APPENDIX G
PROJECT GEOTECHNICAL REPORT

GEOTECHNICAL ENGINEERING REPORT

PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD. AND TANQUE VERDE RD.
PIMA COUNTY, ARIZONA

TERRACON PROJECT NO. 63085014, Revision 1
AUGUST 4, 2008, 2008

Prepared for:

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ATTN: MIKE DALY, P.E.

Expires 06/30/2009

Prepared by:

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August 4, 2008

Psomas
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Tucson, Arizona 85719

Attn: Mike Daly, P.E.

RE: Geotechnical Engineering Report
Pantano Wash Bank Protection
Pantano Wash between Speedway Blvd. and Tanque Verde Rd.
Pima County, Arizona
Terracon Project No. 63085014, Revision 1

Terracon has completed geotechnical engineering exploration for the Pantano Wash Bank Protection located along the Pantano Wash in Pima County, Arizona. This study was performed in general accordance with our proposal number D63085014 dated November 7, 2007. The results of our engineering study are attached. The following is a revised version of the report submitted April 17, 2008.

Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, we have determined the embedment depth and stability of the existing bank protection systems. More detailed design and construction recommendations, based upon geotechnical conditions, are presented in the report.

We appreciate being of service to you in the geotechnical engineering phase of this project. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us.

Sincerely,
Terracon

Bryan W. Reed, P.E.
Project Manager

Oleg B. Lysyj, P.E.
Principal

Copies to: Addressee (3)

N:\Projects\2008\63085014\63085014.revision1.rpt.doc

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Expires 06/30/2009

GEOTECHNICAL ENGINEERING REPORT

PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD. AND TANQUE VERDE RD.
PIMA COUNTY, ARIZONA

TERRACON PROJECT NO. 63085014, REVISION 1

INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the existing Pantano Wash Bank Protection located along the east and west banks of the Pantano Creek between Speedway Boulevard and Tanque Verde Road, in Pima County, Arizona.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- embedment depth of the various bank protection systems
- groundwater conditions
- lateral earth pressures
- slope stability of the current bank protection

The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and experience with similar soil conditions, structures and our understanding of the proposed project.

PROJECT DESCRIPTION

The project consists of the evaluation of the existing bank protection located along both the east and west banks of the Pantano Wash. Portions of the bank protection were damaged or failed during a storm event in the summer of 2006. The existing bank protection consists of several types of protection systems that include: soil cement, gabion, and a rock and rail system. The project limits extends upstream of the Speedway Bridge approximately 500-feet, and downstream of the Tanque Verde Bridge approximately 650-feet.

SITE EXPLORATION PROCEDURES

The scope of the services performed for this project included site reconnaissance by a geotechnical engineer, a subsurface exploration program, laboratory testing, and engineering analyses.

Field Exploration: A total of 3 test borings (B-1, B-2, and B-3) were drilled on March 10, 2008. The borings were drilled to approximate depths of 31-½ feet at the locations shown on the Site Plan, Figures 1 through 7 in Appendix A. Borings were advanced with a truck-mounted drilling rig, utilizing 7-½ inch diameter hollow-stem auger.

We also performed a total of 13 test-pits (TP-1 through TP-13) on March 10, 2008. The test-pits extended to approximate depths of 5 to 15 feet at the locations shown on the Site Plan, Figures 1 through 7 in Appendix A. The test-pit explorations were extended to embedded toe of the bank protection system at each location. At the rock and rail locations the test-pits were only extended to the bottom of rock and wire portion of the system, we did not attempt to determine the depth of embedment of the vertical rails. Test-pits were advanced with a John Deere model 310G tractor-mounted backhoe, utilizing a 16-inch wide bucket.

Three hand samples were obtained near the active flow channel of the wash on February 20, 2008. The samples were all obtained using a shovel, and extended to depths of 2 feet below the surface of the wash bottom. The sample locations are shown on the Site Plan, Figures 1 through 7 in Appendix A.

The explorations were located in the field by measurements from property lines and existing site features. Ground surface elevations at each exploration location were obtained by interpolation from a site map provided by Psomas. Psomas surveyor's were at the site during our field engineering and obtained additional measurements of both horizontal and vertical locations. The accuracy of exploration locations and elevations should only be assumed to the level implied by the methods used to determine each.

Continuous lithologic logs of each boring were recorded by the geotechnical engineer during the exploration operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon or ring-barrel samplers.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel into the subsurface materials with a 140-pound hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency, relative density or hardness of the materials encountered.

Groundwater conditions were evaluated in each boring at the time of site exploration.

Laboratory Testing: Samples retrieved during the field exploration were taken to the laboratory for observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials. Boring logs were prepared and are presented in Appendix A.

Laboratory tests were conducted on selected soil samples and are presented in Appendix B and on the Logs of Borings. The test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations.

Selected soil samples were tested for the following engineering properties:

- Water Content
- Dry Density
- Sieve Analysis
- Percent Fines
- Plasticity Index
- Expansion

SITE CONDITIONS

The site is located within and along the east and west banks of Pantano Wash extending from just south of Speedway Boulevard to just north of Tanque Verde Road.

Western Bank: The bank protection at the southern end of the project consists of soil-cement embankments. The soil cement extends from the southern boundary of the project north approximately 1500 feet. Development along this section of the wash consists of commercial and retail structures, including a Lowe's Home Improvement store. A small park is located on top of the bank protection adjacent to the Lowe's store. The park has a cantilevered sidewalk that extends out over the existing soil cement bank protection. A gabion basket retaining wall forms the bank protection for the wash extending approximately 500 feet north of the soil cement. The gabion baskets protect the Sunrise Office center. The gabion basket system ends at a small unnamed tributary. The bank protection from the unnamed tributary extends approximately 200 feet north and is soil cement. A gabion basket retaining wall extends north of the tributary soil cement to the north side of the Kolb Executive Park. Currently the bank protection at the Kolb Executive Park consists of a temporary rip-rap slope supporting a failed gabian basket wall. The temporary rip-rap extends along the Kolb Executive Park/Pantano property line for approximately 900 feet. The area extending approximately 1300 feet to the north of the Kolb Executive Park is unprotected, this area is also undeveloped. North of the unprotected area, the bank

protection consists of rock-and-rail. The rock and rail system protects approximately 1300 feet of retail and commercial development and the western abutment of Tanque Verde Road Bridge. The rock and rail extends north of the Tanque Verde Road Bridge approximately 1000 feet.

Eastern Bank: From the southern end of the project and extending approximately 2300 feet north, protection on the eastern bank of the Pantano Wash consists of soil-cement. The eastern bank along this portion of the wash, from south to north, contains retail and commercial development, an apartment complex and the Mullins Landfill. At the northern end of the soil cement is a small unnamed tributary separating the Mullins Landfill from Pantano Townhomes to the north of the landfill. Bank protection along the Pantano Townhomes consists of rock and rail. Portions of the rock and rail along this section are completely buried may not be continuous along the entire length. The rock and rail bank protection extends north of the Tanque Verde Bridge to the northern end of the project. Except for retail development located slightly downstream and upstream of the Tanque Verde Bridge development is single-family residential.

SUBSURFACE SOIL CONDITIONS

Soil Conditions: As presented on the Logs of Boring and Logs of Test-Pit, surface soils to the maximum depth of exploration consisted of sand with varying amounts of silt and gravel.

Bank Protection Embedment: The following table shows the depth of embedment of bank protection as measured from the surface of the wash bottom adjacent to our test-pit excavations:

Location	Protection Type	Depth of Embedment (feet)
TP-01	Soil Cement	7
TP-02	Soil Cement	15
TP-03	Soil Cement	13
TP-04	Soil Cement	5
TP-05	Gabion Basket	8
TP-06	Soil Cement	10
TP-07	Soil Cement	13
TP-08	Rock and Rail*	5
TP-09	None Encountered	--
TP-10	Rock and Rail*	8
TP-11	Rock and Rail*	5
TP-12	Rock and Rail*	6

Location	Protection Type	Depth of Embedment (feet)
TP-13	Soil Cement	9

* Excavations were only extended to the bottom of the rock and wire portion of the Rock and Rail bank protection system, the embedment depth of the vertical rails was not determined.

Field and Laboratory Test Results: Field penetration test results from the borings indicate that the sand soils vary from very loose to very dense in relative density.

Field penetration tests and backhoe test-pit observations indicate that the subsoils at shallow depth have a significant potential for hydrocompaction when elevated in moisture content.

Based on our observation of the rip-rap placed along portions of the bank we estimate a D50 of the material to be between 6" to 8" inches.

Groundwater Conditions: Groundwater was not observed in any exploration at the time of field exploration. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations: Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, it appears that all of the soil cement bank protection slopes are stable in their current configurations, with a factor of safety against circular failure greater than 1.5. The remaining bank protections, including the gabion baskets, rip-rap sections, and rock and rail sections have factors of safely against failure less than 1.5. The stability analysis is based on relatively limited observations made of the bank protection systems, for example, we do not know the thickness of the gabion basket protection located at the business center north of the Lowe's shopping center (we assumed a thickness of 4 feet). For the rock and rail system we did not include any contribution of the embedded vertical rail supports to stability of the bank protection (our analysis only included the wire wrapped rock support between the rails. Another assumption made of the rock and rail system was that the rock portion of the system is only two feet thick along the entire face of the support system. We could not determine the presence of any tie-back system that might be present in the Gabion basket system or the rock and rail system.

The following table lists the location, type of bank protection and factor of safely against failure:

Location	Bank Protection	Factor of Safety
TP-01	Soil Cement	2.8
TP-02	Soil Cement	4.7
TP-03	Soil Cement	13.2
TP-04	Soil Cement	1.8
TP-05	Gabian Basket	1.3
TP-06	Soil Cement	12.9
B-02	Rip-Rap Slope	1.3
TP-10	Rock and Rail	1.4
TP-11	Rock and Rail	1.2
TP-12	Rock and Rail	1.1
TP-13	Soil Cement	2.8

The factor of safety provided above is based only on the current slope configuration. Cross sections were developed from topographic information provided by Psomas. The calculations do not include the effect of channel scour or the effect of long term sediment transport that may reduce the effective depth of embedment of the bank protection. Should significant amounts of scour or erosion reduce the embedment depth of the bank protection the factor of safety would be reduced.

Slope Stabilization: For the slopes that have factors of safety less than 1.5 the following techniques could be used to increase the stability of the systems:

A six inch layer of shot-crete could be placed over the face of the existing gabion wall north of the Lowe's center. Current models show wall failure through the gabion system, increasing the strength of the wall would drive the failure surface beneath the slope and increase the factor of safety to over 2. If this option is considered, weep holes to allow for proper drainage will need to be installed in the face of the shot-crete.

For the rip-rap section that is being used to temporarily protect the slope where existing gabion baskets have failed an additional toe-down will be required to increase the stability. A toe-down of 5 feet will increase the factor of safety to 1.5. The analysis does not include the potential of erosion of the rip-rap surface or any scour or channel degradation. The toe down may need to be increased when these additional factors are accounted for.

The rock and rail system could be repaired with a 6-inch layer of shot-crete. The factor of safety generally increases to at least 2 when the geometries are modeled with this repair. The face of the shot-crete will need weep holes to reduce the potential for hydrostatic loading behind the slope faces.

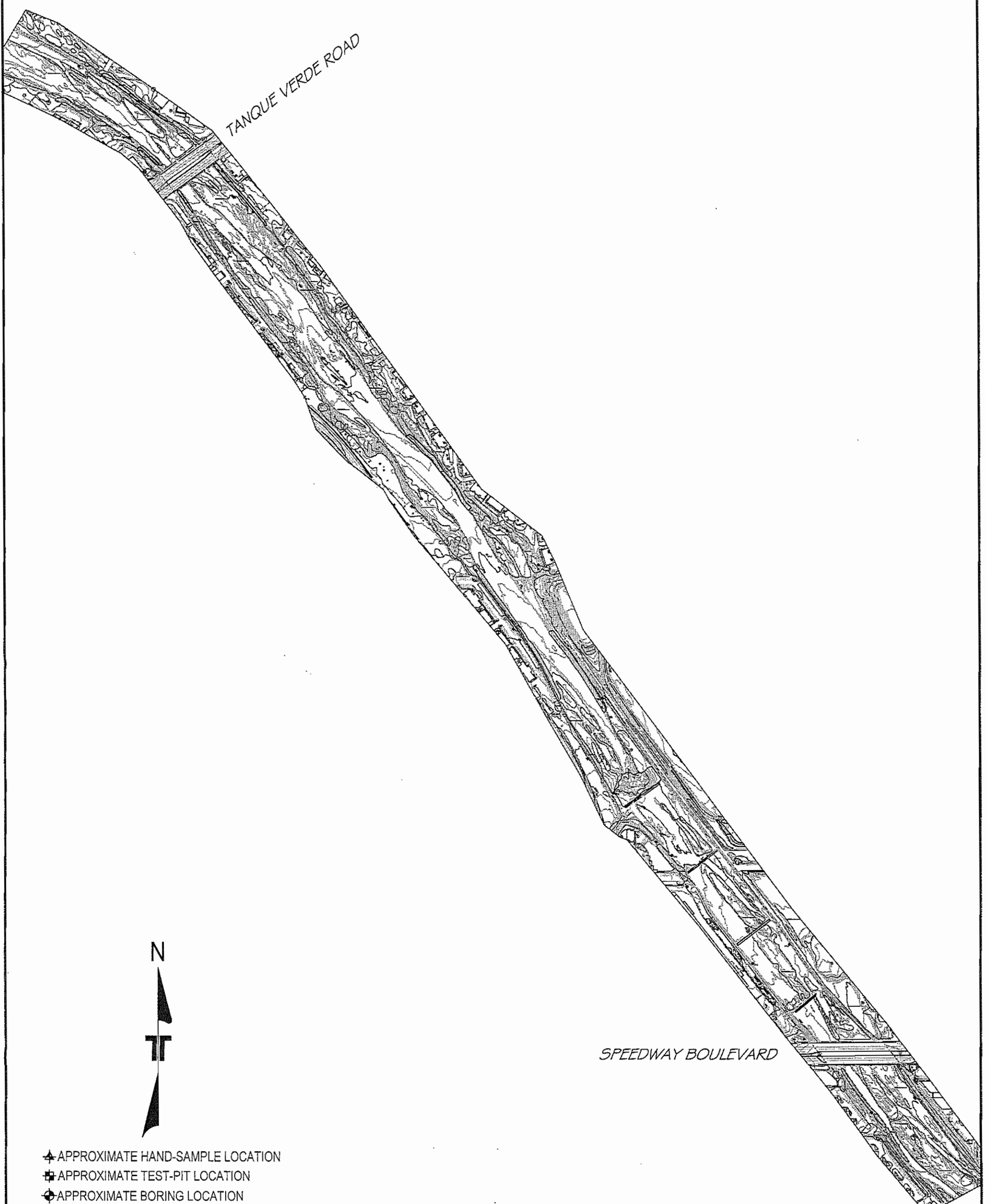
GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide testing and observation during excavation, grading, foundation and construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations which may occur between borings or across the site. The nature and extent of such variations may not become evident until construction. If variations appear, it will be necessary to reevaluate the recommendations of this report.

The scope of services for this project does not include either specifically or by implication any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report, are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes, and either verifies or modifies the conclusions of this report in writing.



APPROXIMATE HAND-SAMPLE LOCATION
APPROXIMATE TEST-PIT LOCATION
APPROXIMATE BORING LOCATION

Project Mngr:	BWB
Drawn By:	BWB
Checked By:	BWB
Approved By:	OBL
Project No.	63085014
Scale:	NA
File No.	63085014.DWG
Date:	4/17/08

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SITE PLAN

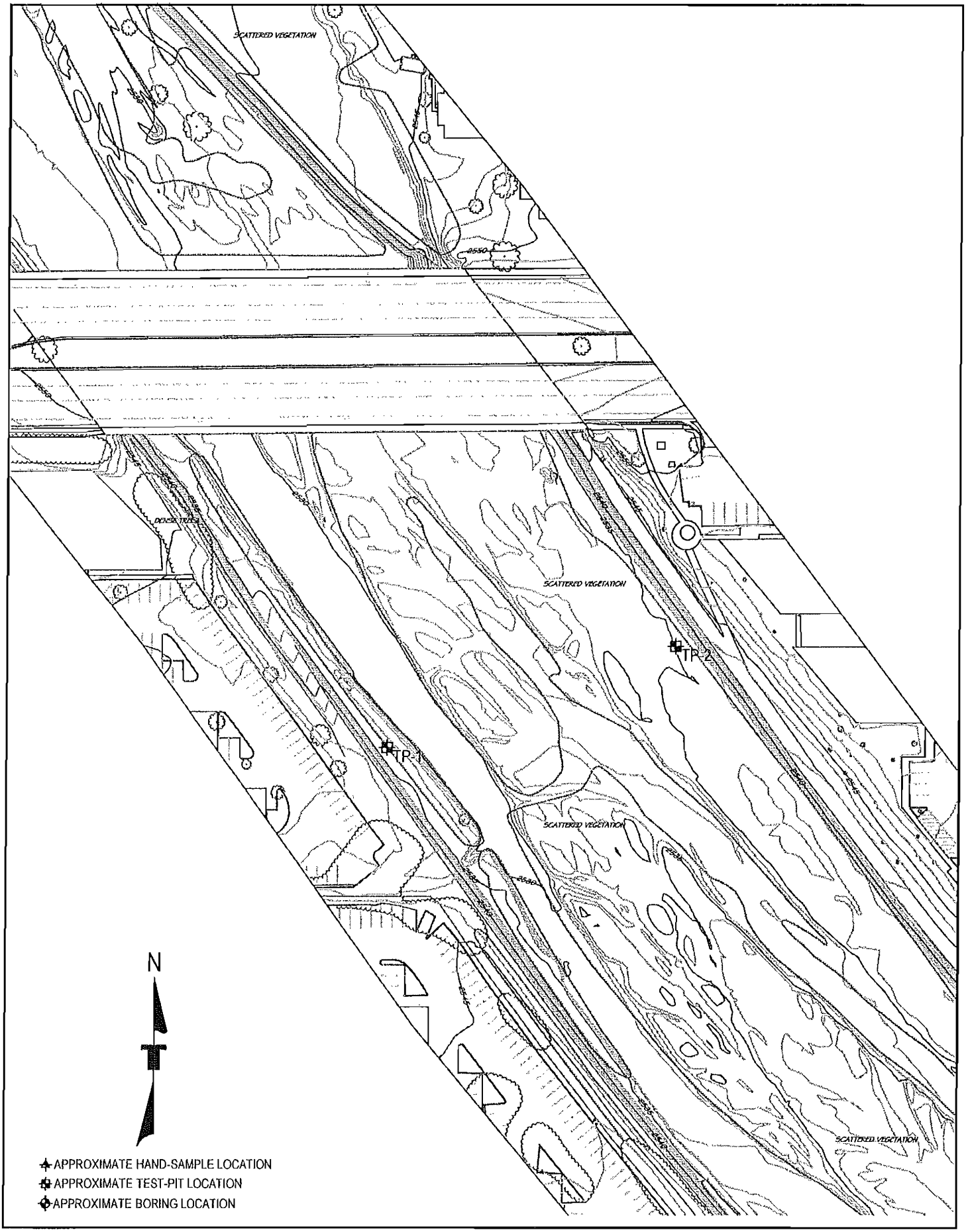
PSOMAS

PANTANO BANK PROTECTION

PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD

PIMA COUNTY ARIZONA

FIG. No. 1



Project Mngr:	BWR
Drawn By:	BWR
Checked By:	BWR
Approved By:	OBL
Project No.	63085014
Scale:	NA
File No.	63085014.DWG
Date:	4/17/08

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SITE PLAN

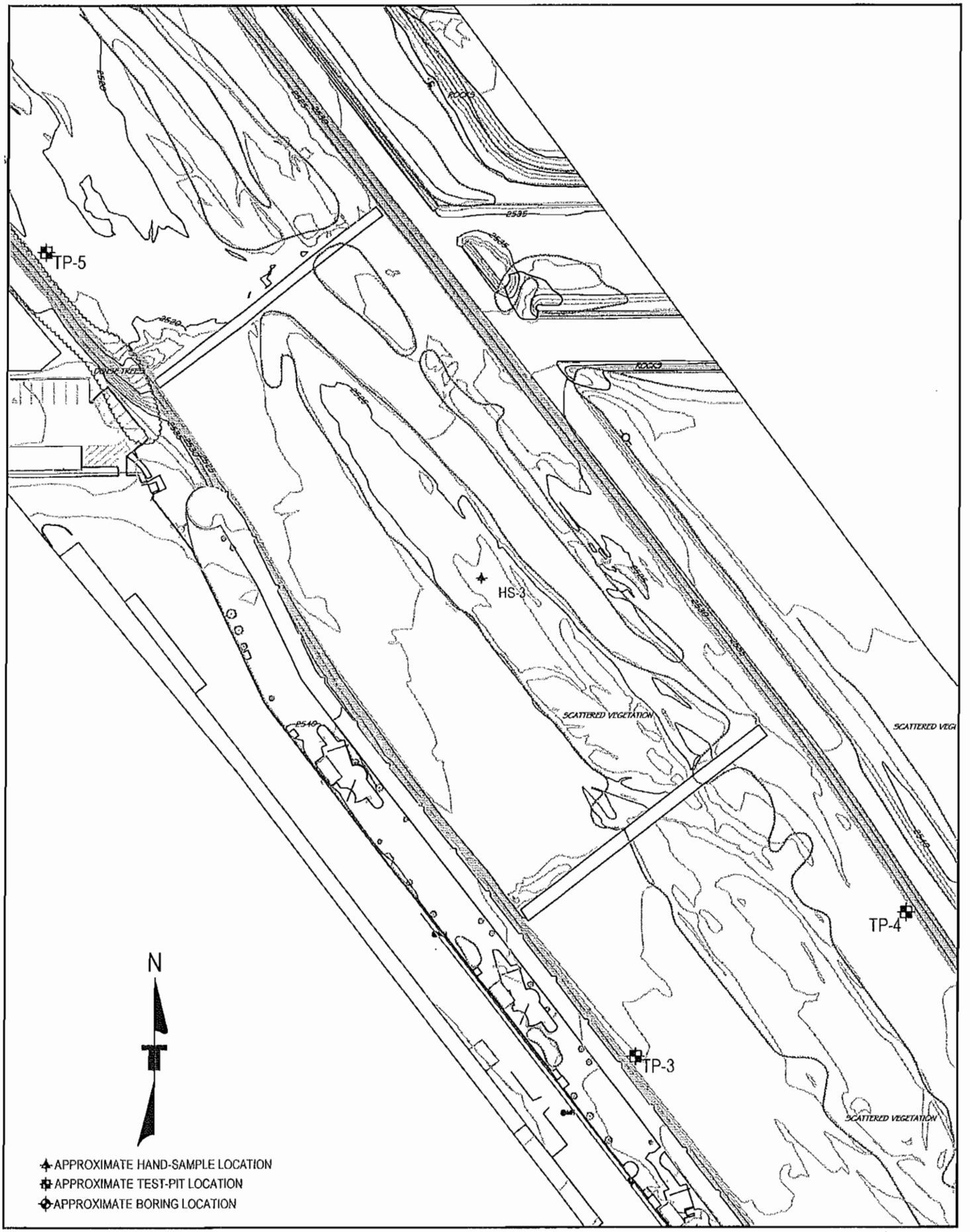
PSOMAS

PANTANO BANK PROTECTION

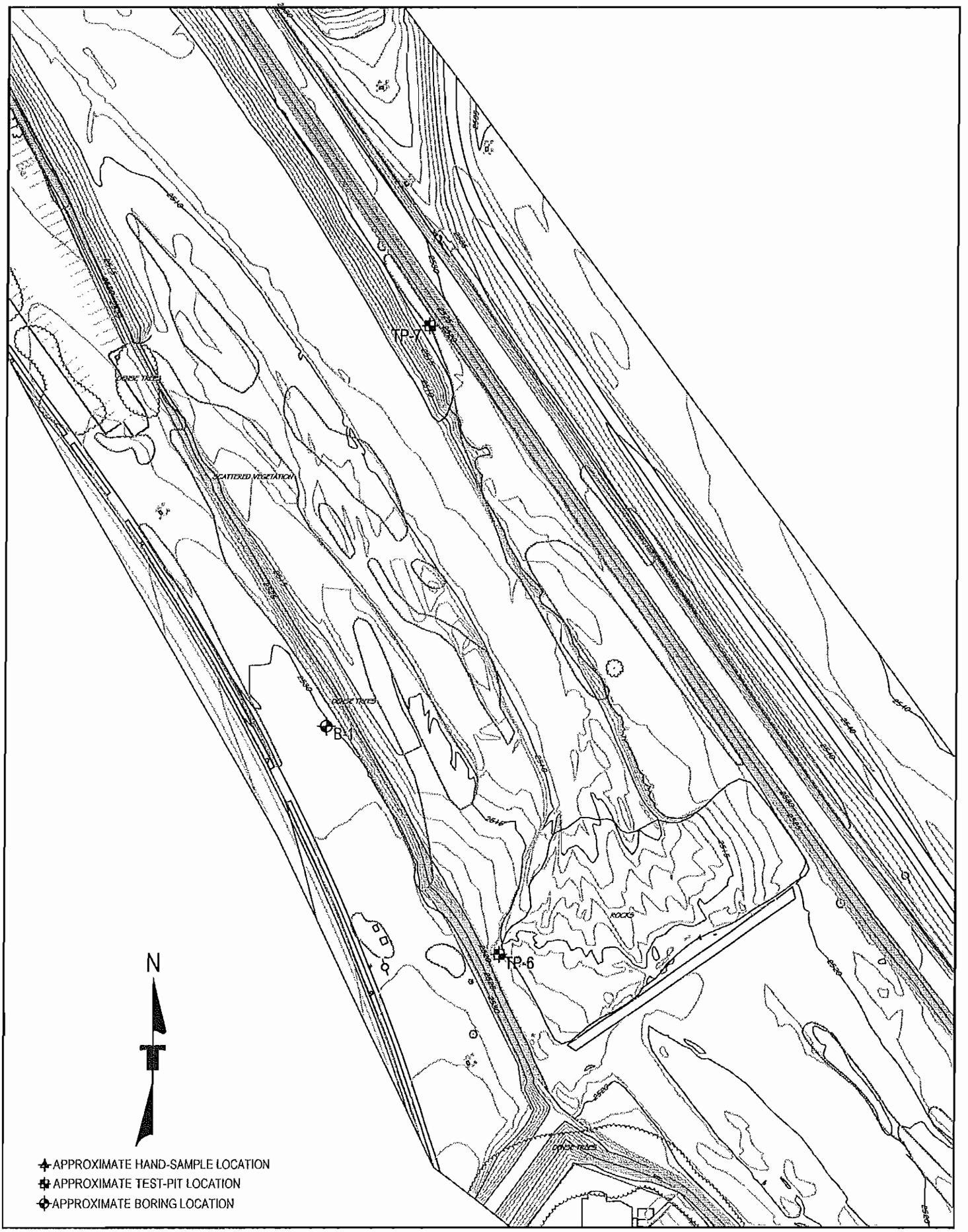
PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD

PIMA COUNTY ARIZONA

FIG. No. 2



Project Mngr: BWR	Project No. 63085014	Terracon Consulting Engineers and Scientists	SITE PLAN	FIG. No.
Drawn By: BWR	Scale: NA	355 SOUTH EUCLID, STE 107 TUCSON, AZ 85719	PSOMAS	3
Checked By: BWR	File No 63085014.DWG	PH. (520) 770-1789 FAX. (520) 792-2539	PANTANO BANK PROTECTION	
Approved By: OBL	Date: 4/17/08		PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD	
			PIMA COUNTY ARIZONA	



Project Mngr:	BWR
Drawn By:	BWR
Checked By:	BWR
Approved By:	OBL

Project No.	63085014
Scale:	NA
File No	63085014.DWG
Date:	4/17/08

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SITE PLAN

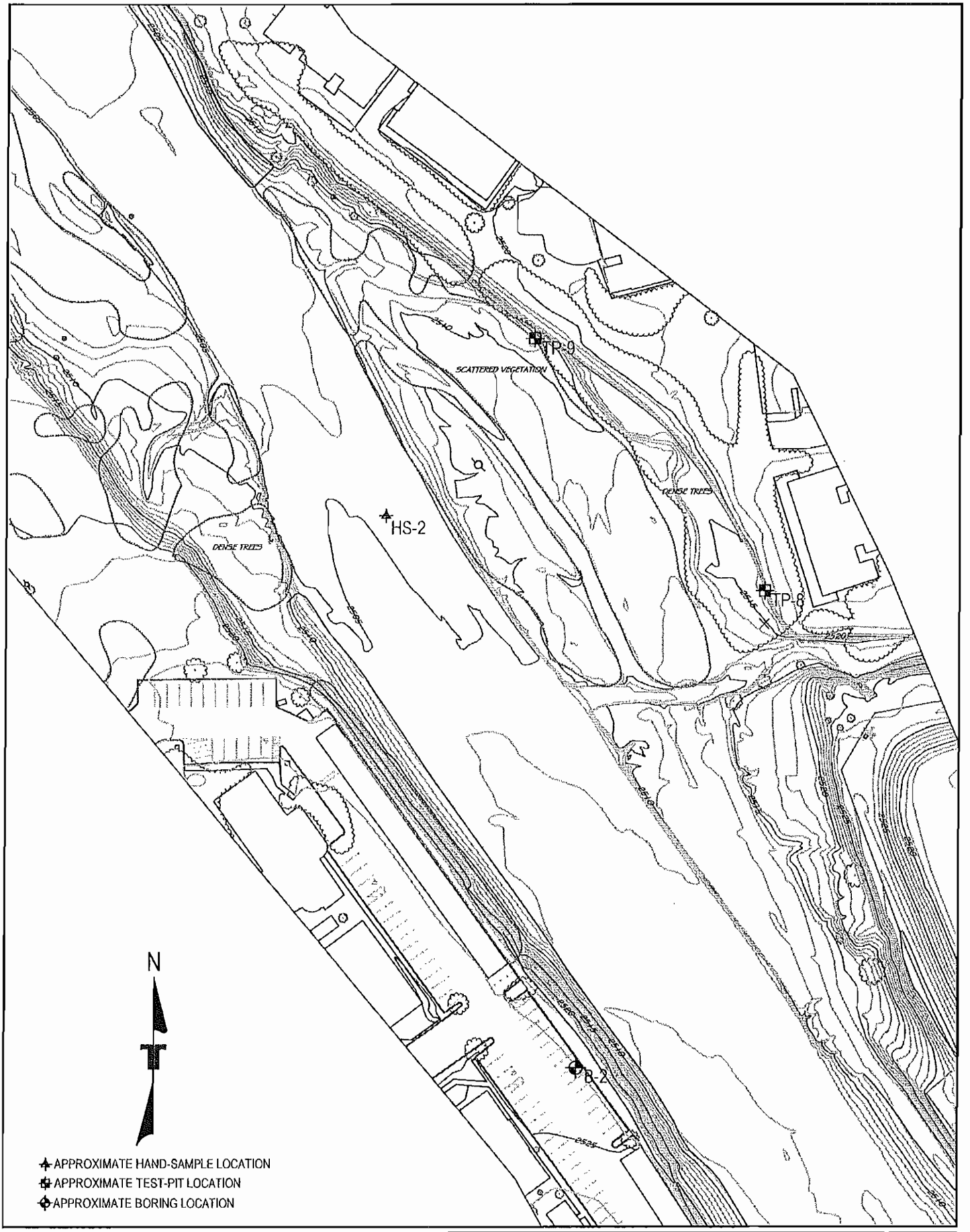
PSOMAS

PANTANO BANK PROTECTION

PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD

PIMA COUNTY ARIZONA

FIG. No. 4



Project Mngr: BWR	Project No. 63085014	Terracon Consulting Engineers and Scientists	SITE PLAN	FIG. No.
Drawn By: BWR	Scale: NA	355 SOUTH EUCLID, STE 107 TUCSON, AZ 85719	PSOMAS	5
Checked By: BWR	File No. 63085014.DWG	PH. (520) 770-1789 FAX (520) 792-2539	PANTANO BANK PROTECTION	
Approved By: OBL	Date: 4/17/08		PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD	
			PIMA COUNTY ARIZONA	

Project Mngr:	BWR
Drawn By:	BWR
Checked By:	BWR
Approved By:	OBL

Project No.	63085014
Scale:	NA
File No.	63085014.DWG
Date:	4/17/08

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SITE PLAN

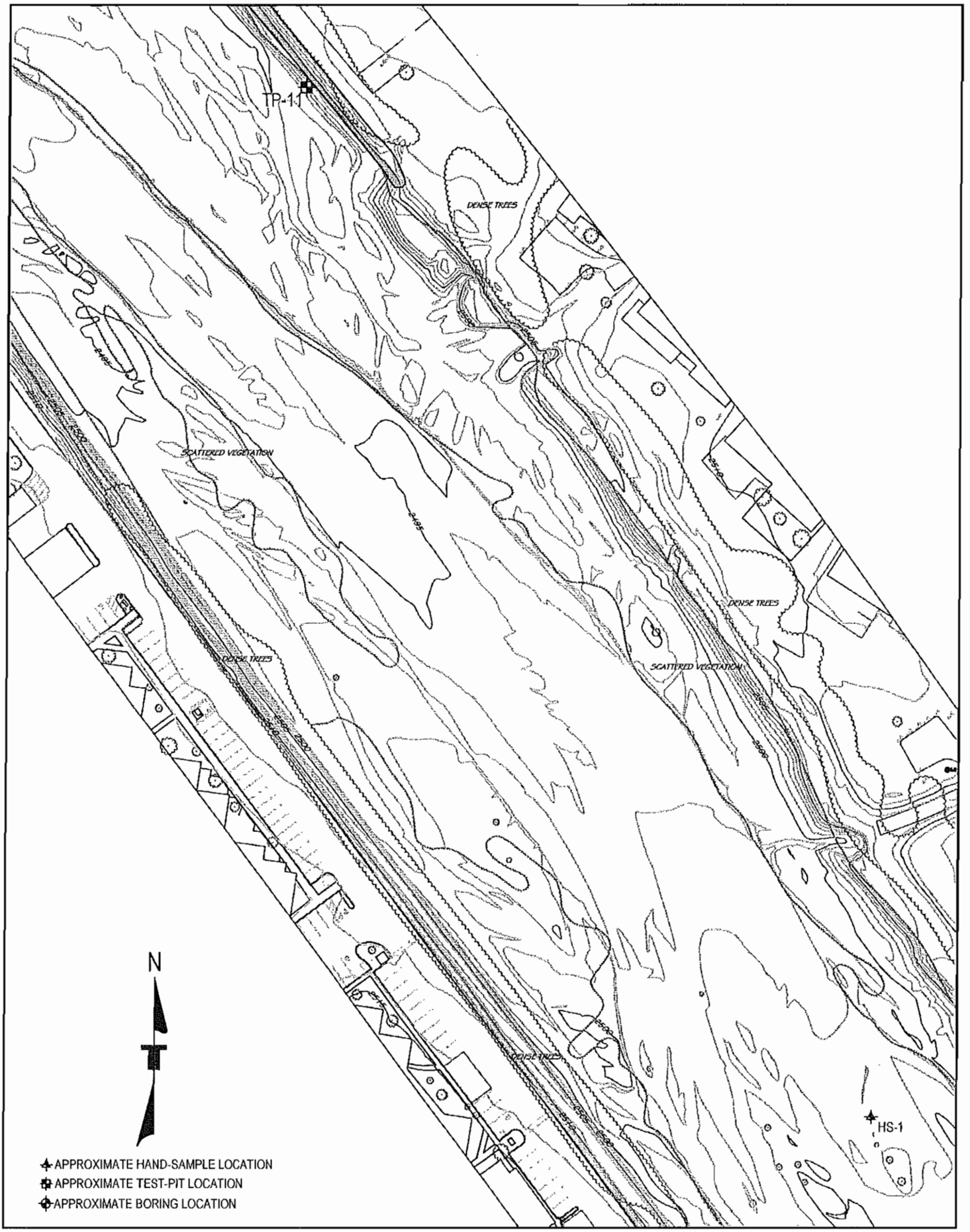
PSOMAS

PANTANO BANK PROTECTION

PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD

PIMA COUNTY ARIZONA

FIG. No. 6



Project Mngr:	BWR
Drawn By:	BWR
Checked By:	BWR
Approved By:	OBL

Project No.	63085014
Scale:	NA
File No.	63085014.DWG
Date:	4/17/08

Terracon
Consulting Engineers and Scientists
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SITE PLAN

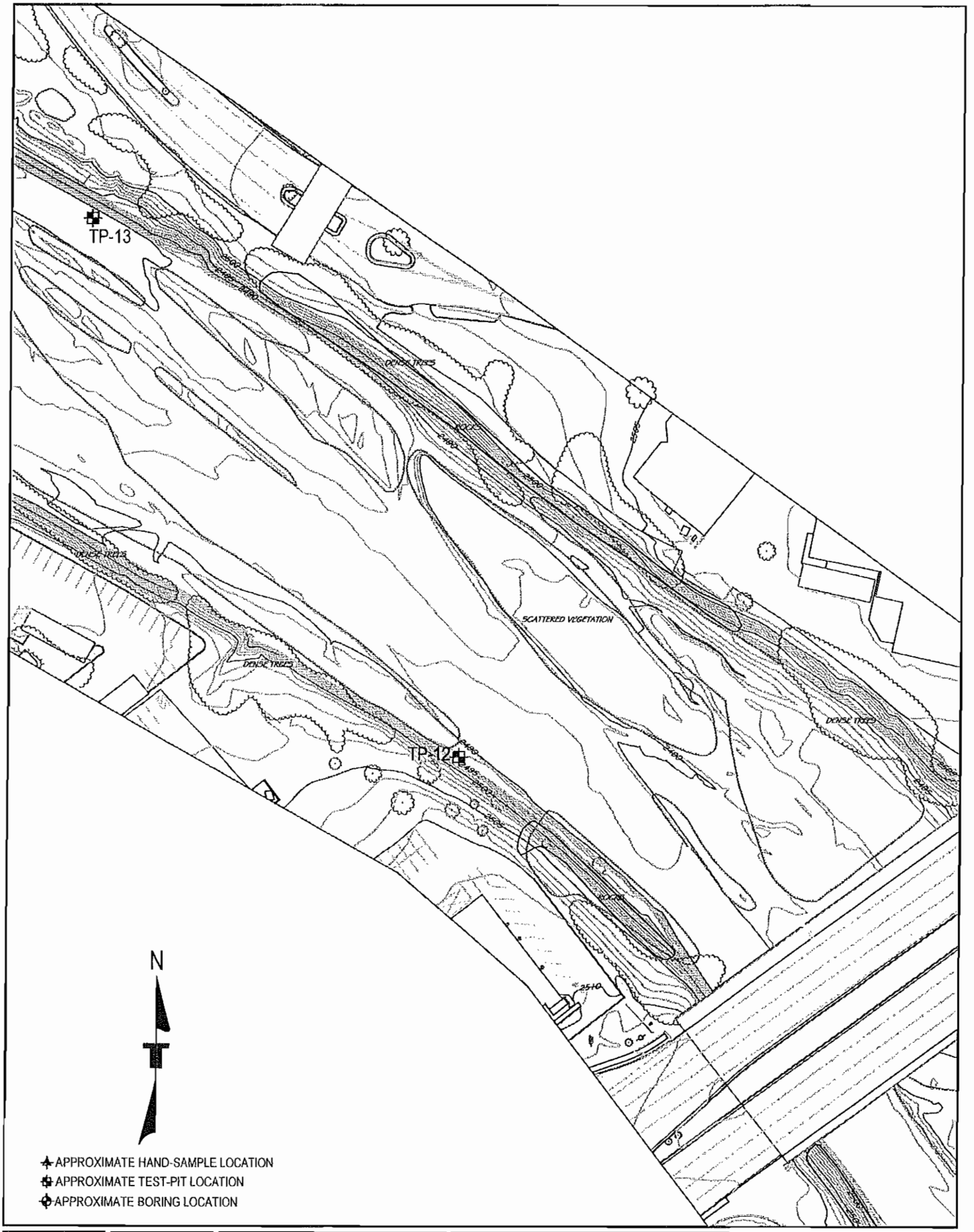
PSOMAS

PANTANO BANK PROTECTION

PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD

PIMA COUNTY ARIZONA

FIG. No. 7



APPROXIMATE HAND-SAMPLE LOCATION
APPROXIMATE TEST-PIT LOCATION
APPROXIMATE BORING LOCATION

Project Mngr.	BWR
Drawn By:	BWR
Checked By:	BWR
Approved By:	OBL

Project No	63085014
Scale:	NA
File No.	63085014.DWG
Date	4/17/08

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SITE PLAN

PSOMAS

PANTANO BANK PROTECTION

PANTANO WASH BTWN TANQE VERDE RD AND SPEEDWAY BLVD

PIMA COUNTY ARIZONA

FIG. No. 8

LOG OF BORING NO. B-01

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND WITH SILT; brown, very dense, non-plastic fines, weak cementation		SP-SM	1	BS					NP	NP	10
			SP-SM	2	RS	12	71/10"					
	SILTY SAND TRACE GRAVEL; brown, medium dense, non-plastic fines, no to weak cementation	5	SM	3	SS	16	43					
	with gravel	10	SM	4	SS	16	22			NP	NP	20
	GRAVELLY SAND TRACE SILT; brown, dense, non-plastic fines, weak cementation	15	SP	5	SS	16	41					
		20	SP	6	SS	16	40					
	GRAVELLY SAND WITH CLAY; brown, very dense, low plasticity fines, moderate cementation	25	SP-SC	7	SS	14	51					
	Bottom of Boring	30	SP-SC	8	SS	16	76					

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			3-10-08
BORING COMPLETED			3-10-08
RIG	CME-75	FOREMAN	JNH
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF BORING NO. B-02

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND WITH SILT; brown, medium dense, non-plastic fines, weak cementation, AC = 2.5		SP-SM	1	BS					NP	NP	7
	4											
	SILTY SAND WITH GRAVEL; brown, very loose, non-plastic fines, no cementation		SP-SM	2	RS	12	46					
	7	5	SM	3	SS	16	6					
	GRAVELLY SAND TRACE SILT; brown, medium dense, non-plastic fines, weak cementation		SP	4	RS	12	15	22	98			
	9											
	GRAVELLY SAND WITH CLAY; brown, loose, low plasticity fines, no cementation	10	SP-SC	5	RS	12	6	32	79			
	12											
	GRAVELLY SAND WITH SILT; brown, dense to very dense, non-plastic fines, weak to moderate cementation		SP-SM	6	RS	12	35					
		15	SP-SM	7	SS	16	41					
		20	SP-SM	8	SS	16	15			NP	NP	6
		25	SP-SM	9	SS	16	31					
		30	SP-SM	10	SS	14	86/12"					
	31.5											
	Bottom of Boring											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED			3-10-08
BORING COMPLETED			3-10-08
RIG	CME 75	FOREMAN	JNH
Approved	OBL	JOB #	63085014

LOG OF BORING NO. B-03

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SILTY SAND WITH GRAVEL; brown, non-plastic fines, no to weak cementation		SM	1	BS					NP	NP	21
			SM	2	RS	12	63					
		5	SM	3	SS	14	44					
	9											
	GRAVELLY SAND WITH SILT; brown, non-plastic fines, weak cementation	10	SP-SM	4	SS	16	28			NP	NP	6
		15	SP-SM	5	SS	16	36					
		20	SP-SM	6	SS	16	35					
		25	SP-SM	7	SS	0	50/3"					
	30.5	30	SP-SM	8	SS	0	50/5"					
	Bottom of Boring											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED			3-10-08
BORING COMPLETED			3-10-08
RIG	CME 75	FOREMAN	JNH
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF HAND SAMPLE NO. HS-1

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
2	**POORLY GRADED SAND WITH GRAVEL**; light brown, non-plastic fines, no cementation		SP	1	BS					NP	NP	3
	Bottom of Sample											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	2-20-08		
BORING COMPLETED	2-20-08		
RIG		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF HAND SAMPLE NO. HS-2

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	POORLY GRADED SAND WITH GRAVEL; light brown, non-plastic fines, no cementation	2	SP	1	BS					NP	NP	3
	Bottom of Sample											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	2-20-08		
BORING COMPLETED	2-20-08		
RIG		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF HAND SAMPLE NO. HS-3

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	POORLY GRADED SAND WITH GRAVEL; light brown, non-plastic fines, no cementation	2	SP	2	BS					NP	NP	2
	Bottom of Sample											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	2-20-08		
BORING COMPLETED	2-20-08		
RIG		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-01

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SILTY SAND TRACE GRAVEL; light brown, non-plastic fines, strong cementation	5	SM	1	BS							
7	Backhoe Refusal, Bottom of Soil Cement = 7'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-02

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND TRACE SILT COBBLES AND BOULDERS; light brown, non-plastic fines, no cementation	5	SP	1	BS					NP	NP	5
	15	10										
	Bottom of Test Pit, Bottom of Soil Cement = 15'	15										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED			3-10-08
BORING COMPLETED			3-10-08
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-03

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL TRACE SILT, COBBLES AND BOULDERS; light brown, non-plastic fines, no cementation	5	SP	1	BS							
		10										
	13											
	Bottom of Test Pit, Bottom of Soil Cement = 13'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-04

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND TRACE SILT & COBBLES; light brown, non-plastic fines, no cementation	5	SP	1	BS							
	Bottom of Test Pit, Bottom of Soil Cement = 5'	5										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-05

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL AND SILT TRACE COBBLES; light brown, non-plastic fines, no cementation	5	SP-SM	1	BS					NP	NP	9
	Bottom of Test Pit, Bottom of Gabian Basket = 8'	8										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-06

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND TRACE SILT & COBBLES; light brown, non-plastic fines, no cementation	5	SP	1	BS							
	Bottom of Test Pit, Bottom of Soil Cement = 10'	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G	FOREMAN	JWC	
Approved OBL	JOB #	63085014	

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-07

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL TRACE SILT AND COBBLES; light brown, non-plastic fines, no cementation	5	SP	1	BS					NP	NP	4
	13	10										
	Bottom of Test Pit, Bottom of Soil Cement = 13'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G	FOREMAN	JWC	
Approved OBL	JOB #	63085014	

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-08

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND WITH SILT TRACE COBBLES; light brown, non-plastic fines, no cementation	5	SP-SM	1	BS							
	Bottom of Test Pit, Bottom of Soil Cement = 5'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-09

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL TRACE SILT; light brown, non-plastic fines, no cementation, no bank protection found	5	SP	1	BS							
	Bottom of Test Pit 10'	10										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft		
WL	▽ None WD	▼ None AB
WL	▽	▼
WL	Backfilled Upon Completion	

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G	FOREMAN	JWC	
Approved OBL	JOB #	63085014	

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-10

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL TRACE SILT & COBBLES; light brown, non-plastic fines, no cementation	5	SP	1	BS							
	Bottom of Test Pit, Bottom of Rock and Rail = 8'	8										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-11

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL TRACE SILT & COBBLES; light brown, non-plastic fines, no cementation	5	SP-SM	1	BS							
	Bottom of Test Pit, Bottom of Rock and Rail = 5'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-12

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	SAND WITH GRAVEL TRACE SILT & COBBLES; light brown, non-plastic fines, no cementation	5	SP-SM	1	BS							
	6											
	Bottom of Test Pit, Bottom of Rock and Rail = 6'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

LOG OF TEST PIT NO. TP-13

CLIENT **Psomas**

SITE **Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona**

PROJECT **Pantano Wash Bank Protection**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (in)	SAMPLES BLOWS/FT.	TESTS WATER CONTENT, %	TESTS DRY DENSITY pcf	TESTS Liquid Limit	TESTS PLASTICITY INDEX	TESTS -200
	GRAVELLY SAND TRACE SILT AND COBBLES; light brown, non-plastic fines, no cementation	5	SP	1	BS					NP	NP	2
	9 Bottom of Test Pit, Bottom of Soil Cement = 9'											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None AB	
WL	▽	▼	
WL	Backfilled Upon Completion		

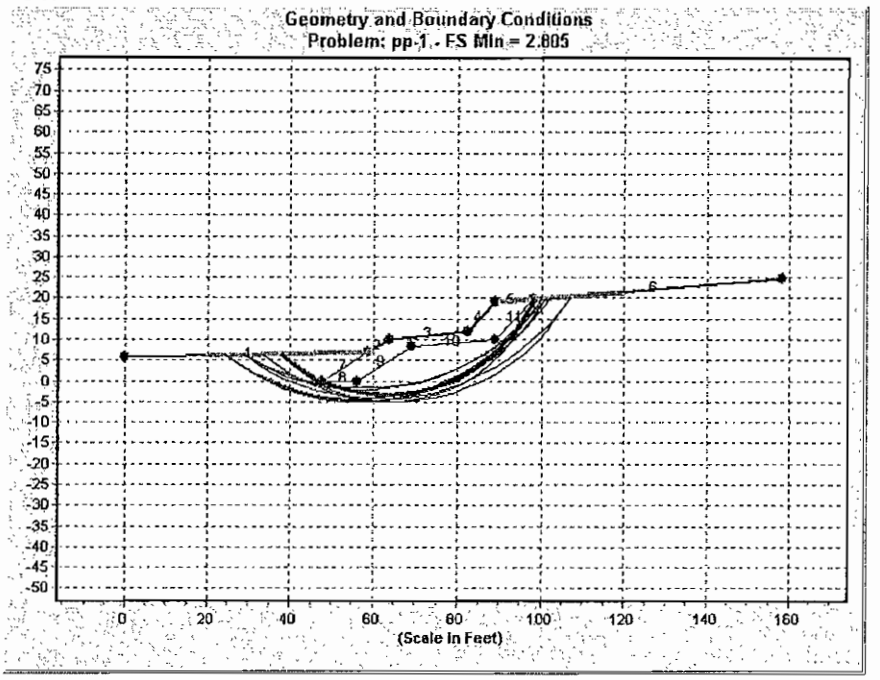
Terracon

BORING STARTED	3-10-08		
BORING COMPLETED	3-10-08		
RIG John Deere 310G		FOREMAN	JWC
Approved	OBL	JOB #	63085014

BOREHOLE 2000 63085014.GPJ TERR2000.GDT 7/30/08

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

TP-01:



TP-02:

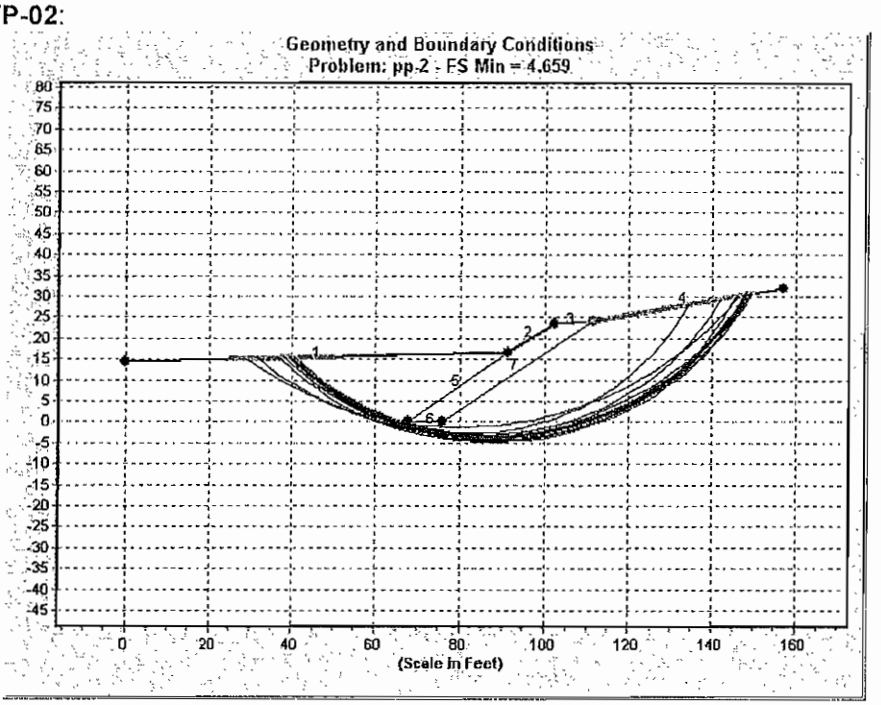
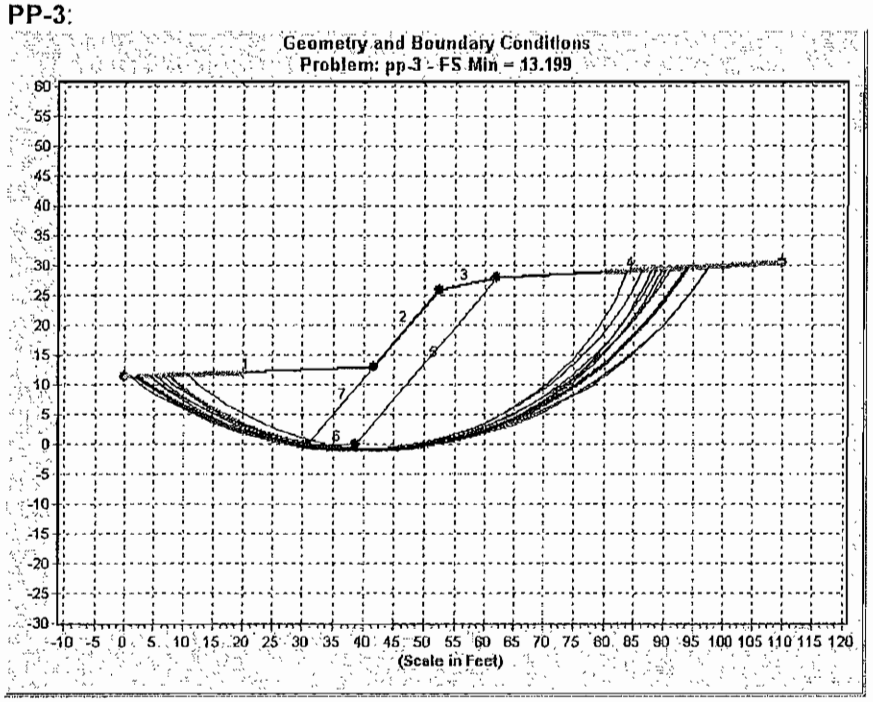


Figure 9

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-3:



PP-4:

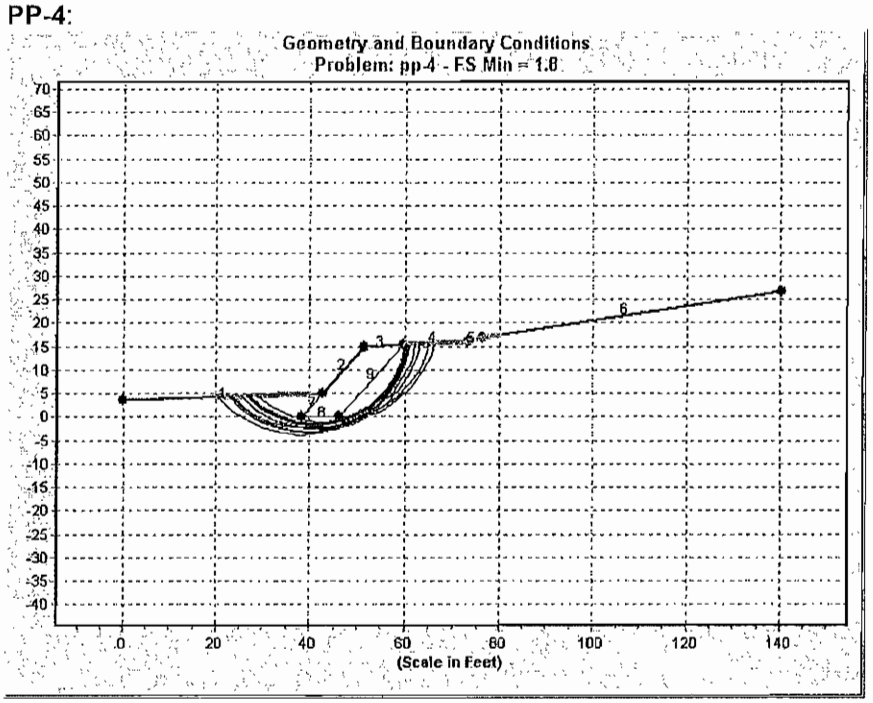
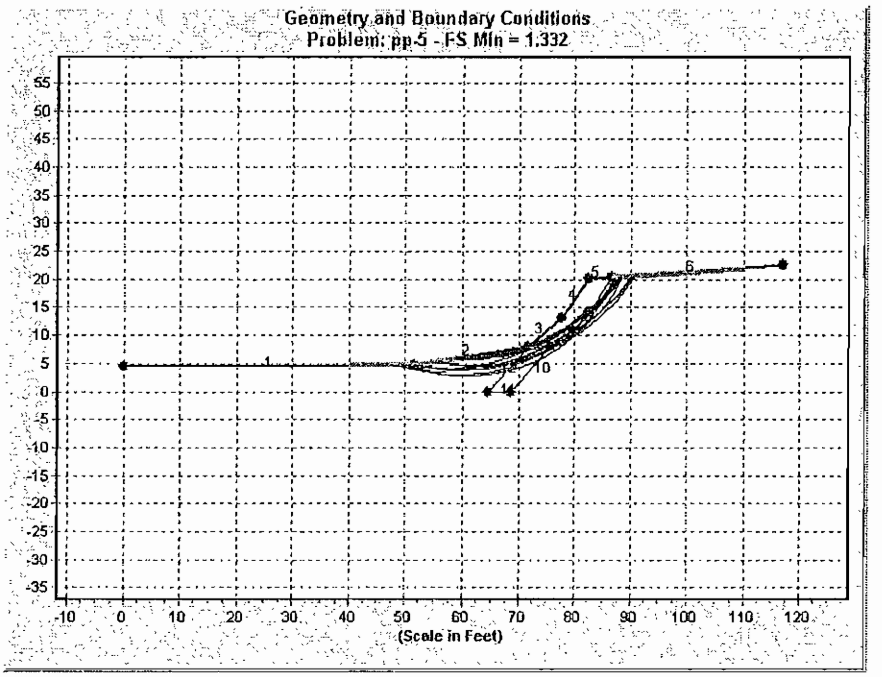


Figure 10

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-5:



PP-5, Repair:

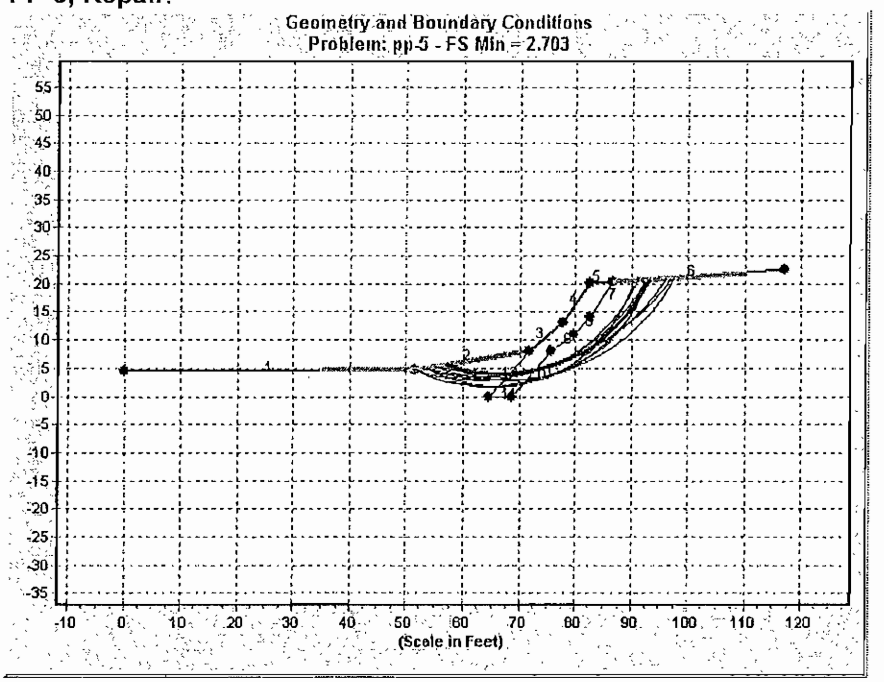
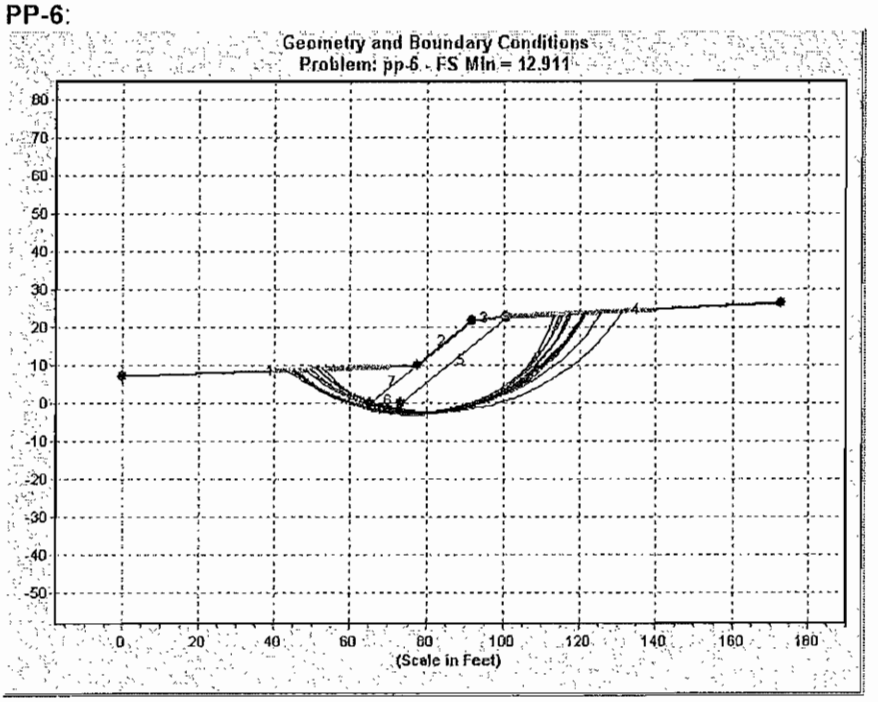


Figure 11

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-6:



PP-9:

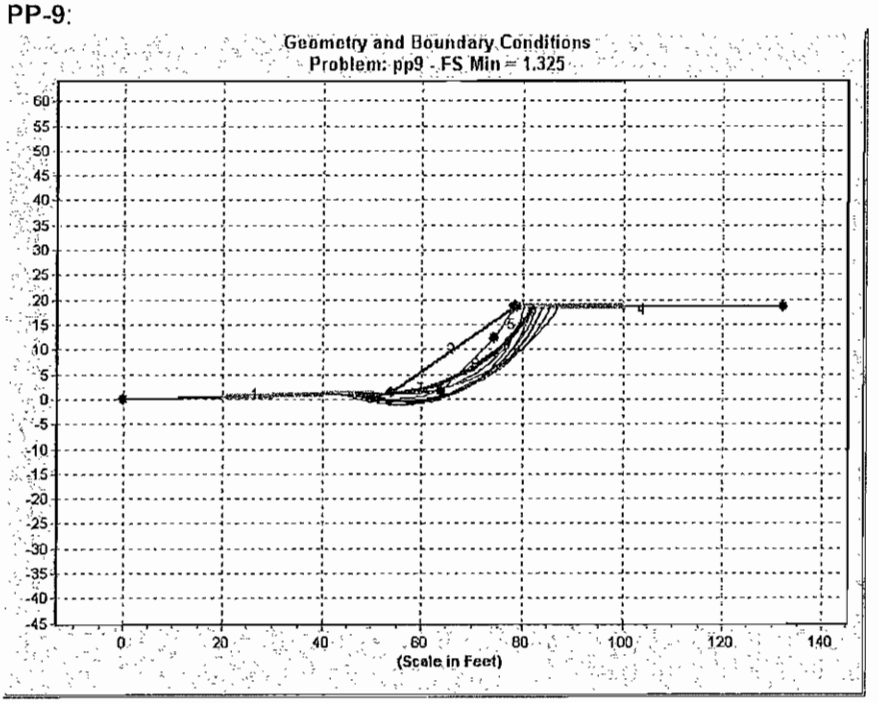
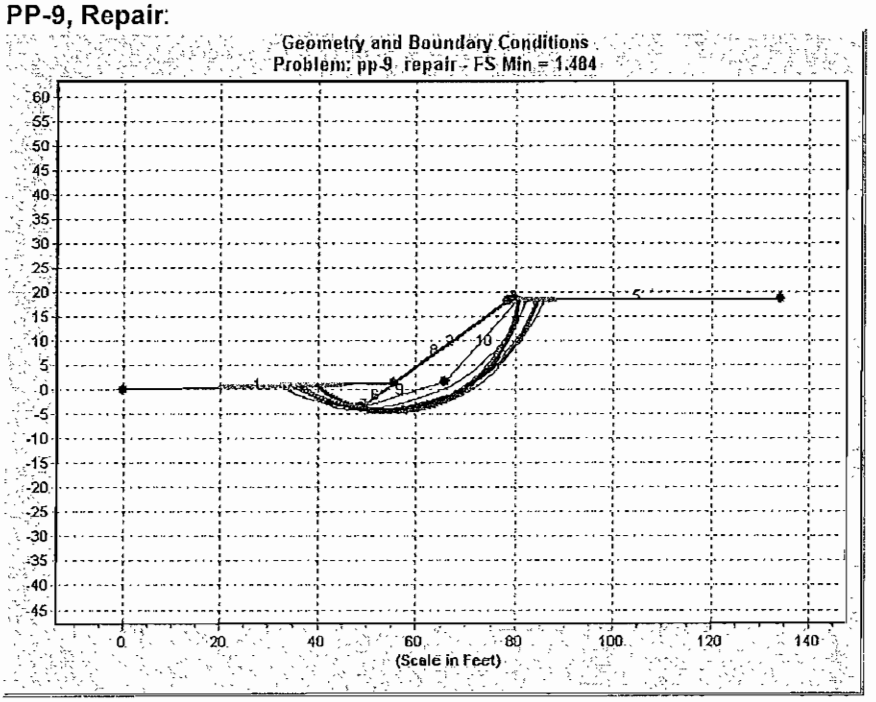


Figure 12

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-9, Repair:



PP-13:

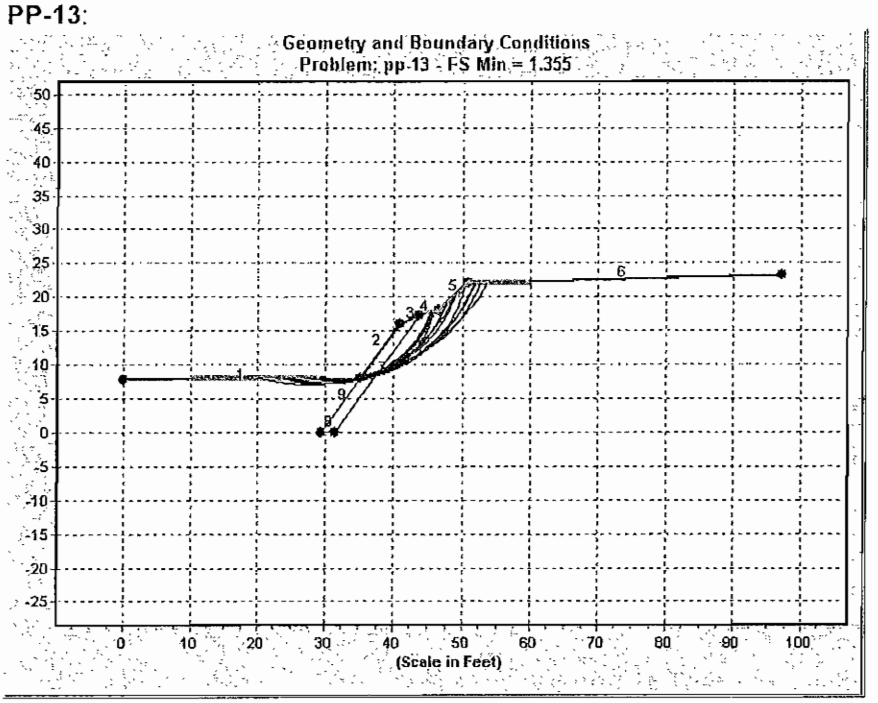
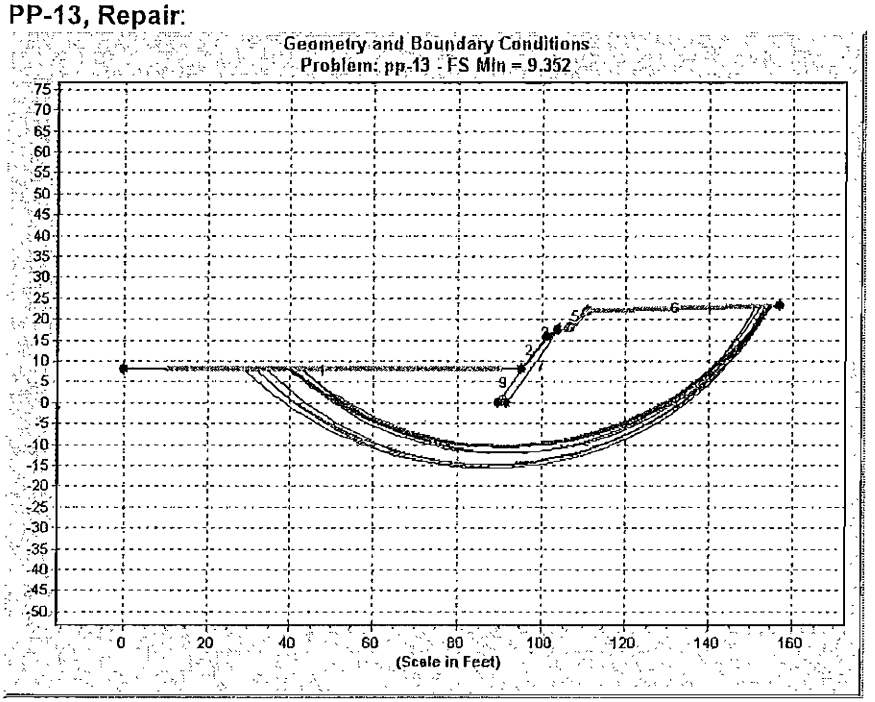


Figure 13

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-13, Repair:



PP-14:

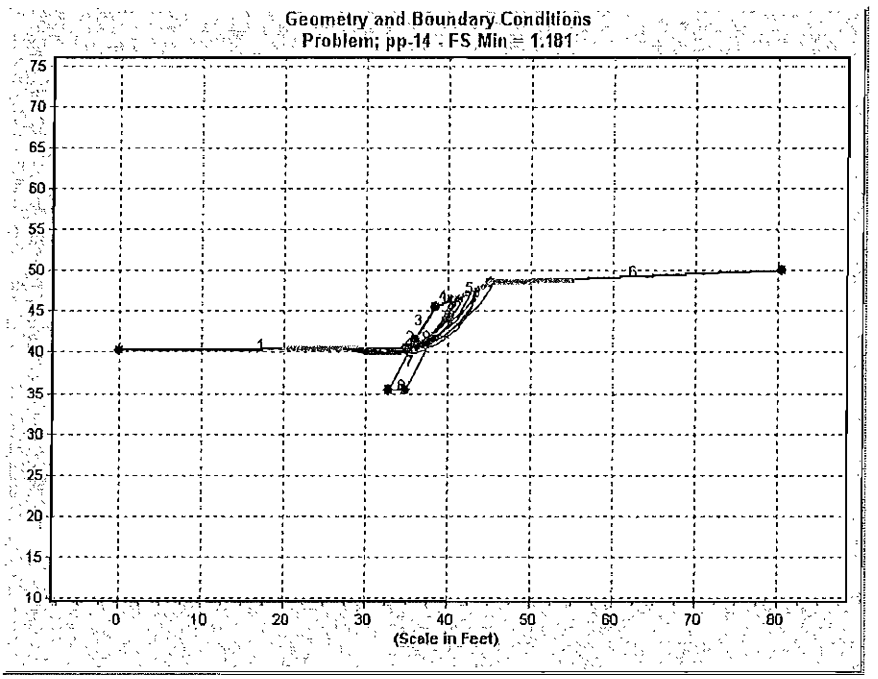
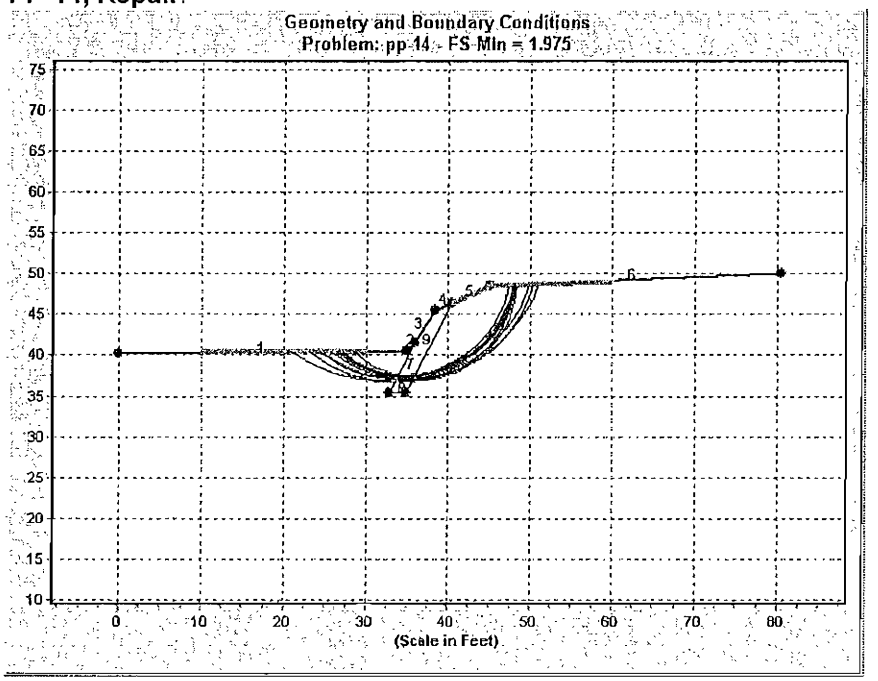


Figure 14

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-14, Repair:



PP-15:

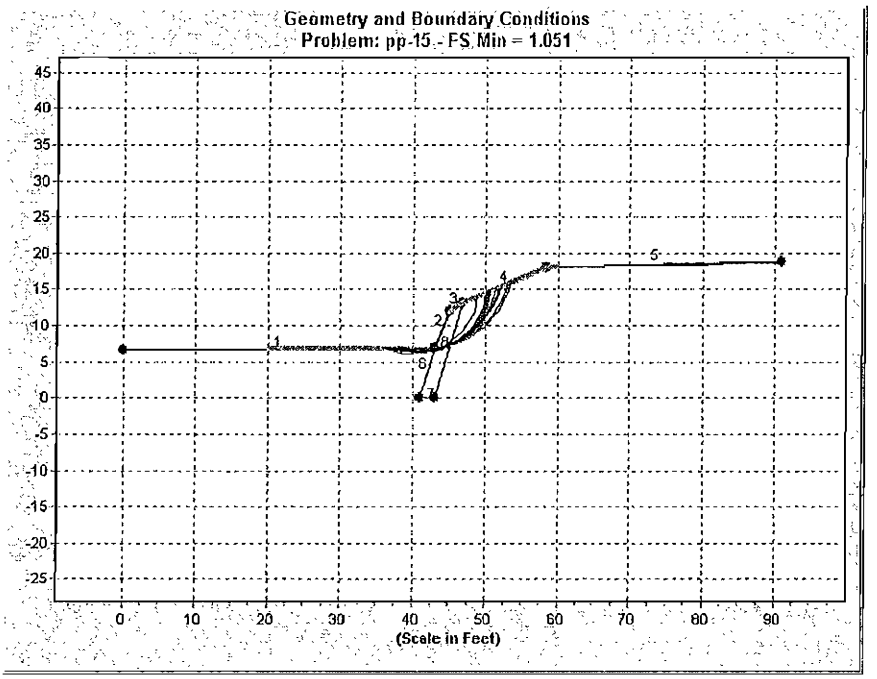
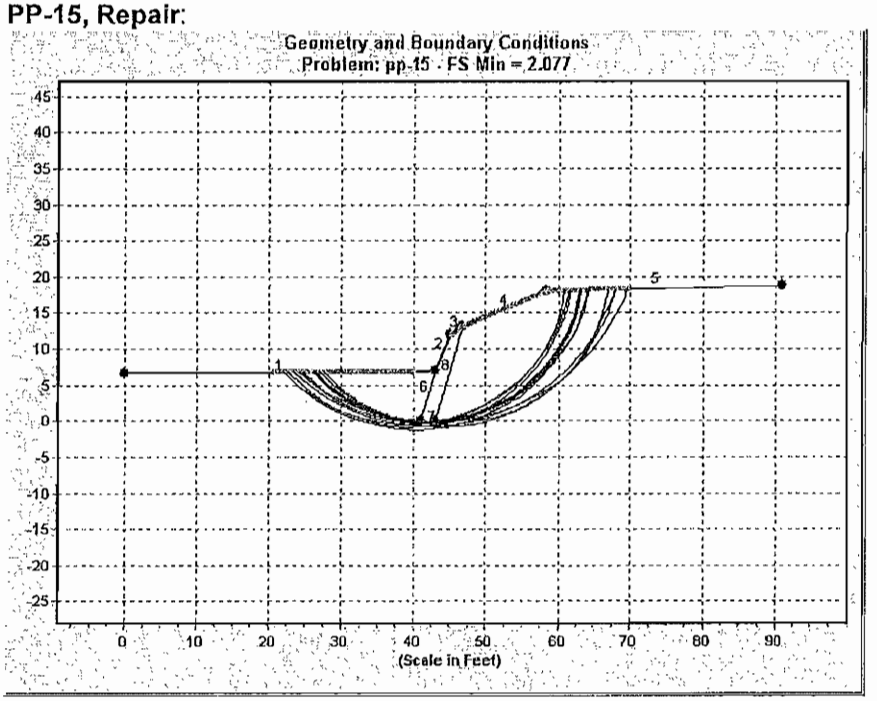


Figure 15

CROSS SECTIONS AND SLOPE STABILITY ANALYSIS
PANTANO WASH BANK PROTECTION
PANTANO WASH BETWEEN SPEEDWAY BLVD AND TANQUE VERDE RD
PIMA COUNTY, ARIZONA
TERRACON PROJECT NO. 63085014

PP-15, Repair:



PP-16:

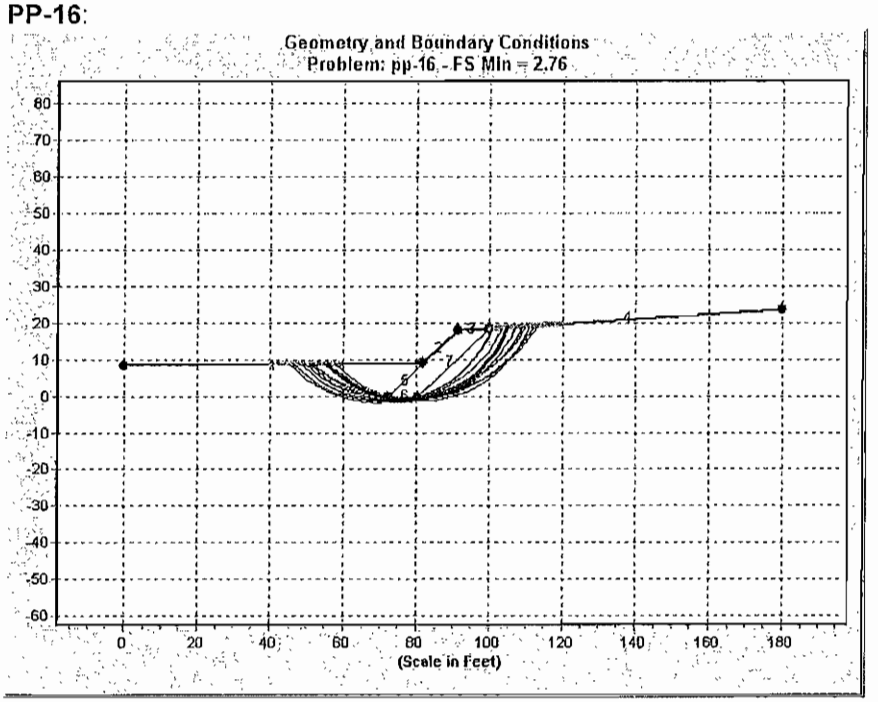
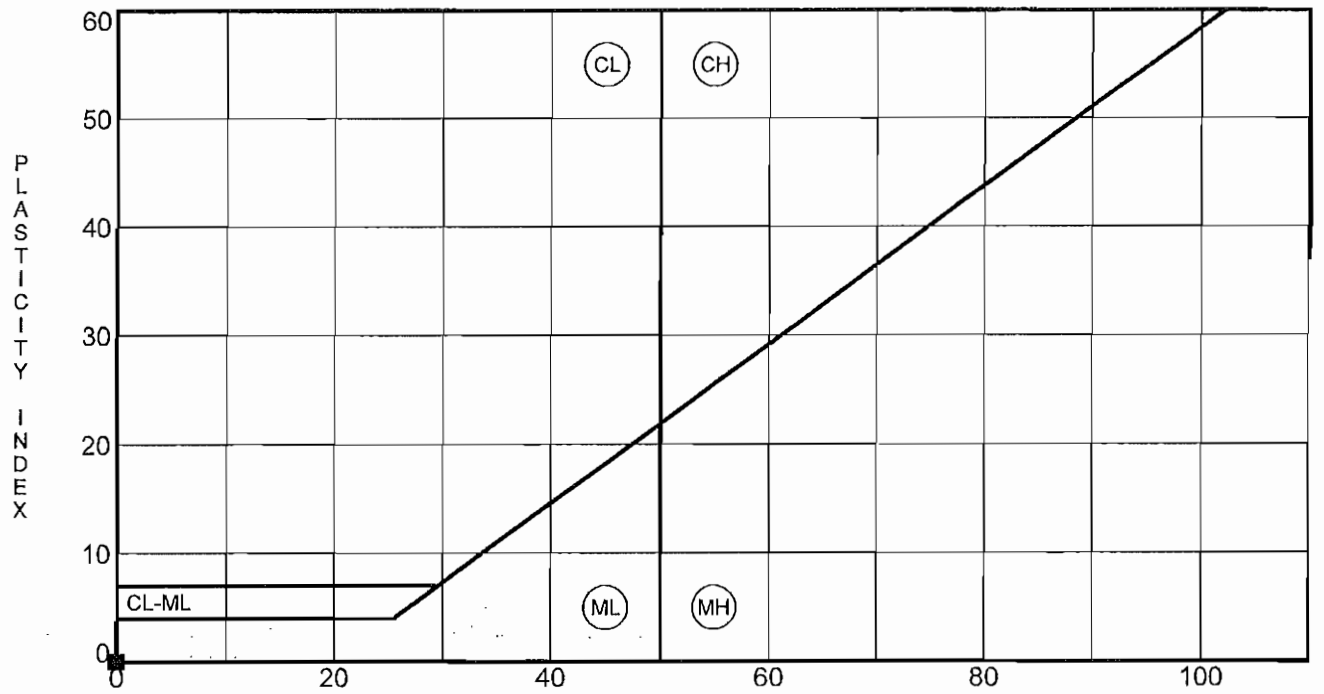


Figure 16



Specimen Identification			LL	PL	PI	%Fines	Classification
●	B-01	0.0ft - 4.0ft	NP	NP	NP	10	GRAVELLY SAND WITH SILT (SP-SM)
⊠	B-01	10.0ft - 11.5ft	NP	NP	NP	20	SILTY SAND TRACE GRAVEL (SM)
▲	B-02	0.0ft - 2.5ft	NP	NP	NP	7	GRAVELLY SAND WITH SILT (SP-SM)
★	B-02	20.0ft - 21.5ft	NP	NP	NP	6	GRAVELLY SAND WITH SILT (SP-SM)
⊙	B-03	0.0ft - 5.0ft	NP	NP	NP	21	SILTY SAND WITH GRAVEL (SM)
✿	B-03	10.0ft - 11.5ft	NP	NP	NP	6	GRAVELLY SAND WITH SILT (SP-SM)
○	HS-1	0.0ft - 2.0ft	NP	NP	NP	3	POORLY GRADED SAND WITH GRAVEL (SP)
△	HS-2	0.0ft - 2.0ft	NP	NP	NP	3	POORLY GRADED SAND WITH GRAVEL (SP)
⊗	HS-3	0.0ft - 1.0ft	NP	NP	NP	2	POORLY GRADED SAND WITH GRAVEL (SP)
⊕	TP-02	0.0ft - 15.0ft	NP	NP	NP	5	GRAVELLY SAND TRACE SILT COBBLES AND BOULDERS (SP)
□	TP-05	0.0ft - 8.0ft	NP	NP	NP	9	SAND WITH GRAVEL AND SILT TRACE COBBLES (SP-SM)
⊖	TP-07	0.0ft - 13.0ft	NP	NP	NP	4	SAND WITH GRAVEL TRACE SILT AND COBBLES (SP)
◓	TP-13	0.0ft - 9.0ft	NP	NP	NP	2	GRAVELLY SAND TRACE SILT AND COBBLES (SP)

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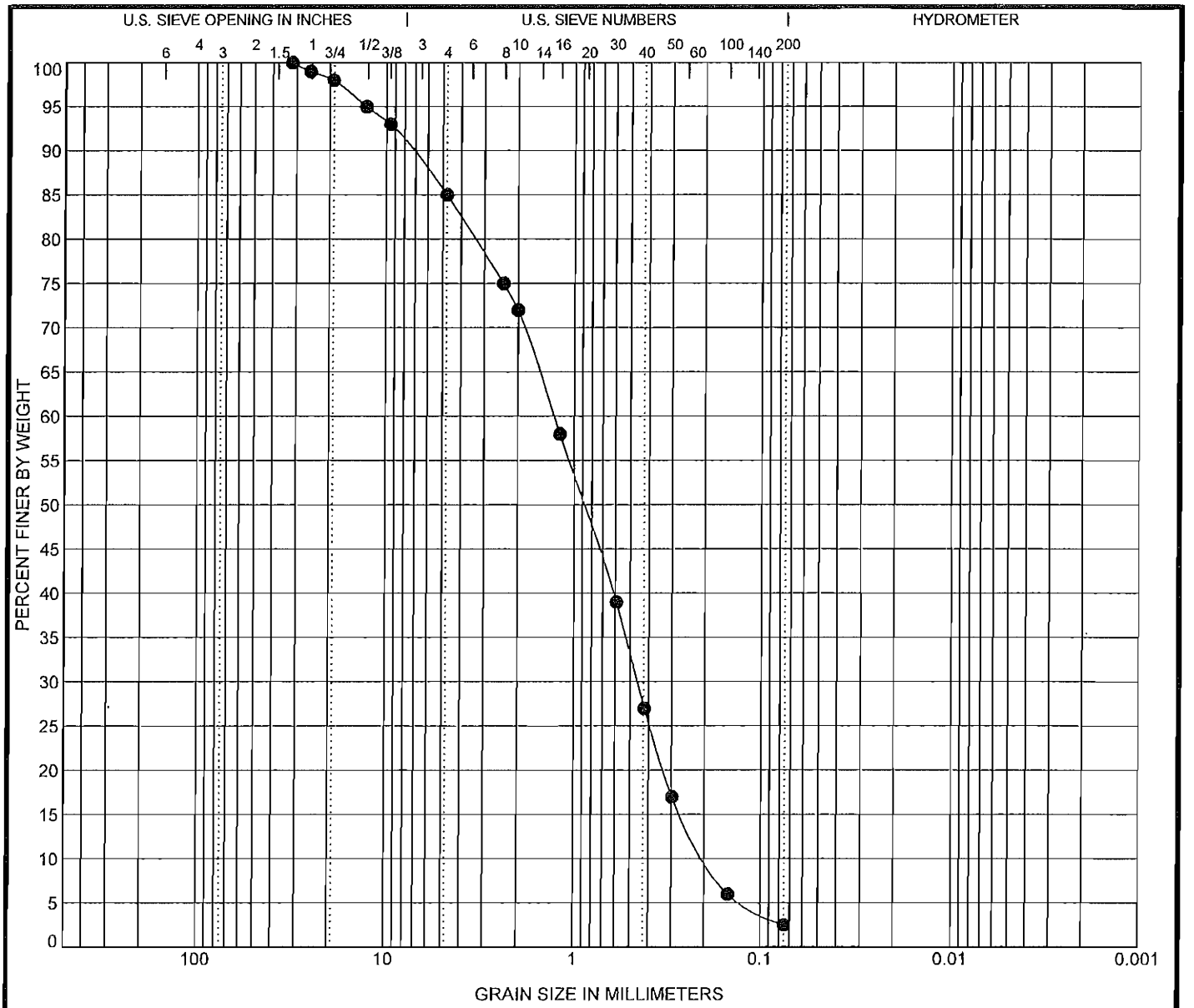
ATTERBERG LIMITS RESULTS

Project: Pantano Wash Bank Protection
Site: Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona
Job #: 63085014
Date: 7-30-08

TC ATTERBERG LIMITS 63085014.GPJ TERRACON.GDT 7/30/08



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	HS-1 0.0ft - 2.0ft	POORLY GRADED SAND WITH GRAVEL (SP)	NP	NP	NP	0.85	6.69
⊠							
▲							
★							
⊙							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	HS-1 0.0ft - 2.0ft	31.75	1.282	0.457	0.191	15.0	82.5	2.5	
⊠									
▲									
★									
⊙									

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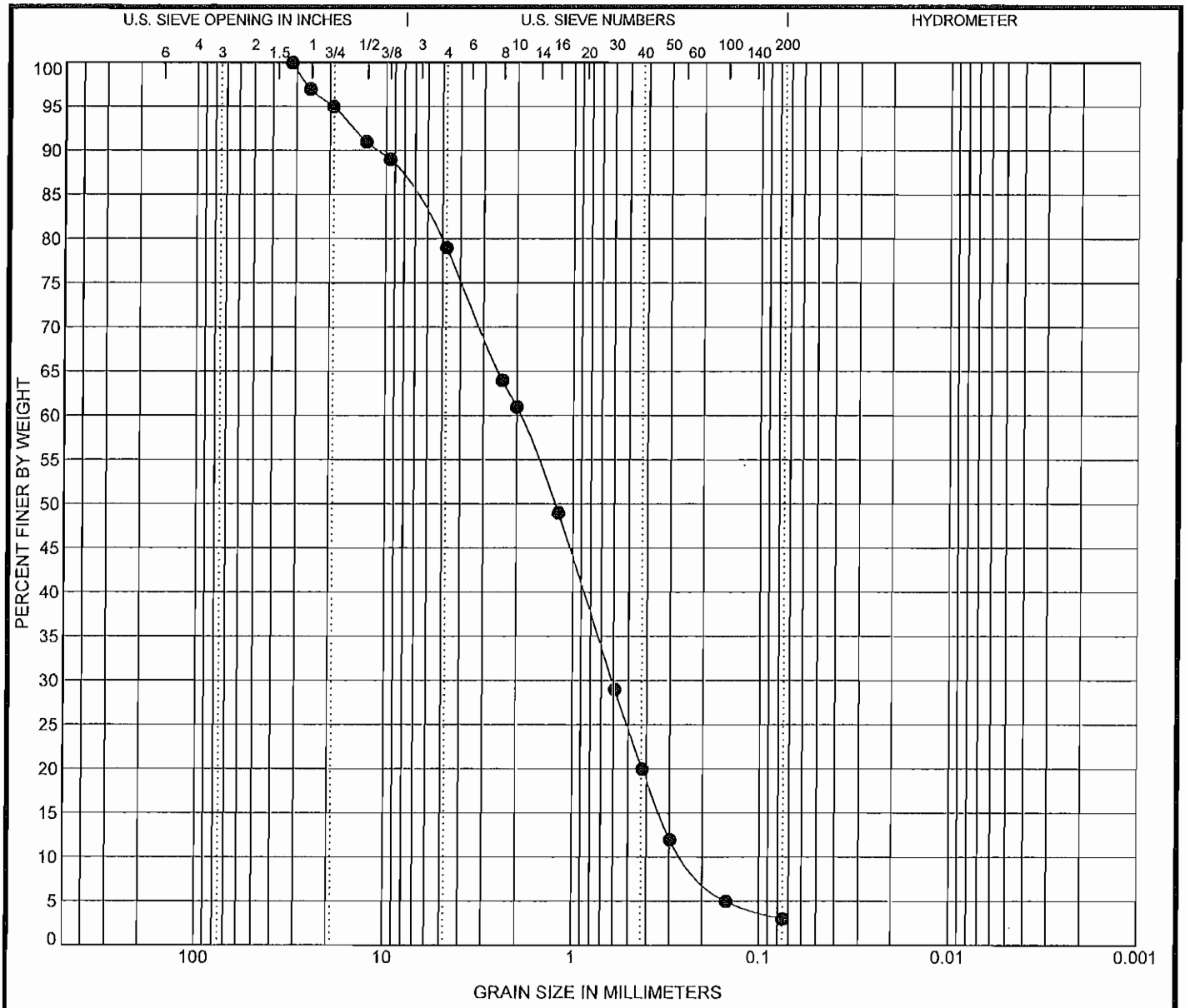
GRAIN SIZE DISTRIBUTION

Project: Pantano Wash Bank Protection
Site: Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona
Job #: 63085014
Date: 7-30-08

TC GRAIN SIZE 63085014.GPJ TERRACON.GDT 7/30/08



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	HS-2 0.0ft - 2.0ft	POORLY GRADED SAND WITH GRAVEL (SP)	NP	NP	NP	0.80	7.85
⊠							
▲							
★							
⊙							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	HS-2 0.0ft - 2.0ft	31.75	1.915	0.611	0.244	21.0	76.0	3.0	
⊠									
▲									
★									
⊙									

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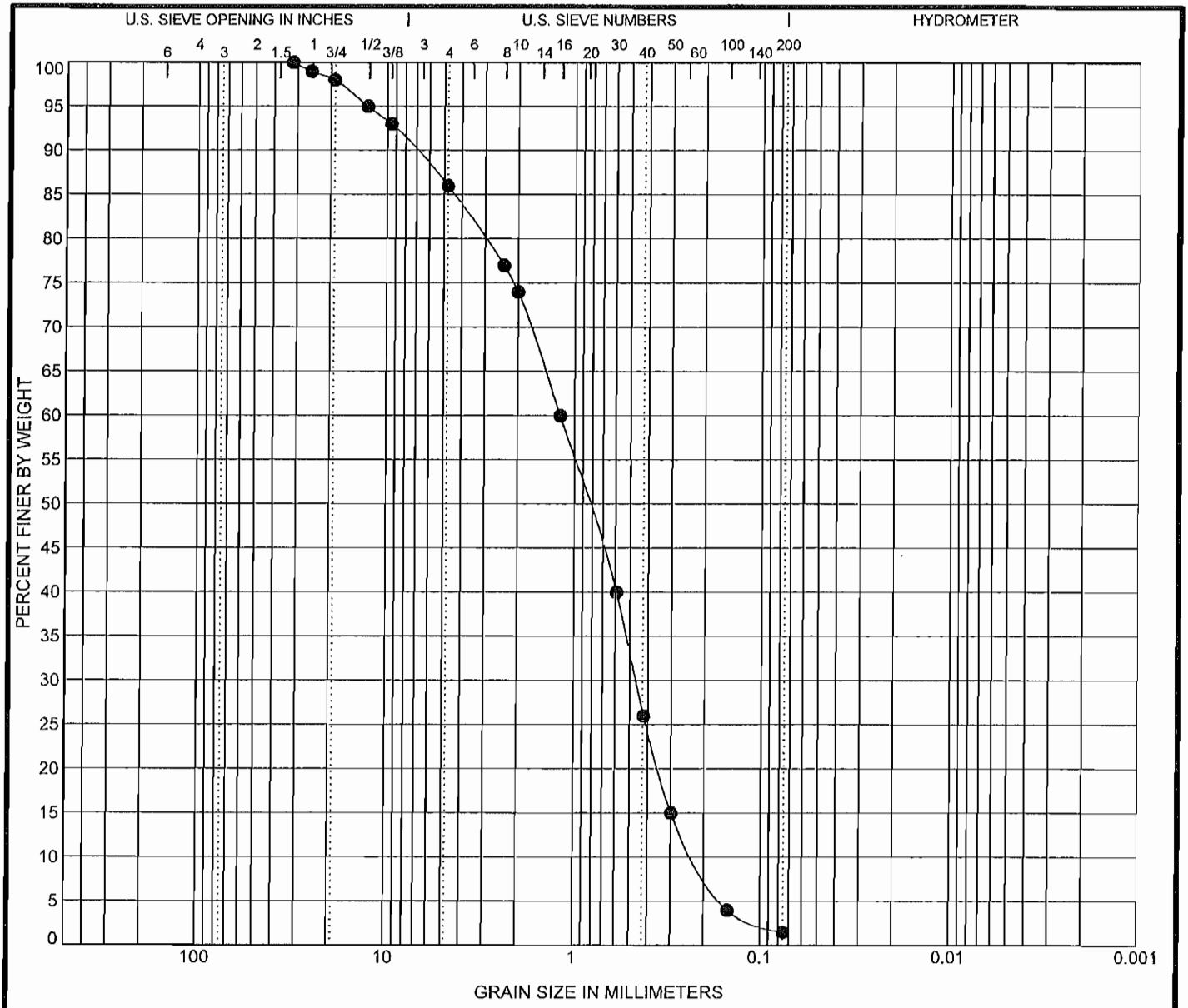
GRAIN SIZE DISTRIBUTION

Project: Pantano Wash Bank Protection
Site: Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona
Job #: 63085014
Date: 7-30-08

TC GRAIN SIZE 63085014.GPJ TERRACON.GDT 7/30/08



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	HS-3 0.0ft - 1.0ft	POORLY GRADED SAND WITH GRAVEL (SP)	NP	NP	NP	0.83	5.48
⊠							
▲							
★							
⊙							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	HS-3 0.0ft - 1.0ft	31.75	1.19	0.463	0.217	14.0	84.5	1.5	
⊠									
▲									
★									
⊙									

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GRAIN SIZE DISTRIBUTION

Project: Pantano Wash Bank Protection
Site: Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona
Job #: 63085014
Date: 7-30-08

TC GRAIN SIZE 63085014.GPJ TERRACON.GDT 7/30/08

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Remolded Expansion				Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	pH	Resistivity (ohm-cm)	Chlorides (ppm)	Sulfates (ppm)	
						LL	PL	PI									
B-01	0.0 - 4.0	SP-SM			10	NP	NP	NP									
B-01	10.0 - 11.5	SM			20	NP	NP	NP									
B-02	0.0 - 2.5	SP-SM			7	NP	NP	NP									
B-02	7.5 - 8.5	SP	98	22													1, 2
B-02	10.0 - 11.0	SP-SC	79	32													1, 2
B-02	20.0 - 21.5	SP-SM			6	NP	NP	NP									
B-03	0.0 - 5.0	SM			21	NP	NP	NP									
B-03	10.0 - 11.5	SP-SM			6	NP	NP	NP									
HS-1	0.0 - 2.0	SP			3	NP	NP	NP									
HS-2	0.0 - 2.0	SP			3	NP	NP	NP									
HS-3	0.0 - 1.0	SP			2	NP	NP	NP									
TP-02	0.0 - 15.0	SP			5	NP	NP	NP									
TP-05	0.0 - 8.0	SP-SM			9	NP	NP	NP									
TP-07	0.0 - 13.0	SP			4	NP	NP	NP									
TP-13	0.0 - 9.0	SP			2	NP	NP	NP									

REMARKS

1. Dry density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Compacted density (approximately 95% of ASTM D698 maximum density at moisture content slightly below optimum).
5. Corrosivity Results reported as 0 indicate the sample was at a Non-Detectible level.

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SUMMARY OF LABORATORY RESULTS

Project: Pantano Wash Bank Protection

Site: Pantano Wash Bet. Speedway & Tanque Verde Pima County, Arizona

Job #: 63085014

Date: 7-30-08

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 3" O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per foot," and is not considered equivalent to the "Standard Penetration"or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 -15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

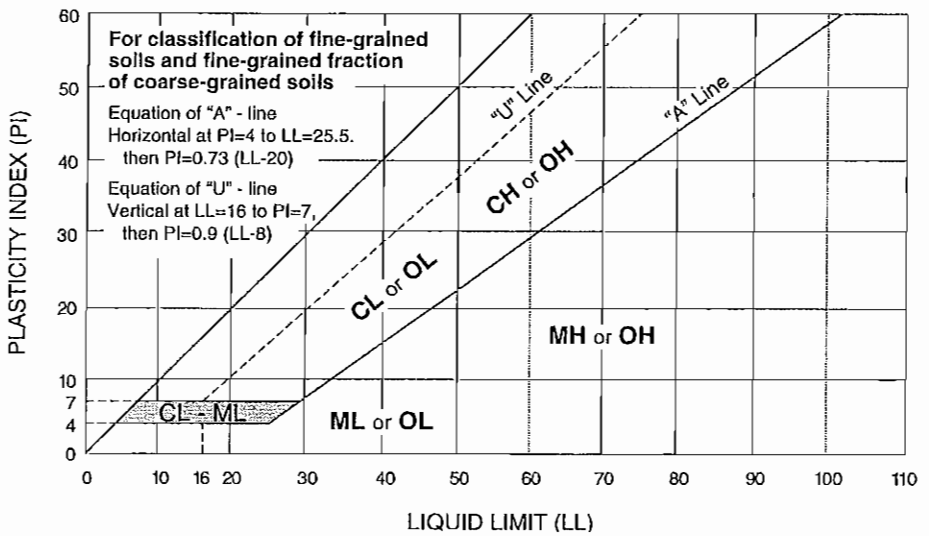
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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