6.0	8.2	9.9	12.0		
DRY DENSITY, PCF	119.1	122.6	126.4	122.1		



MAXIMUM DRY DENSITY 126.4 PCF OPTIMUM MOISTURE CONTENT 9.9 %
 LIQUID LIMIT NP % PLASTIC LIMIT NP % SPECIFIC GRAVITY -
 PERCENT PASSING: 3/4" 100, No. 4 100, No. 10 90, No. 40 51, No. 200 20

FIGURE NO. 15

ALLOWABLE (DESIGN) CAISSON CAPACITIES

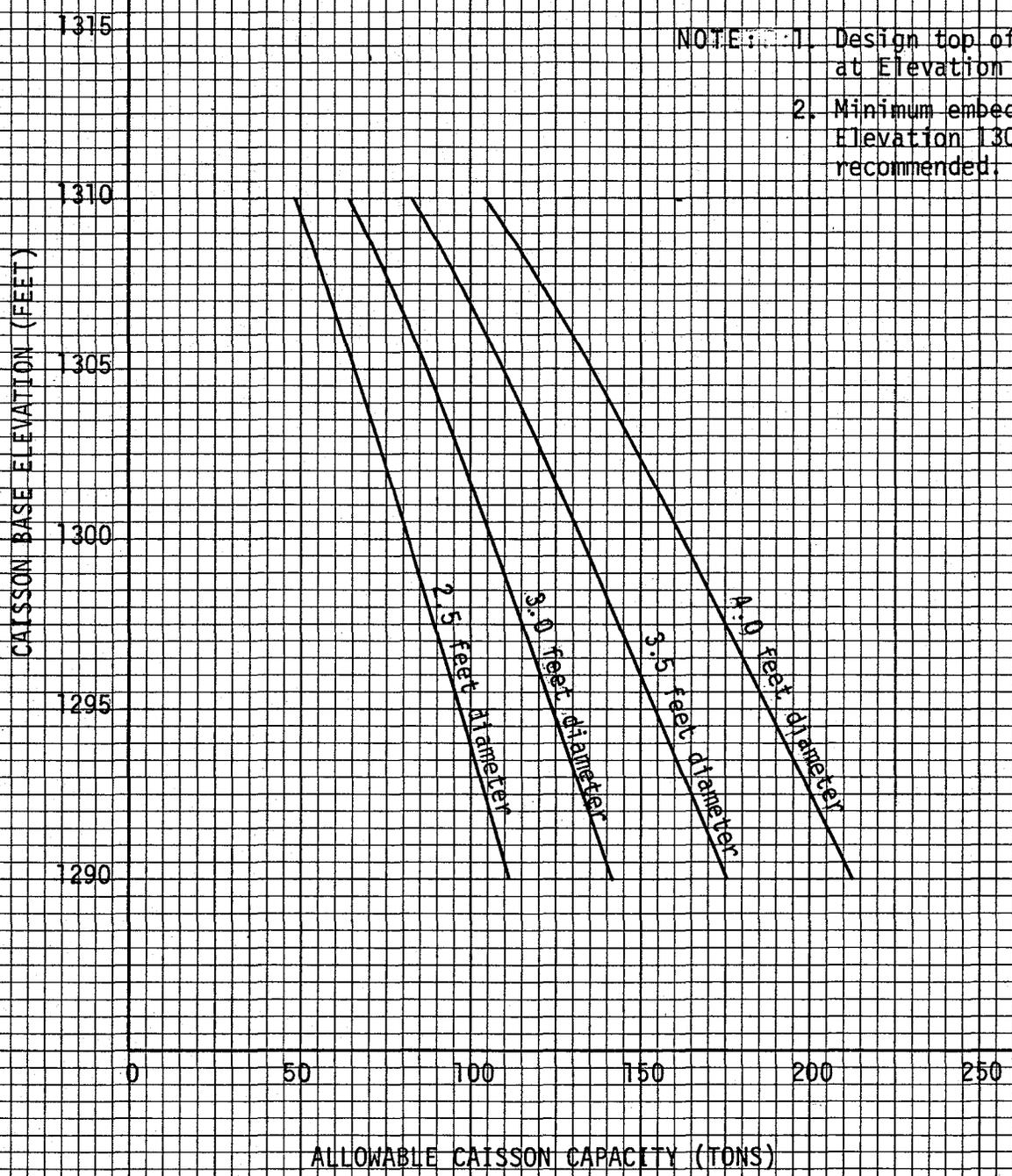
	<u>Diameter (Feet)</u>	<u>Vertical Load (Tons)</u>	<u>Lateral Loads (Tons)</u>
Baseline Road*	2.0	85	18
	2.5	125	24
	3.0	165	31
	3.5	210	40
	4.0	260	49
Elliot Road**	2.5	(see graph)	21
	3.0	"	28
	3.5	"	36
	4.0	"	43

*Caissons founded on Hard SILTY CLAY, Elevation 1308.

**Caissons embedded to depth of 14.0 feet.

2-12-80/2-21-80

ALLOWABLE (DESIGN) CAISSON CAPACITY
ELLIOT ROAD BRIDGE



NOTE: 1. Design top of caisson at Elevation 1315.
2. Minimum embedment to Elevation 1305 is recommended.

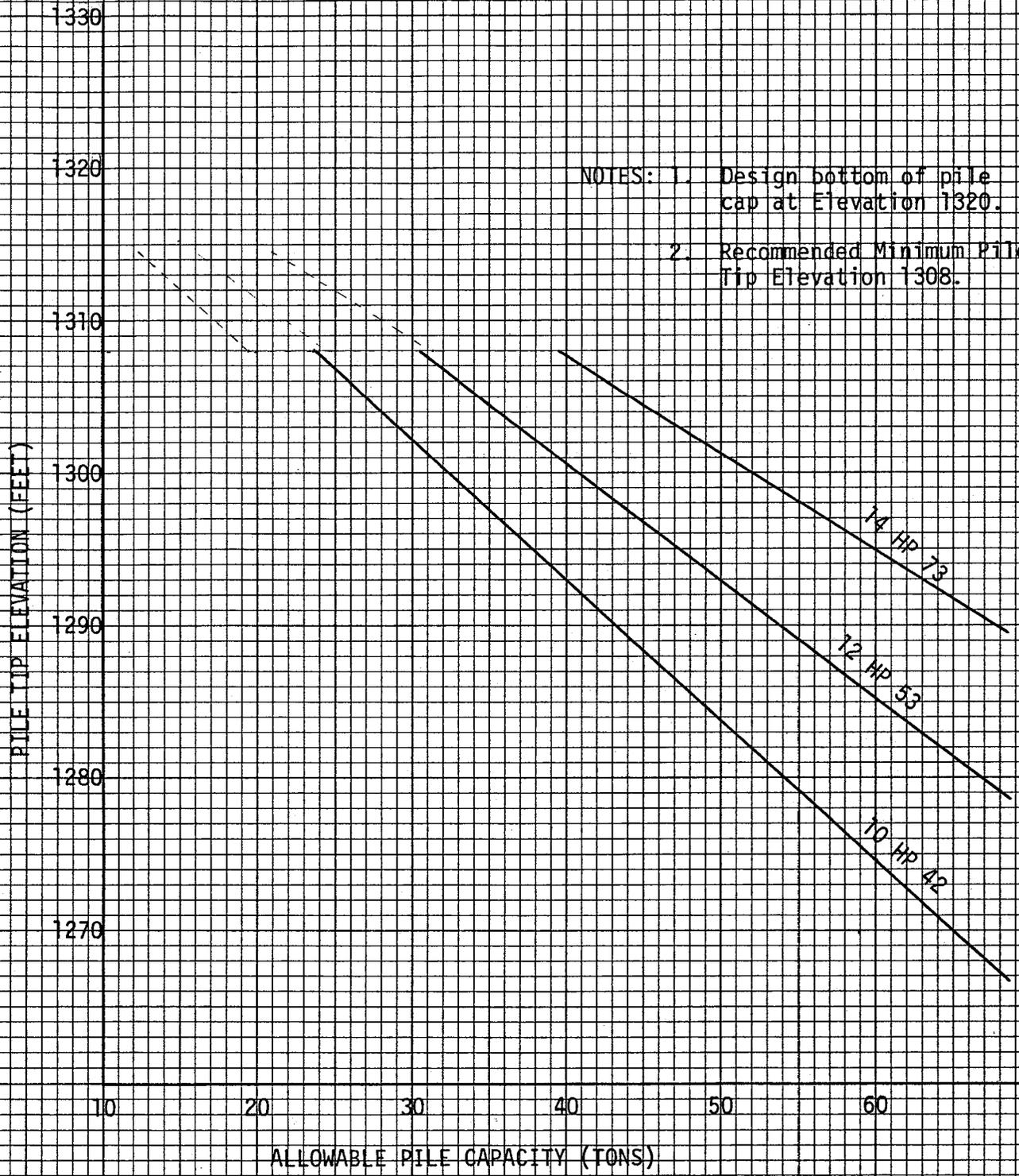
HALPERT ASSOCIATES
February 12, 1980
Project No. 88902

FIGURE NO. 17

EUGENE DIETZGEN CO. NO. 340-10 DIETZGEN GRAPH PAPER PER 10

EUGENE DIETZGEN CO.
DESIGNED IN
NO. 340-10 DIETZGEN GRAPH PAPER
PER
10

BASELINE ROAD BRIDGE



- NOTES: 1. Design bottom of pile cap at Elevation 1320.
2. Recommended Minimum Pile Tip Elevation 1308.

FIGURE NO. 18

HALPERT ASSOCIATES
February 6, 1980
Project No. 88902

ELLIOT ROAD BRIDGE

- NOTES: 1. Design bottom of pile cap at Elevation 1313.
2. Recommended minimum Pile Tip Elevation 1300.

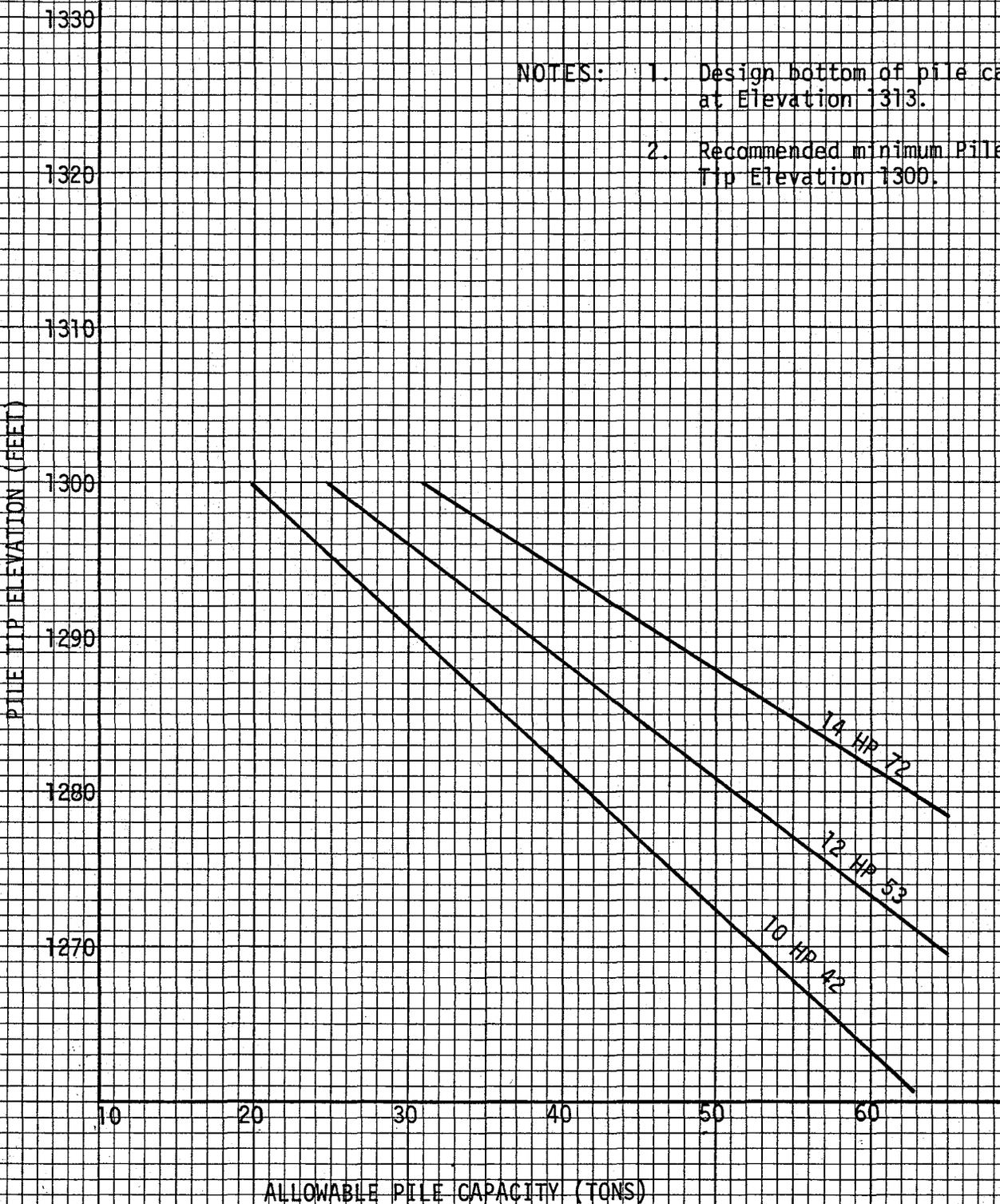


FIGURE NO. T-9

HALPERT ASSOCIATES

February 12, 1980

Project No. 88902

ALLOWABLE LATERAL LOADS - DRIVEN PILES

	<u>Section</u>	<u>Load Parallel To Web (Tons)</u>	<u>Load Parallel To Flange (Tons)</u>
Baseline Road	10 HP 42	5.1	4.0
	12 HP 53	6.9	5.2
	14 HP 73	9.3	7.1
Elliot Road	10 HP 42	4.3	3.3
	12 HP 53	5.8	4.4
	14 HP 73	7.8	6.0

2-12-80/2-21-80