APPENDIX A

Exploration Logs

GMU
GEOTECHNICAL, INC.

APPENDIX A

GMU GEOTECHNICAL EXPLORATION PROCEDURES, BORING LOGS, CONE PENETRATION TESTS, AND TEST PIT LOGS

Our exploration at the subject site consisted of three bucket auger borings, one hollow stem auger boring, and two continuous core borings. The estimated locations of the borings are shown on Plate 2. Our bucket auger and hollow stem auger borings were logged, and undisturbed samples were taken using a 3.0-inch outside-diameter drive sampler which contains a 2.416-inch-diameter brass sample sleeve 6 inches in length. In addition, blow counts recorded during sampling from the drive sampler are shown on the drill hole logs. Standard Penetration Tests (SPT) were also taken in hollow stem drill hole. Small bulk samples of the material were collected, and blow counts for each SPT were recorded on the logs. Continuous core samples were collected in the core borings. The logs of all GMU borings are contained in Appendix A-1 and the Legend to Logs is presented as Plate A-1. Logs of subsurface investigations performed by others are contained in Appendix A-2.

The geologic and engineering field descriptions and classifications that appear on these logs are prepared according to Corps of Engineers and Bureau of Reclamation standards. Major soil classifications are prepared according to the Unified Soil Classification System as modified by ASTM Standard No. 2487. Since the description and classification that appear on the Log of Drill Hole are intended to be that which most accurately describe a given interval of a drill hole (frequently an interval of several feet), discrepancies do occur in the Unified Soil Classification System nomenclature between that interval and a particular sample in that interval. For example, an 8-foot-thick interval in the Log of Drill Hole may be identified as silty sand (SM) while one sample taken within the interval may have individually been identified as sandy silt (ML). This discrepancy is frequently allowed to remain to emphasize the occurrence of local textural variations in the interval.

The descriptive terminology of the logs is modified from current ASTM Standards to suit the purposes of this study and is summarized as follows:

a.	Soil Type	- per Legend to Logs
b.	Color	- at field moisture
c.	Moisture	- (as estimated during drilling)
	"dry"	
	"damp"	- some moisture but less than optimum for compaction
	"moist"	- near optimum
	"wet"	- above optimum
	"saturated"	- containing free moisture

d. Grain size - "fine," "medium" and "coarse"

e. Density (granular soils) – "loose," "medium dense" and "dense"

f. Consistency (cohesive soils)

"very soft"	Thumb will penetrate soil more than 1 inch (25 mm).
"soft"	Thumb will penetrate soil about 1 inch (25 mm).
"firm"	Thumb will indent soil about 3 inch (5 mm).
"hard"	Thumb will not indent soil but readily indented with thumbnail.
"very hard"	Thumbnail will not indent soil.

APPENDIX A-1

GMU Geotechnical Boring Logs

MAJOR DIVISIONS			Group Letter	Symbol	TYPICAL NAMES
COARSE-GRAINED SOILS More Than 50% Retained On No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	GRAVELS 50% or More of Coarse Fraction Retained on No.4 Sieve	Clean Gravels	GW		Well Graded Gravels and Gravel-Sand Mixtures, Little or No Fines.
			GP		Poorly Graded Gravels and Gravel-Sand Mixtures Little or No Fines.
		Gravels With Fines	GM		Silty Gravels, Gravel-Sand-Silt Mixtures.
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures.
	SANDS More Than 50% of Coarse Fraction Passes No.4 Sieve	Clean Sands	SW		Well Graded Sands and Gravelly Sands, Little or No Fines.
			SP		Poorly Graded Sands and Gravelly Sands, Little or No Fines.
		Sands With Fines	SM		Silty Sands, Sand-Silt Mixtures.
			SC		Clayey Sands, Sand-Clay Mixtures.
FINE-GRAINED SOILS 50% or More Passe The No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	SILTS AND CLAYS Liquid Limit Less Than 50%		ML		Inorganic Silts, Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts With Slight Plasticity.
			CL		Inorganic Clays of Low To Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
			OL		Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit 50% or Greater		MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils, Elastic Silts.
			CH		Inorganic Clays of High Plasticity, Fat Clays.
			OH		Organic Clays of Medium To High Plasticity, Organic Silts.
HIGHLY ORGANIC SOILS			PT		Peat and Other Highly Organic Soils.

ADDITIONAL TESTS

DS = Direct Shear
HY = Hydrometer Test
TC = Triaxial Compression Test
UC = Unconfined Compression
CN = Consolidation Test
(T) = Time Rate
EX = Expansion Test
CP = Compaction Test
PS = Particle Size Distribution
EI = Expansion Index
SE = Sand Equivalent Test
AL = Atterberg Limits
FC = Chemical Tests
RV = Resistance Value
SG = Specific Gravity
SU = Sulfates
CH = Chlorides
MR = Minimum Resistivity
pH
(N) = Natural Undisturbed Sample
(R) = Remolded Sample

SAMPLE SYMBOLS

Undisturbed Sample (California Sample)

Undisturbed Sample (Shelby Tube)

Bulk Sample

Unsuccessful Sampling Attempt

SPT Sample

Nuclear Density Test and Bag for Moisture

10. 10 Blows for 12-Inches Penetration
6/4: 6 Blows Per 4-Inches Penetration
P: Push
(13): Uncorrected Blow Counts ("N" Values) for 12-Inches Penetration-Standard Penetration Test(SPT)

GEOLOGIC NOMENCLATURE

B = Bedding
S = Shear
C = Contact
F = Fracture
J = Joint
Flt = Fault
RS = Rupture Surface

▼ = Groundwater

GMU GEOTECHNICAL, INC.

LEGEND TO LOGS

ASTM Designation: D 2487
(Based on Unified Soil Classification System)

Plate
X

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Drill Hole DH-1** Sheet 1 of 5

Date(s) Drilled	6/15 - 6/16/10	Logged By	WAD	Checked By	LBS
Drilling Method	Bucket Auger	Drilling Contractor	Alroy Drilling Services, Inc.	Total Depth of Drill Hole	103.0 feet
Drill Rig Type	EZ Bore	Diameter(s) of Hole, inches	30	Approx. Surface Elevation, ft MSL	145.0
Groundwater Depth [Elevation], feet	N/A ▯	Sampling Method(s)	Open drive sampler with 6-inch sleeve	Drill Hole Backfill	Native, Tamped
Remarks	Refusal at 103 feet; Not downhole logged below 93 feet due to low oxygen levels			Driving Method and Drop	Kelly

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			SOUTH SHORES LANDSLIDE (Qols) Upper 5.1 feet of hole cased due to fractured cherty siltstone and caving		CLAYEY SILT (ML), gray, light brown to brown, damp, hard to very hard						
140	5		Intact remnant bedrock - large block of remnant Altamira Shale member of Monterey Formation; clayey siltstone with interbeds of siliceous siltstone, siliceous siltstone beds up to 2 inches thick	B: N70W, 10S	Becomes very firm to hard at 5 feet	■	2	4800	36	72	
			Bedding on siliceous siltstone bed at 6 feet Zone of siliceous siltstone, 3 feet thick, fractured, well-bedded at 7 feet		SILT (ML), gray, damp, very hard						
135	10		Interbedded clayey siltstone, siltstone, siliceous siltstone, moderately defined bedding at 10 feet	B: N70W, 10S	CLAYEY SILT (ML), gray to light brown, damp, very firm to hard	■	5	4800	41		
			Clayey siltstone interbedded with siliceous siltstone, joints are randomly oriented, infilled with gypsum, up to 1/8-inch thick at 12.5 feet		Becomes light brown to brown at 12.5 feet						
130	15		Interbedded clayey siltstone, siltstone, and siliceous siltstone, fractured and jointed; two prominent joints with gypsum infilling, up to 1/4-inch thick, at 15 feet	J: N17E, 74NW J: N5W, 84E	Becomes damp to moist at 15 feet	■	3	4800	60	64	FC
			Moderately defined bedding at 16.5 feet	B: N87W, 8S							
			Siliceous siltstone zone, 0.75 feet thick, highly fractured, orange staining on joint and bedding surfaces, gypsum infilling up to 1/4-inch thick at 17.5 feet		SILT (ML), brownish gray, damp, very hard						
			Interbedded siltstone and clayey siltstone at 19 feet	B: N58W, 6SW	CLAYEY SILT (ML), brown and light gray, damp to moist, very firm to hard						

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

GMU GEOTECHNICAL, INC.

Drill Hole DH-1

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-1

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							4	4800	44	75	
			Interbedded siltstone and siliceous siltstone, gypsum infilling up to 1/4-inch predominately on bedding, rarely on joints, well-defined bedding, dark brown staining on bedding and joints at 22 feet								
			Siliceous siltstone bed, 1-foot thick, at 24 feet		SILT (ML), gray, damp, very hard						
120	25		Bedding at 25 feet	B: N74E, 8S	CLAYEY SILT (ML), gray and brown, moist, hard to very hard		6	4800	40	75	DS
				B: N82W, 9S							
			Siliceous siltstone zone, well defined beds up to 8-inches thick, gypsum infilling along bedding planes, moderately fractured at 28.5 feet		SILT (ML), gray, damp, very hard Using core bucket during drilling at 29 feet						
115	30		Siltstone, poorly defined bedding at 30 feet Silty clay bed, gypsum infilling along joint that crosses bed, bed is up to 3/4-inch thick, at 27 feet		CLAYEY SILT (ML), gray and brown, moist, hard to very hard Too hard to sample at 30 feet						
			Increase in density, difficult to excavate at 32.5 feet		Becomes very hard at 32.5 feet						
110	35		Clayey siltstone, massive, 2-feet thick at 34.5 feet		CLAYEY SILT (ML), brown to orange brown, damp to moist, hard to very hard		7	3350	24	82	
					SILT (ML), gray and brown, moist, hard to very hard						
			Bedding at 38.5 feet	B: N38E, 4SE							
105	40						4	3350	43	79	
			Siliceous siltstone zone, 6-inches thick at 43 feet; below is poorly defined bedding		Becomes very hard at 43 feet Becomes hard at 43.5 feet						
			Subparallel joint set at 44 feet	J: N18W, 62SW							

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-1

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							12	3350	28	105	
			Siliceous siltstone zone, moderately fractured, open joints up to 1/3-inch (may be mechanical), lined with gypsum, massive, zone is 1-foot thick, below 46.5 feet Interbedded siltstone, clayey siltstone with moderately defined laminations at 47.5 feet		SILT (ML), gray, moist, very hard CLAYEY SILT (ML), gray and orange brown, moist, hard						
95	50						8	3350	36	85	
			Clayey siltstone, massive, random gypsum infilling at 52 feet		Becomes grayish brown at 52 feet						
90	55		Siliceous siltstone zone, dark brown staining on joint surfaces at 55 feet		SILT (ML), gray and brown, moist, hard to very hard Too hard to sample at 55 feet						
			Very minor seepage on NE wall, along joint surfaces at 58 feet		Becomes moist to wet at 58 feet						
85	60		Bedding at 59.5 feet	B: N79E, 8S	CLAYEY SILT (ML), gray and brown, moist, hard to very hard		11	2045	44	99	
			Discontinuous lenses of unoxidized material up to 2-inches thick, no bedding observed, gypsum-filled veins up to 1/8-inch thick below 63 feet		Becomes orange brown with dark bluish gray at 63 feet						FC
80	65		Increase in density, very difficult to excavate at 65.5 feet		Too hard to sample at 65 feet Becomes very hard at 65.5 feet						
			Grading to unoxidized siltstone, no bedding observed, very finely laminated, slight seepage along joints, difficult to excavate below 66.5 feet Unoxidized clayey siltstone, massive, random gypsum veins below 67.5 feet		SILT (ML), very dark brown, moist, very hard Becomes very dark gray at 67.5 feet						
			Prominent joint at 69.5 feet	J: N34W, 84SW							

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-1

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							15	2045	36	82	
			Siltstone, massive, prominent joint at 73.5 feet	J: N4W, 87W							
70	75						16	2045	30	86	DS
			Continues massive, difficult to excavate at 75.5 feet		Becomes dark blulsh gray at 75.5 feet						
					Becomes dark gray at 77.5 feet						
65	80		Poorly defined bedding, very difficult to excavate to 81.5 feet, used core bucket during drilling at 80 feet		Too hard to sample at 80 feet						
60	85						23	2045	34	85	
			Finely laminated, very difficult to excavate below 86.5 feet								
			Bedding at 88.5 feet	B:N70W, 8S							
55	90				Too hard to sample below 90 feet						
			End of downhole log due to lack of oxygen in boring at 93 feet								

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	Log of Drill Hole DH-1 Sheet 5 of 5

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA			TEST DATA		
						SAMPLE	NUMBER OF BLOWS	DRIVING WEIGHT, lbs	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
45	100										

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Drill Hole DH-2** Sheet 1 of 3

Date(s) Drilled	6/28/10	Logged By	LBS	Checked By	N/A
Drilling Method	Bucket Auger	Drilling Contractor	Alroy Drilling Services, Inc.	Total Depth of Drill Hole	63.0 feet
Drill Rig Type	EZ Bore	Diameter(s) of Hole, Inches	30	Approx. Surface Elevation, ft MSL	560.0
Groundwater Depth [Elevation], feet	N/A ▯	Sampling Method(s)	Open drive sampler with 6-inch sleeve	Drill Hole Backfill	Native, Tamped
Remarks	Refusal at 63 feet due to severe caving below 55 feet; not downhole logged below 55 feet			Driving Method and Drop	Kelly

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			SOUTH SHORES LANDSLIDE (Qols) Remnant blocks of bedrock, interbedded cherty siltstone and siltstone with some bentonitic tuff, scattered pockets of topsoil and remolded clayey silt, abundant rootlets below 0 feet Bedding at 2 feet	B: N-S, 32E	CLAYEY SILT (ML), light gray to light brown, dry to damp, soft to firm, locally hard	X			36		PS, HY, AL, CP, DS
555	5				Poor sample, very disturbed, loose, rocky at 5 feet	■	P	4800	39		
			Bedding at 8 feet	B: N20W, 26NE	Increase in density during drilling at 8 feet						
550	10					■	3	4800	23	101	
			Grades to siltstone and bentonitic tuff, jumbled and chaotic, no continuous structure below 13 feet		Becomes light gray and orange brown, damp to moist, firm at 13 feet						
545	15		Siliceous zone with minor interbedded bentonitic tuff, bedding highly discontinuous and folded below 14 feet Bedding at 15 feet	B: N40W, 34NE	SILT (ML), with some CLAY (CL), light gray and orange brown, damp, moist, firm to hard	■	3	4800	42	68	DS
					Increase in density, difficult drilling between 17 and 19 feet						
			Interbedded siliceous siltstone, siltstone, and bentonitic tuff, some shearing along		CLAYEY SILT (ML), light gray to light brown with orange brown, moist, firm to						

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-2

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			bedding below 19 feet		hard Too hard to sample at 20 feet						
			Bedding at 22 feet	B: N28W, 37NE							
535	25						2	4600	38		
			Siliceous siltstone zone between 25.5 and 27 feet	B: N20W, 27NE	SILT (ML), gray, damp to moist, hard						
			Sheared zone of predominately siltstone and bentonitic tuff fragments, jumbled, fractured, chaotic, no structure observed, abundant orange and black staining below 27 feet		CLAYEY SILT (ML), light gray to light brown, dry to damp, firm to very firm						
530	30						3	3350	33	65	DS
			Remnant blocks of siliceous siltstone up to 2 feet long within sheared debris matrix, very fractured, contorted, randomly oriented fragments and blocks, between 33.5 and 39 feet		SILT (ML), with some CLAY, gray, light brown, orange brown, damp, firm to hard						
525	35						5	3350 3350	29	81	PS, HY, AL, CP, FC, DS
					Increase in density, begin using crowds during drilling at 37 feet						
			Remnant fragments of bedrock, jumbled, chaotic, highly sheared, no continuous structure, scattered open fractures, many appear to be mechanical, below 39 feet		CLAYEY SILT (ML), light gray to light brown, orange brown, damp to moist, firm to very firm						
520	40						3	3350	23	78	

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-2

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			Remnant blocks of siliceous siltstone up to 2 feet long within sheared debris matrix, very fractured, contorted, randomly oriented fragments and blocks, between 45 and 49 feet General fabric or texture of debris trending E-W and dipping 20 S at 46 feet Prominent joint set within remnant blocks of siliceous siltstone, 2 to 6-inch spacing, at 47 feet	J: N36W, 84NE	SILT (ML), with some CLAY, gray, light brown, orange brown, damp, firm to hard		3	3350	24	76	
510	50		Siliceous siltstone, jumbled and chaotic, on NW wall is block of relatively intact partially oxidized clayey siltstone, block is about 2-feet wide and 2.5 feet wide, ragged edges, bound by debris between 49 and 51.5 feet	B: N70W, 43NE	CLAYEY SILT (ML), light gray to light brown and brown to dark brown, damp, very firm to hard		8	3350	28	77	
			Moderate caving of siliceous siltstone blocks below 51.5 feet		SILT (ML), gray, damp, very firm to hard						
505	55		Severe caving of siliceous siltstone blocks, some diatomaceous siltstone in cuttings, hole belled out to about 5-feet diameter; not downhole logged below 55 feet		Sample is siliceous/diatomaceous and rocky at 55 feet		3	3350	15	76	
500	60							3350	25	67	DS
			Probable base of caving, cuttings are clayey siltstone, siltstone, bentonitic tuff and some siliceous siltstone fragments, below 62 feet		CLAYEY SILT (ML), gray to brown, damp to moist, very firm						

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Drill Hole DH-3** Sheet 1 of 3

Date(s) Drilled	6/29 - 6/30/10	Logged By	LBS	Checked By	N/A
Drilling Method	Bucket Auger	Drilling Contractor	Alroy Drilling Services, Inc.	Total Depth of Drill Hole	60.0 feet
Drill Rig Type	EZ Bore	Diameter(s) of Hole, inches	30	Approx. Surface Elevation, ft MSL	663.0
Groundwater Depth [Elevation], feet	N/A []	Sampling Method(s)	Open drive sampler with 6-inch sleeve	Drill Hole Backfill	Native, Tamped
Remarks	Refusal at 60 feet due to severe caving below 53 feet; not downhole logged below 22 feet due to severe caving			Driving Method and Drop	Kelly

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			ARTIFICIAL FILL (Qaf) Upper 3.5 feet of hole cased due to caving and rocky fill soils		SANDY CLAY (CL), dark brown, orange mottled, dry to damp, firm						
660			Vari-colored fill soils from road grading, abundant rock fragments to 8-inches diameter, no visible lifts observed below 3.5 feet						17		PS, HY, AL
	5						2	4800	30		
655											
	10						P	4800			
650			Abundant siliceous siltstone fragments within fill soils up to 18-inches diameter, between 13 and 15 feet		Abundant gravel, cobble, and boulder-sized rock fragments at 13 feet						
	15						2	4800	34	72	
			Lower contact is diffuse and generally horizontal at 16 feet								
645			**SOUTH SHORES LANDSLIDE (Qols)** Soil matrix of sandy clay with abundant siliceous siltstone fragments up to 12-inches diameter, abundant staining, scattered small pockets of reddish orange bentonitic tuff, weathered, sheared, no continuous structure below 16 feet		SANDY CLAY (CL) with SILT (ML), light brown with black, orange, and white staining, damp, firm						
			Abundant siliceous siltstone fragments within landslide matrix, chaotic, no								FC

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

GMU GEOTECHNICAL, INC.

Drill Hole DH-3

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-3

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			observed structure below 19 feet Large block of siliceous siltstone on west wall, moderately bedded, general remnant bedding at 20 feet	B: N20E, 18SE			1	4800	38	62	DS
			Severe caving on west wall, belled out about 2 to 3 feet, within siliceous siltstone zone, fractured, discontinuous layers and lenses at 22 feet Not downhole logged below 22 feet due to severe caving		SILT (ML), gray, damp, hard						
640	25		Blocks of interbedded clayey siltstone, bentonitic tuff and siliceous siltstone within landslide matrix, fractured, abundant brown and orange staining, some shearing observed in sample at 25 feet		CLAYEY SILT (ML), light brown, yellow brown, light gray, damp, firm to very firm with local hard areas		2	4800	24	84	
635											
	30						3	3350	28	81	DS
630											
	35		Increase in density, using crowds during drilling below 35 feet		Becomes light brown to light gray with orange at 35 feet		3	3350	36	63	
625											
	40		Increase in siliceous siltstone content, siliceous fragments in sample are fractured, fractures lined with brown staining, randomly oriented at 40 feet		Becomes light gray, light brown, yellow gray, firm at 40 feet		1	3350	37	72	
620											

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-3

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			Some gypsum infilling in sample at 45 feet				3	3350	43	70	
615											
	50		Siliceous siltstone and siltstone, continued fractured in sample at 50 feet		SILT (ML), gray, damp, firm to very firm		1	3350	41	66	
610			Siliceous siltstone, difficult drilling, severe caving due to fractured siliceous material; inspection from surface indicates hole is belled out between 5 and 7 feet; below 53 feet		Becomes hard to very hard at 53 feet						
	55										
605											
	60										

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Drill Hole DH-4** Sheet 1 of 3

Date(s) Drilled	7/8/10	Logged By	LBS	Checked By	N/A
Drilling Method	Hollow Stem Auger	Drilling Contractor	2R Drilling, Inc.	Total Depth of Drill Hole	46.5 feet
Drill Rig Type	CME 75	Diameter(s) of Hole, inches	10	Approx. Surface Elevation, ft MSL	403.0
Groundwater Depth [Elevation], feet	N/A ▯	Sampling Method(s)	Open drive sampler with 6-inch sleeve/SPT	Drill Hole Backfill	Concrete Slurry
Remarks				Driving Method and Drop	Auto Hammer

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	NUMBER OF BLOWS	DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			RECENT ALLUVIUM (Qal) Upper 2 to 3 feet clast-supported material with abundant subangular to subrounded fragments of bedrock with minor sandy clay soils		CLAY (CL/CH) with SAND, dark brown, moist, soft						
400			Debris from canyon mud and debris flows; no structure, abundant bedrock fragments, unconsolidated below 3 feet		Sample very disturbed at 2.5 feet		10	140	27 46		PS, HY, AL, FC
	5				Becomes dark brown and orange brown at 5 feet		(10)	140			
395					With scattered plant fragments, soft to firm at 7.5 feet		26	140	36	83	
	10				CLAY (CL/CH) with trace SAND, dark brown, moist to wet, soft		(9)	140			
390					With scattered bedrock fragments at 12.5 feet		26	140	32	84	CN
	15						(38)	140			
385							24	140	38	76	CN

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-4

Sheet 2 of 3

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
							(9)	140	35		PS, HY, AL
380							26	140	40	74	CN
	25						(9)	140			
375					Poor sample, very disturbed at 27.5 feet		17	140	23		
	30						(40)	140			
			SOUTH SHORES LANDSLIDE (Qols) Remnant blocks of bedrock within silty clay matrix; blocks range from relatively intact to highly disturbed below 31 feet		SANDY SILT (ML), orange brown, moist, very firm, fine grained						
370					Disturbed sample, soft, at 32.5 feet		49	140	29	81	
	36		Abrupt significant increase in density reported by driller at 34.5 feet		SANDY CLAY (CL), with some SILT, reddish brown, orange brown, pale gray, moist, very firm		(25)	140			
365							88	140	32 35	89 83	
	40						(23)	140			
360							42	140	42 34	80 80	

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Drill Hole DH-4

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA			TEST DATA		
						SAMPLE	NUMBER OF BLOWS	DRIVING WEIGHT, lbs	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
					Becomes yellow brown to reddish brown at 45 feet		(31)	140			
365											

DH_REV3 10-036-00.GPJ GMULAB.GPJ 10/05/10

GMU GEOTECHNICAL, INC.

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Core Hole C-1** Sheet 1 of 10

Date(s) Drilled	06/22/10	Logged By	WAD	Checked By	LBS
Drilling Method	Continuous Core	Drilling Contractor	Ruen Drilling, Inc.	Total Depth of Drill Hole	149.0 feet
Drill Rig Type		Drill Bit Size/Type	HQ	Approx. Surface Elevation, ft MSL	
Groundwater Level and Date Measured		Backfill	Slurry	Inclination from Horizontal/Bearing	90
Comments					

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
0								**SOUTH SHORES LANDSLIDE (Qols)** CLAYEY SILT (CL); dark brown, rock fragments (Tma) up to 1" in diameter, moist, moderately stiff	1401	
1	1		53		0					
2										
3								3/4" thick in diameter fragment of Tma Tma pieces: SHALE and SILICIOUS SANDSTONE; grey and tan in matrix of SILTY CLAY (CL); dark brown, moist, moderately stiff, largest fragment is 2.5"	1405	S-Hammer= 26, R2
4										
5	2		28		0					
6		1						rock fragments		
7								matrix: SILTY CLAY (CL); dark brown, minor Tma shale fragments up to 3/4" in diameter, moist, stiff	1424	
8										
9	3		38		13					
10										
11									1442	
12								same as above, gradational lower contact		
13	4		100		0			SILTY CLAY/CLAYEY SILT (CL); brown and tan,slightly moist, very firm, siltstone fragments up to 1/2" in diameter		

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
13		1				1		1) 5° irregular fracture along siltstone fragment		
14								SILTY CLAY (CL); gray, brown, and tan, slightly moist, very firm	1452	
15								Irregular contact SILTY CLAY (CL); dark brown, slightly moist, very firm, orange to brown rock fragments up to 1/2" in diameter		
16	5		77		0			irregular contact		
17						2		2) 15° ash beds?, CLAY (CL); orange brown, orange, white, slightly moist, very firm, tight, no infilling		
18								highly fractured chert, less then 1/2" in diameter pieces		
19										
20										
21	6		14		0					
22										
23		2								
24									1609	
25	7		0		0					
26										
27									1525	
28	8		0		0			In the tip only: SILTY CLAY (CL) with Siltstone fragments, tan, moist		
29										

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Sheet 3 of 10

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
	29								SILTY CLAY (CL); brown and tan mottled, moist, very firm	1533/0752	
	30	9		100		0			SILTSTONE (ML); grey, highly fractured (mechanical), hard, moist		
	31		2				1		CLAYEY SILT (CL); brown and grey to brown	0755	
									1) 20° B, no infilling, tight, siltstone, grey, hard		
	32								CLAYEY SILT (CL); brown and grey mottled, no bedding gypsum crystals up to 1/4"		
	33	10		90		0					
	34						2		CLAYEY SILT (CL); brown and orange brown, subtle bedding, hard, slightly moist		
									2) 15° B, subtle bedding, tight, no infilling, marked by color changes		
	35								highly fractured siltstone, grey		
									SILTSTONE; grey with orange brown staining on joints, highly fractured		
	36								CLAYEY SILT (CL); mottled grey, orange brown, and brown, slightly moist, hard, subtle bedding 5°		
	37	11		100		0			color changes to orange brown and grey		
									subtle bedding, color changes brown and dark brown		
	38						1		1) 5° B, infilled with gyp, 0.1" thick		
							2		2) 15° B, subtle layering, tight		
	39						B		SILTSTONE; gray and brown, hard, subtle bedding, moist B) 5° B, tight, indistinct	0842	
	40		3				1		1) 7° B, tight, no infilling, orange brown staining		
							2		2) 20° J gyp infilled, 0.5" thick		
	41						3		3) 12° B clay seam, 0.15" thick, tight, sticky		
		12		88		22	4		CLAYEY SILTSTONE; brown and orange brown mottled, no bedding observed, slightly moist, hard		
									4) 70° J, tight, orange brown and black staining, no infilling		
	42						7		SILTSTONE; grey, very hard, massive 7) 65° J, gyp infilling 0.1" thick		S. Hammer= 38, R2
							5		5) 65° J, gyp infilling, 0.1" thick, orange brown and black staining		
	43						6		6) 15° J, gyp infilling 0.1" thick		
	44						1		1) 55° J, gyp infilling to 0.05"		
							2		2) 11° B, subtle, tight		
									SILTSTONE; grey, very hard, subtle bedding, black bed/lense, gradational change to a CLAYEY SILTSTONE; grey and orange		
	45										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Sheet 4 of 10

Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
45						1		brown, very subtle bedding, hard, slightly moist		
								1) 12° B, no infilling, subtle		
46	13		62		42	2		2) 8° B, no infilling, tight, black staining on surface SILTSTONE; grey, hard, interbedded with CLAYEY SILTSTONE, gray and orange brown		S. Hammer= 38, R2
47										
48						3		3) 23° J, gypsum infilled up to 0.2", loose, fr, highly fractured		
						1		1) 7° B, tight, no infilling	0906	
49								interbedded SILTSTONE; grey and brown gray, very hard, with clayey siltstone, dark brown, hard, slightly moist		
						1				
50						2		subtle horizontal bedding CLAYEY SILTSTONE; very dark brown, hard, subtle bedding, rare orange brown veins		
		4				2				
51	14		94		15			2) 0° V, gypsum, 1.3" thick CLAY to SILTY CLAY (CL) right orange mottled with tan and yellow, no bedding apparent, random gypsum veins, irregular and discontinuous, deformed, no regular bedding or jointing, very mottled		
52						3		3) 8° B, subtle, finely laminated, tight, no infilling SILTSTONE, very dark brown, hard, subtle laminations		
53						4		4) 34° J, gypsum infilling 0.2" thick		
								SILTSTONE; grey and brown, interbedded hard and very hard	0921	
54						1		BENTONITE and GYPSUM; orange, pink, and white, slighty moist, sticky, firm		
						9		55° J, gyp. infilled, variable 0.1" to 0.4" thick, loose, deformed/disturbed		
55						2		SILTSTONE; dark brown and grey brown, hard to very hard SILTSTONE; grey, very hard, massive		
						3		9) <5° B, clay seam, tan to brown, sticky, 0.2" to 0.3" thick 2) 68° J, tight, no infilling, black and orange brown staining on surface		
						4		3) 5° B, no infilling, narrow		
56	15		92		0			4) 65° J, 0.05" gypsum infilling, vary narrow, orange brown staining		
						6		6) 25° J, narrow, orange brown staining, no infilling		
						7		7) 33° J, narrow, orange brown staining, no infilling		
57						8		8) 20° J, narrow, orange brown staining, no infilling		
						5		SILTSTONE; grey brown, becoming dark brown below clay seam		
								5) 10° B, clay seam, tan, sticky, 0.4" thick, soft		
58								subtle bedding,hard, slightly moist		
59						1		8° B, gypsum infilling 0.2" thick	0935	
								Interbedded SILTSTONE; grey and dark brown, hard and very hard, subtle bedding, tight		
		5				2				
60								2) 12° B, tight, CLAYEY SILTSTONE, finely laminated, subtle		
						3				
								3) 0° B, CLAY (CL) seam, brown, sticky, 0.2" thick, soft, slightly moist		
61										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
61	16	5	98		45	4		4) 8° B, tight, no infilling		
62								gradational change to SILTSTONE; tan, slightly moist, hard, massive, minor very fine sand		S. Hammer= 18, R1
63						5		5) 65° J, narrow, no infilling, irregular surface		
64								interbedded SILTSTONE and CLAYEY SILTSTONE; orange brown, brown and gray, slightly moist, hard to very hard.		
65						1		1) 8° B, dark orange, clayey silt bed, tight		
						2		2) 35° V, irregular, gypsum, < 0.1"		
						3		CLAY (CL); orange and grey, mottled, deformed/distorted, slightly moist, firm		
66	17		100		31	3		3) 25° B, tight, no infilling		
								Irregular contacts: CLAY (CL); bright red, orange and white, sticky, slightly moist, firm		
67						4		4) 20° B, tight, narrow		
68						5		5) 15° B, tight, narrow		
						5		Interbedded CLAY (CL) and SILTSTONE, no well defined bedding, irregular clay veins		
69		6						SILTSTONE to CLAYEY SILTSTONE, brown and orange brown, slightly moist, hard	1002	
						1		1) 7°-12° B, clay seams, tan, 0.1 to 0.4" thick		
70								SILTY CLAYSTONE; pale tan, very firm, slightly sticky, tight, 0.7 to 1.5" thick, interbedded with tan clay seams, 0.1 to 0.4" thick		
71										S. Hammer= 10, R1
	18		100		86					
72										
73						2		2) 30° J, gyp, up to 0.1"		
						3		3) 30° J, gyp up to 0.2"		
								SILTSTONE; dark brown and gray, subtle bedding, hard to very hard		
74								SILTSTONE, very dark brown, very hard, fractured, rare gypsum veins up to 0.05" thick, irregular	1113	
75		7								
76	19		68		22	1		1) 5° B, narrow, no infilling, orange brown staining		
77										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Sheet 6 of 10

Elevation, feet / Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
77						2		2) 21° J, tight, no infilling		
						3		3) 40° J, tight, no infilling, orange brown staining on surface SILTSTONE, grey and brown, hard, slightly moist, subtle bedding		
						4				
78						4		4) 18° B, color changes: orange, black, orange brown beds <0.1" thick, tight, otherwise bedding very subtle		
						4				
79								SILTSTONE; grey and brown, highly fractured, very hard		
		7				1				
	20		89		0			1) 60° J, no infilling		
80								SILTSTONE; very dark brown, subtle bedding, hard, rare, irregular gypsum veins <0.1" thick		
						2		2) 5° B, tight, orange brown, CLAYEY SILTSTONE, up to 1" thick, irregular upper contact		
81									1149	
						1		CLAYEY SILTSTONE; dark brown, slightly moist, very firm to hard, no bedding observed		
								1) 5° B, CLAY (CL) seam, brown up to 0.4" thick, irregular		
82						2		2) 53° J, gypsum infilling, 0.05" thick, orange brown staining		
						1				
								SILTSTONE and CLAYEY SILTSTONE; brown and grey, subtle bedding, hard to very hard		
83	21		96		25					
84						3		3) 12° B, subtle bedding, grey, orange brown, tan beds, ≤ 0.1"		
85						4		4) 70° J, gypsum infilling up to 0.05" thick, tight		
								SILTSTONE; dark brown, no bedding observed, highly fractured, slightly moist, hard to very hard	1203	
86										
87						1		1) 45° J, gypsum infilling < 0.05" thick, tight		
	22		100		26	2		2) 38° B, contact with orange tan, clay, very stiff, slightly moist		
88						3		3) highly irregular contact with tan and yellow tan SILTY CLAY (CL), slightly moist, hard, interbeds of brownish tan clay, irregular, up to 0.4" thick		
89						1		1) 70° tight, gypsum infilling up to 0.05"		
						2		2) irregular 0° B, gypsum infilling up to 0.3"		
90						3		BENTONITE; orange and grey with tan, very firm, mottled/deformed, tight, tight, no shearing, irregular lower contact (3) with a SILTSTONE; very dark brown, highly fractured, many discontinuous gypsum veins, up to 0.1" thick, no distinct bedding to subtle bedding < 5° B		
91										
	23		100		32					
		8								
92						4		4) 10° to 15° irregular BENTONITE bed up to 0.5" thick, tan with orange mottling		
								SILTSTONE; dark brown, highly fractured, hard gypsum veins, discontinuous		
93						5		SILTSTONE; grey and dark grey, very hard, massive		

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
93						6 7		5) 15° B, subtle color changes observed to mark bedding 6) 50° J, trace of gypsum 7) 65° J, traces of gypsum CLAYSTONE and CLAY lens; distorted, clay lens up to 0.4" thick		
94		8				1		**ALTAMIRA SHALE MEMBER OF THE MONTEREY FORMATION (Tma)** SILTSTONE; grey, very hard, massive		S. Hammer= 34, R2
95						1		1) 26° B, tight, no infilling, bedding marked by subtle color changes		
96	24		100		80					
97										
98						2		2) 28° J, gypsum infilling up to 0.05"		
99						1		SILTSTONE; tan and gray, hard to very hard, subtle bedding 1) 14° B		
100		9				2 3 3 5		2) 25° J, gypsum up to 0.4" thick 3) 20° B, colored beds, grey, orange brown, tan, mark bedding 5) 30° J gypsum up to 0.4" thick		
101						3 3 4		4) 5° B CLAY (CL) seam, brown/tan, 0.2" thick		
102	25		90		32	6		6) 20° J, gypsum up to 0.2" thick SILTSTONE; dark brown, subtle bedding, slightly moist, hard Mottled grey, tan and orange CLAYEY SILTSTONE		
103								contact between oxidized (above) and unoxidized (below) bedding SILTSTONE; dark grey, very hard, rare gypsum veins, up to 0.1" thick, random		
104								CLAYEY SILTSTONE; dark grey, slightly moist, massive, rare gypsum veins up to 0.1", hard, sticky in areas	1254	
105						1		1) 34° J, tight Interbeds of very hard SILTSTONE up to 1" thick (2)		
106		10				2				S. Hammer= 32, R2
107	26		100		62			2) 5° B, interbedded very hard SILTSTONE		
108								mechanically fractured		
109										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Sheet 8 of 10

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
109						1		1) 43° J, no infilling		
						2		2) 50° J, no infilling, slightly wavy surface, narrow		
110								SILTSTONE; very dark grey, very hard, laminated, highly fractured		
		10								
111	27		98		10	3		3) 24° B, grey beds up to 0.1" thick, laminated		
112								CLAYEY SILTSTONE; very dark grey, interbedded with very hard, dark grey SILTSTONE, highly fractured		
113									1328	
114						1		1) 6° B, grey beds up to 0.1" thick, laminated		
115										
	28		92		0					
116						2		2) 10° B, subtle bedding marked by lighter and dark grey		
117								CLAYEY SILTSTONE; very dark grey, minor discontinuous gypsum veins up to 0.1", highly fractured, no bedding observed		
118										
									1348	
119						1		SILTSTONE; dark grey and grey interbedded, beds up to 1" thick, moderate discontinuous fractures		
								1) 17° B		
120		11				1		Minor interbeds of grey CLAYEY SILTSTONE up to 0.75" thick		
								Very tight, few fractures, very consistent bedding		
121	29		100		52					S. Hammer= 38, R2
122										
123										
124						1		1) 7° B, very tight, very consistent bedding, few fractures		
125										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Sheet 9 of 10

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
	125		11								
	126	30		100		37	2		more fractured zone		S. Hammer= 16, R1
	127								50° J, tight, no infilling, wavy		
	128						3		3) 22° B, very consistent bedding, beds <0.1" thick abundant Mn staining on irregular joints, Mn staining is very shiny may be 0.05" thick, void open to 0.4", lined with Mn		
	129								SILTSTONE; dark grey, very hard, very fractured, heavy Mn staining on joint surfaces		
	130	31		14		0			Core caught in barrel and retrieve disturbed	1453	
	131									1405	
		32		0		0					
	132		12				1		SILTSTONE; very dark grey, hard, moist	0738	
							2		1) 8° B, clay seam, dark grey, 0.4" thick, sticky, no shearing observed		
	133	33		100		0	2		2) 18° B, interbedded SILTSTONE and fine grained SANDY SILTSTONE, bedding very consistent, bedding planes cleave easily, beds 0.5" to 2" thick		
	134						2				
							2				
	135						1		SILTSTONE; very dark grey, very hard, interbedded with SANDY SILTSTONE and SILTY SANDSTONE, very fine grained, grey and dark grey. Beds range from laminations to 1" thick and well defined	0755	
							2		1) 26° B 2) 22° B		
	136						3		3) 62° J, narrow, no infilling		
	137	34		100		23	4		4) 73° F, offset 0.5", irregular surface infilled with up to 0.2" clay gouge		
	138						6 5		6) 43° J, tight 5) 23° B		
	139						1		CLAY (CL); bluish grey, sticky, moist, stiff		
									SILTSTONE; dark gray and bluish grey, scattered clay seams <0.05"		
	140	35	13	83		22	2		1) 4° B clay seam		
							3		2) 6° B clay seam 3) 10° B clay seam		
	141										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-1

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
141								SILTSTONE; dark grey, very hard, tight bedding, few joints, scattered SILTY SANDSTONE beds, fine grained		
142						1		1) 26° B, clay lined <)>05" thick		
143	36	13	100		70	2		2) 12° B, clay bed, 0.4" thick, bluish grey, stiff, sticky		
144						3		Bedding below clay bed opposite dip appears core rotated about 180° on clay 3) 24° B CLAYEY SILTSTONE; dark bluish grey, very hard, subtle bedding		
145						5 4		5) 22° B, SILTSTONE and SILTY SANDSTONE, dark grey brown 4) 73° J, narrow, no infilling, very hard, tight, well bedded		
146						1		SILTSTONE; very dark brownish grey, very hard, well bedded, beds generally <0.5" thick 1) 16° B, very consistent bedding	0846	S. Hammer= 22, R1
147	37	14	100		25	1				
148						1		SILTY SANDSTONE, dark brownish grey, fine grained, very hard, well bedded		
149								T.D. 149	0858	
150										
151										
152										
153										
154										
155										
156										
157										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Core Hole C-2** Sheet 1 of 7

Date(s) Drilled	06/25/10	Logged By	WAD	Checked By	LBS
Drilling Method	Continuous Core	Drilling Contractor	Ruen Drilling, Inc.	Total Depth of Drill Hole	103.8 feet
Drill Rig Type		Drill Bit Size/Type	HQ	Approx. Surface Elevation, ft MSL	
Groundwater Level and Date Measured		Backfill	Slurry	Inclination from Horizontal/Bearing	90
Comments					

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
0								AC pavement section, 0.7' thick, aggregate up to 1" in asphalt	856	
1								**ARTIFICIAL FILL (Qaf)**		
2	1		2		0			SANDY SILT (SM) and SILTY CLAY (CL) matrix with abundant gravel, rare rock fragments up to 6". Tan, slightly moist, very firm, gravel is angular, no layering observed		
3										
4										
5										
6										
7	2	1	100		0			matrix becomes brown and grey brown		
8										
9	3		100		0					
10										
11	4		85		0					
12										S. Hammer= R2, 44 In Silicious Siltstone chunk
13										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-2

Sheet 2 of 7

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
13										
14								Abundant angular gravel in SILTY CLAY (CL) and SANDY SILT (SM) matrix. Matrix is grayish brown, slightly moist, stiff/ firm to moderately loose. No layering observed		
15										
16	5		57		0					
17										
18		2								
19								**RECENT LANDSLIDE DEBRIS (Qlsr)** CLAYEY SILT (ML) with SAND (SP); loose, slightly moist, dark brown CLAYEY SILT (ML) with SAND (SP) ; dark brown, slightly moist, medium firm, rare caliche, scattered angular rock fragments of Monterey formation		
20										
21	6		90		0					
22										
23										
24								SANDY SILT (SM) with CLAY (CL); grey tan, moist, firm, abundant rock fragments up to 3", roots and rootlets		
25								Gradually becomes tan, SANDY SILT (SM) minor CLAY (CL), very firm, abundant gravel fragments, scattered cobble size fragments, no layering		
26	7		92		0					
27		3								
28										
29									1050	

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-2

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
29										
30								SANDY SILT (SM); tan, slightly moist, very firm, abundant gravel sized rock fragments, rare rock fragments up to 6"		
31	8		91		0					
32		3								S. Hammer= 32, R2
33								SANDY SILT (SM) and CLAYEY SILT (ML); tan, slightly moist, very firm, abundant gravel sized rock fragments up to 6"		
34										
35	9		98		0					
36										
37										
38									1116	
39		4				1		1) 26° Sh: Highly polished surface, slightly wavy, no striations		
40	10		100		0			SOUTH SHORES LANDSLIDE (Qols) Distorted bentonite clay beds and lenses, orange, tan, and grey, slightly moist, very stiff, waxy, highly irregular		
41								SANDY SILT (SM) and CLAYEY SILT (ML); tan and grey, slightly moist, firm to very firm, abundant angular rock fragments		
42										
43								CLAYEY SILTSTONE; orange brown with grey mottling, slightly moist, hard		
44								Scattered black mottling, subtle distorted bedding, beds 0.1" thick to 0.5" thick		
45						1				

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-2

Sheet 4 of 7

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
45								1) Approximately 1° B on undulatory/distorted bedding		
46	11		88		0					
47										
48										
49						1		BENTONITIC CLAY and altered ASH beds, interbedded, soft sediment, deformation, clay beds up to 0.2" thick, orange, white, grey and orange brown		
50						2		1) approximately 7° to 10° B 2) 25° B		
51	12	5	92		0	3		SILTSTONE, CLAYEY SILTSTONE interbedded Gray and orange brown, moist hard to very hard		
52						4		3) 7° B, very hard siltstone bed 4) 55° J, orange brown and black staining, no infilling, irregular surface		
53										
54								SILTSTONE and CLAYEY SILTSTONE, tan and grey mottled, subtle distorted bedding, minor black and orange brown staining, hard to very hard, very hard areas highly fractured		
55						1				
56	13		86		0			1) 27° B, very hard SILTSTONE bed, 0.4" thick		
57										
58										
59		6				1		SILTSTONE; tan, slightly moist, hard, grey mottles, interbeds of brown and tan clay 0.3" to 0.6" thick, each bed has a slightly variable thickness		
60						2		SILTSTONE; tan, highly fractured, very hard, black staining on joint surfaces, interbedded with clayey siltstone and sandy siltstone, grey, orange brown, hard SANDSTONE; very fine grained, grey and tan, very hard, subtle bedding		
61	14		98		31	3		ASH bed; pale tan, SILTY CLAY (CL), slightly moist, hard		

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon Project Location: 25th Street, Rancho Palos Verdes Project Number: 10-036-00	**Log of Core Hole C-2** Sheet 5 of 7

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
61										
								3) 21° B		
62						4		Finely bedded SILTSTONE and CLAYEY SILTSTONE, tan, brown and gray, very hard, consistent bedding		
								4) 12° B		
63										
		6							1239	
64								SILTSTONE, orange brown and grey, hard to very hard, poorly defined bedding, slighlly moist		
65										
	15		58		0	1				
66								1) 15° B		
67										
68										
						1		SILTSTONE, tan, slightly moist, hard with brown clay interbeds up to 0.5" thick		
69								1) 10° B		
								SILTSTONE, gray, very hard, fractured		
						2		Finely bedded orange brown, tan, and gray, SILTSTONE, and CLAYEY SILTSTONE		
70								2) 10° B		
						3		3) 65° J		
	16		92		44			SANDSTONE, very fine grained, tan and grey, very hard, few joints or fractures, massive		
71										
								Interbedded SILTSTONE, SANDY SILTSTONE, CLAYEY SILTSTONE; tan, brown, orange brown, indistinct bedding, hard to very hard, slighlty moist		S. Hammer= 16, R1
72		7								
73										
								subtle bedding		
74						1		1) 12° B		
						2		2) 18° B		
75								SILTSTONE bed, gray, very hard		
76	17		94		12	3		3) 13° B Contact with bright orange CLAY (CL), waxy, very stiff, slighlty moist, interbedded with grey brown and tan siltstone, deformed in clay portion, highly fractured in siltstone portion		
77										

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-2

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
	77						4		4) 63° J		
	78		7								
	79								Bright orange clay with white mottling		
							1		Interbedded SILTSTONE; gray and tan, hard to very hard, highly fractured and CLAY (cl); brown, slightly moist, sticky, very stiff 1) 5° B		
	80								Orange, white, and gray mottled BENTONITE CLAY; slightly moist, waxy, very stiff		
									SANDSTONE; very fine grained, massive, very hard		
	81	18		98		24	2		2) 78° J		
	82		8				3		SILTSTONE; grey and tan, very hard, slightly moist, subtle fine laminations interbedded with orange, grey, and white bentonite CLAY (CL), slightly moist, very stiff, waxy 3) 18° B		
	83										
	84								BENTONITE CLAY; pale grey, tan, orange brown, waxy, very stiff, tight, slightly moist, no bedding observed	1331	
	85										
	86								becomes crumbly		
		19		100		0					
	87										
	88										
	89		9						SILTY CLAY (CL) and CLAYEY SILT (ML); tan and brown, rock fragments up to 0.2", slightly moist, slightly sticky, no bedding observed, very firm, no discernible bedding, layering, or gradation, scattered very hard siltstone, does not appear to be in place. No jointing or bedding.		
	90										
	91										
		20		85		0					
	92										
	93										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

Project: San Ramon Canyon
Project Location: 25th Street, Rancho Palos Verdes
Project Number: 10-036-00

Log of Core Hole C-2

Sheet 7 of 7

Elevation, feet / Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	GEOLOGIC AND ENGINEERING DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND LAB TESTS
93										
94									434	
95		9				5		5) 13° irregular/wavy contact, no striations observed		
96	21		86		36	1		1) 37° B SILTSTONE, grey and dark grey, very hard, tight, few joints, rarely broken along bedding planes		
						2		2) 32° B		
97						3		3) 40° B		S. Hammer= 54, R3
98						4		4) 55° B SILTSTONE; tan, well defined, consistent bedding, slightly moist, very hard, minor black staining on joints		
99						1		1) 35° to 37° B		
100										
101	22	10	96		27	2		2) 90° J		
102										
103										
104									1459	
105										
106										
107										
108										
109										

CORE_LOG 10-036-00.GPJ GM&U.GDT 10/05/10

APPENDIX A-2

Exploration by Others

Ehlert, 1997

LOG OF BORING

BORING 1

PROJECT NO. P.N.3891-97 LOG NO. PAGE 1 of 2

Project 2700 1/2 SAN RAMON DRIVE, RANCHO PALOS VERDES, CA

Method of Drilling 24" BUCKET AUGER Ground Elevation

Location SEE SITE PLAN Logged by DL Date Observed

Depth (Ft.)	GRAPHIC LOG	DESCRIPTION	Symbol	Remarks
0		**NATURAL SOIL**: 0 to 2.5 feet of depth Natural soil consists of dark brown silty clay containing scattered pebble sized rock fragments, firm, moist, gradational contact with underlying slope wash.		
5		**TERRACE DEPOSITS**: 2.5 to 19.5 feet of depth material consists of dark brown silty clay mottled with abundant angular rock fragment, abundant white caliche staining, firm and tight. At 6.0 feet color changes to a light pale gray brown clayey silt matrix containing sub-rounded rock fragments to pebble and cobble size, firm, tight.		
10				
15		At 14.0 feet material consists of pale gray brown clayey silt matrix containing scattered sub-rounded pebble and cobble sized rock fragments, very firm and tight. At 18.0 feet start a gradational contact with highly weathered bedrock, contact consists of hard siliceous siltstone boulders that are encased in a dark brown silty clay matrix. In place bedrock occurs at a depth of 19.5 feet.		
20		**BEDROCK**: MONTEREY FORMATION, 19.5 to 76.5 feet of depth Bedrock consists of light gray siliceous siltstone, well bedded, firm, tight. Bedding attitude at 21.0 feet of depth is N51W 28SW.		
25		Bedrock consists of thinly layered cherty siltstone, green gray to orange brown in color, bedding layers are 1/4 inch thick or less, fish scales to 1/4 inch in diameter, very firm and tight. Between 23 feet to 26 feet of depth bedrock consists of extremely hard dolostone, light gray in color, breaks our in boulder sized blocks, coring required, well bedded.		
30		Bedding attitude at 26 feet of depth is N64W 29SW. Starting at 26 feet below dolostone layer bedrock consists of pale brown, greenish brown, orange brown siliceous siltstone, well bedded, thinly bedded with beds on the order of 1/8 inch thick, very tight, firm. Bedding attitude at 30 feet of depth is N62W 27SW.		
35		From 30.0 to 33.5 feet of depth siltstone becomes cherty, brittle, very hard, well bedded, and jointed. At 33.5 feet of depth bedrock changes back into a pale brown firm siliceous siltstone, not cherty, firm, tight, well bedded. Bedding attitude at 35.5 feet of depth is N55W 27SW.		
40				

LOG OF BORING

BORING 1

PROJECT NO. P.N.3891-97 LOG NO. PAGE 2 of 2

Project 2700 1/2 SAN RAMON DRIVE, RANCHO PALOS VERDES, CA

Method of Drilling 24" BUCKET AUGER Ground Elevation

Location SEE SITE PLAN Logged by DL Date Observed

Depth (Ft.)	GRAPHIC LOG	DESCRIPTION	Symbol	Remarks
40		Bedrock consists of light gray to light yellow brown siltstone, firm, tight, very well bedded with beds on the order of 1/8 inch thick, scattered fish scales to 1/4 inch in diameter.		
		Bedding attitude at 41 feet of depth is N56W 29SW.		
45		Bedrock consists of the same pale orange brown to light gray siliceous siltstone, firm tight, abundant fish scales, bedding is well defined.		
		Staring at 42.0 feet and 7.0 inches seepage is observed around sides of boring, water appears to be percolating through bedding layers and is dripping slowly down side of boring.		
50		Between 43.0 feet and 4.0 inches to 44.0 feet 3.0 inches is a bentonitic layer, light green to gray brown, contains discontinuous polished surfaces that are dipping parallel to bedding, slick and wet. At a depth of 44.0 feet, bentonitic material is dry and it appears that water is traveling along the top of the bentonitic layer, but is not present in the lower portion of the bentonitic layer. No continuous polished slip surfaces observed, appears to be somewhat jointed, bedding attitude at a depth of 44.0 feet 3.0 inches is N45W 24SW and was taken at the base of the bentonitic layer.		
55		Bedding attitude at 46.5 feet of depth is N60W 30SW.		
		Bedrock consists of light orange brown, pale gray siliceous siltstone, locally cherty layers, no fish scales observed at this depth, very firm to locally hard, tight, thinly bedded.		
60		At 48.5 feet of depth bedrock becomes very cherty and brittle, light orange brown, very hard, thinly bedded. At 50 feet of depth bedrock changes back into pale orange gray siliceous siltstone.		
		Bedding attitude at 50 feet of depth is N54W 29SW.		
		Bedding attitude at 52 feet of depth is N58W 40SW.		
		Between 50 and 52 feet of depth bedrock appears slightly folded and is dipping steeper and more westerly than above.		
65		Bedding attitude at 55.5 feet of depth is N82W 33SW.		
		Bedrock consists of pale orange gray brown siliceous siltstone, firm, tight, well bedded, thinly bedded on the order of 1/8 inch thick.		
		Bedding attitude at 61 feet of depth is N87E 40SE.		
		Bedding attitude at 64 feet of depth is N75W 42SW.		
70		A light gray dolostone layer starts at 64 feet and extends down to 66 feet of depth, this layer is extremely hard and required coring, well bedded, blocky appearance.		
		Bedding attitude at 68 feet of depth is N56E 38SW.		
		Bedrock consists of light orange brown pale gray siliceous siltstone, very firm, tight, well bedded.		
75		Bedding attitude at 71 feet of depth is N51W 46SW.		
		Bedding attitude at 75 feet of depth is N54W 47SW.		
80				

LOG OF BORING

BORING 2

PROJECT NO. P.N.3891-97 LOG NO. PAGE 1 of 1

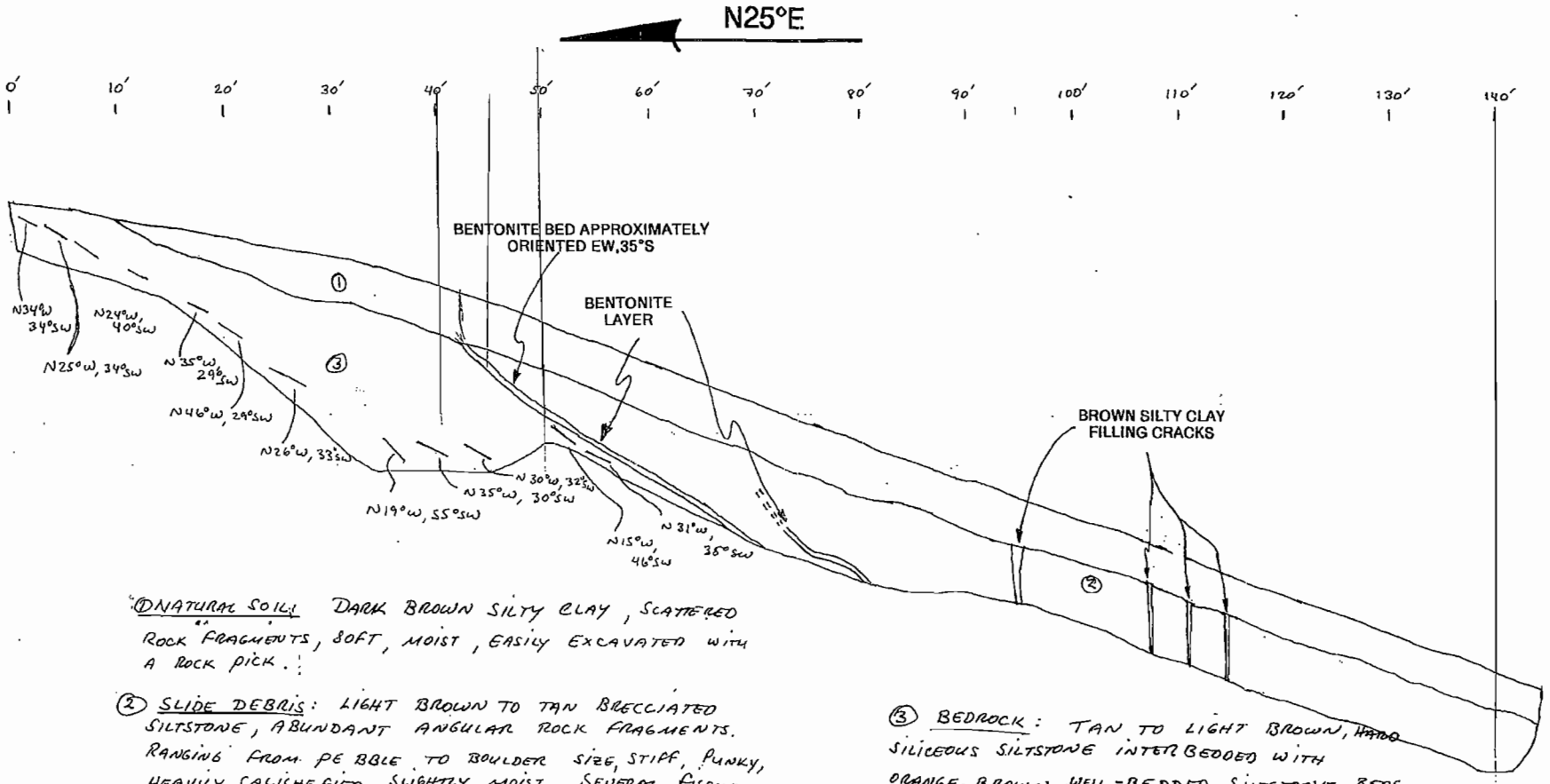
Project 2700 1/2 SAN RAMON DRIVE, RANCHO PALOS VERDES, CA

Method of Drilling 24" BUCKET AUGER Ground Elevation

Location SEE SITE PLAN Logged by DL Date Observed

Depth (Ft.)	GRAPHIC LOG	DESCRIPTION	Symbol	Remarks
0		**NATURAL SOIL**: 0 to 1.0 feet of depth Natural soil consists of dark brown silty clay containing scattered pebble sized rock fragments, firm, moist, gradational contact with underlying slope wash.		
5		**TERRACE DEPOSITS**: 1.0 to 2.5 feet of depth Light brown to gray silty clay containing scattered angular rock fragments with white caliche mottling, gradational change into bedrock, firm, tight.		
10		**BEDROCK**: MONTEREY FORMATION, 2.5 to 30.0 feet of depth Upper portion of bedrock is highly weathered to a depth of 15.0 feet, very hard, siliceous siltstone, barite crystals on faces of bedrock, bedding is very poorly defined. Grades downward into less weathered bedrock that is pale gray siliceous siltstone, very hard, tight, required coring.		
15		Bedding attitude at 16 feet of depth is N70W 20SW. Bedding attitude at 19 feet of depth is N54W 53SW. Bedding attitude at 20 feet of depth is N47W 45SW.		
20				
25		Bedding attitude at 25 feet of depth is N52W 60SW. Bedrock is very hard siliceous siltstone, light gray to light orange brown, coring was required for most of boring in bedrock. Moderately well defined bedding.		
30				
35				
40				

Ehlert, 1998



① NATURAL SOIL: DARK BROWN SILTY CLAY, SCATTERED ROCK FRAGMENTS, SOFT, MOIST, EASILY EXCAVATED WITH A ROCK PICK.

② SLIDE DEBRIS: LIGHT BROWN TO TAN BRECCIATED SILTSTONE, ABUNDANT ANGULAR ROCK FRAGMENTS. RANGING FROM PEBBLE TO BOULDER SIZE, STIFF, PUNKY, HEAVILY CALICHEFIED, SLIGHTLY MOIST. SEVERAL FISSURES FILLED WITH DARK BROWN CLAY (SOIL), ABUNDANT KROTOVINA.

③ BEDROCK: TAN TO LIGHT BROWN, ~~HARD~~ SILICEOUS SILTSTONE INTERBEDDED WITH ORANGE-BROWN WELL-BEDDED SILTSTONE. BEDS ARE ON THE ORDER OF ½ INCH THICK, HARD, TIGHT, MODERATELY JOINTED.

SCALE: 1"=10'

SKETCH LOG OF TRENCH 1 BY EHLERT, 1998

P.N. 3844-98

APPENDIX B

GMU Geotechnical Laboratory Test Results

GMU
GEOTECHNICAL, INC.

APPENDIX B

GEOTECHNICAL LABORATORY PROCEDURES AND TEST RESULTS

Moisture and Density. Field moisture content and in-place density were determined for each 6-inch sample sleeve of undisturbed soil material obtained from the drill holes. The field moisture content was determined in general accordance with ASTM Test Method D 2216 by obtaining one-half the moisture sample from each end of the 6-inch sleeve. The in-place dry density of the sample was determined by using the wet weight of the entire sample.

At the same time the field moisture content and in-place density were determined, the soil material at each end of the sleeve was classified according to the Unified Soil Classification System. The results of the field moisture content and in-place density determinations are presented on the right-hand column of the Log of Drill Hole and are summarized on Table B-1. The results of the visual classifications were used for general reference.

Particle Size Distribution. As part of the engineering classification of the materials underlying the site, samples were tested to determine the distribution of the particle sizes. The distribution was determined in general accordance with ASTM Test Method D 422 using U.S. Standard Sieve Openings 3", 1.5", 3/4, 3/8 and U.S. Standard Sieve Nos. 4, 10, 20, 40, 60, 100, and 200. In addition, on some samples a standard hydrometer test was also performed to determine the distribution of particle sizes passing the No. 200 sieve (i.e., silt and clay-size particles). The results of the tests are contained in Appendix B. Key distribution categories (% gravel; % sand, etc.) are contained on Table B-1.

Atterberg Limits. As part of the engineering classification of the soil underlying the site, samples of the on-site soil materials were tested to determine relative plasticity. This relative plasticity is based on the Atterberg limits determined in general accordance with ASTM Test Method D 4318. The results of this test are contained in Appendix B and also Table B-1.

Chemical Tests. The corrosion potential of typical on-site materials under long-term contact with both metal and concrete was determined by chemical and electrical resistance tests. The soluble sulfate test for potential concrete corrosion was performed in general accordance with California Test Method 417, the minimum resistivity tests for potential metal corrosion were performed in general accordance with California Test Method 643, and the concentration of soluble chlorides was determined in general accordance with California Test Method 422. The results of these tests are contained in Appendix B and also Table B-1.

Compaction Tests. A bulk sample representative of the underlying on-site materials was tested to determine the maximum dry density and optimum moisture content of the soil. These compactive characteristics were determined in general accordance with ASTM Test Method D 1557. The results of this test are contained in Appendix B and also Table B-1.

Consolidation Tests. The one-dimensional consolidation properties of "undisturbed" samples were evaluated in general accordance with the provisions of ASTM Test Method D 2435. Sample diameter was 2.421 inches and sample height was 1.00 inch. Water was added during the test at various normal loads to evaluate the potential for hydro-collapse and to produce saturation during the remainder of the testing. Consolidation readings were taken regularly during each load increment until the change in sample height was less than approximately 0.0001 inch over a two-hour period. The graphic presentation of consolidation data is a representation of volume change in change in axial load. In addition, time rate tests were performed for select samples. The results of these tests are contained in Appendix B.

Direct Shear Strength Tests. Direct shear tests were performed on typical on-site materials. The general philosophy and procedure of the tests were in accord with ASTM Test Method D 3080 - "Direct Shear Tests for Soils Under Consolidated Drained Conditions".

The tests are single shear tests and are performed using a sample diameter of 2.421 inches and a height of 1.00 inch. The normal load is applied by a vertical dead load system. A constant rate of strain is applied to the upper one-half of the sample until failure occurs. Shear stress is monitored by a strain gauge-type precision load cell and deflection is measured with a digital dial indicator. This data is transferred electronically to data acquisition software which plots shear strength vs. deflection. The shear strength plots are then interpreted to determine either peak or ultimate shear strengths. Residual strengths were obtained through multiple shear box reversals. A strain rate compatible with the grain size distribution of the soils was utilized. The interpreted results of these tests are shown in Appendix B.

TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information								Sieve/Hydrometer				Atterberg Limits			Compaction					Chemical Test Results			
Boring Number	Depth, feet	Elevation, feet	Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Gravel, %	Sand, %	<#200, %	<2μ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %	Expansion Index	R-Value	pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH-1	5	140.0	Qols	ML	36.0	72	74																
DH-1	10	135.0	Qols	ML	41.4																		
DH-1	15	130.0	Qols	ML	59.7	64	99													8	430	160	360
DH-1	20	125.0	Qols	ML	43.9	75	97																
DH-1	25	120.0	Qols	ML	39.8	75	87																
DH-1	35	110.0	Qols	ML	24.3	82	64																
DH-1	40	105.0	Qols	ML	42.9	79	105																
DH-1	45	100.0	Qols	ML	28.2	105	131																
DH-1	50	95.0	Qols	ML	35.5	85	99																
DH-1	60	85.0	Qols	ML	44.3	99	173																
DH-1	62	83.0	Qols	ML																7	563	390	170
DH-1	70	75.0	Qols	ML	35.8	82	93																
DH-1	75	70.0	Qols	ML	29.9	86	85																
DH-1	85	60.0	Qols	ML	33.7	85	93																
DH-2	1	559.0	Qols	SM	36.3			9	42	49	17	76	46	30	77.0	37.0							
DH-2	5	555.0	Qols	ML	39.0																		
DH-2	10	550.0	Qols	ML	23.0	101	96																
DH-2	15	545.0	Qols	ML	41.5	68	78																
DH-2	25	535.0	Qols	ML	37.9																		
DH-2	30	530.0	Qols	ML	33.1	65	57																
DH-2	35	525.0	Qols	ML	28.9	81	73	12	29	60	26	72	48	24	87.8	28.0			7.8	4	230	300
DH-2	40	520.0	Qols	ML	22.6	78	53																
DH-2	45	515.0	Qols	ML	24.0	76	53																
DH-2	50	510.0	Qols	ML	28.1	77	64																
DH-2	55	505.0	Qols	ML	15.2	76	34																

GMU_TABLE_SOIL_LAB_DATA 10-036-00.GPJ FNC AB GWGN01.GDT 9/29/10

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

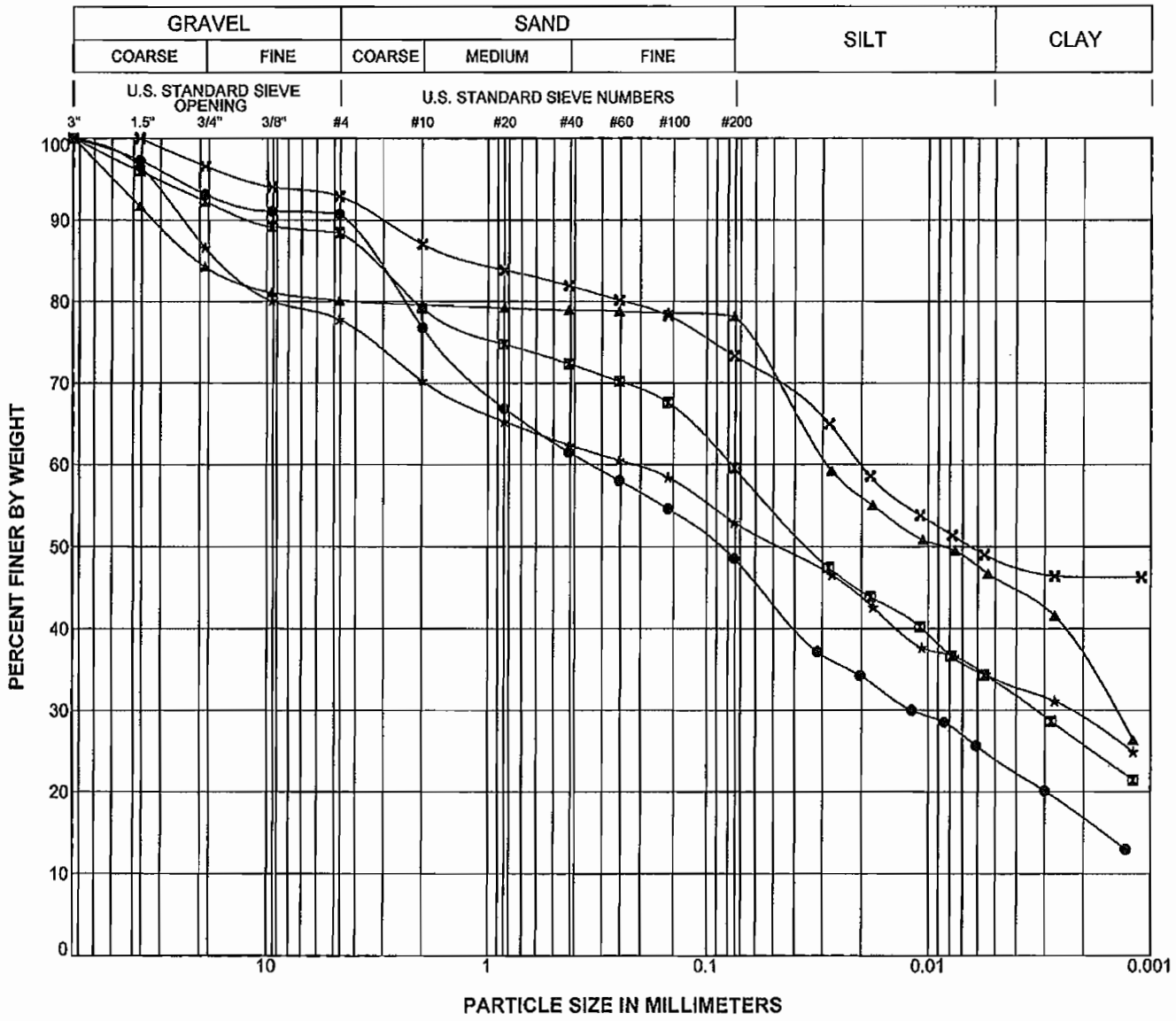
TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information								Sieve/Hydrometer				Atterberg Limits			Compaction				Chemical Test Results			
Boring Number	Depth, feet	Elevation feet	Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Gravel, %	Sand, %	<#200, %	<2μ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %	Expansion Index	R-Value	pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH-2	60	500.0	Qols	ML	24.6	67	44															
DH-3	3	660.0	Qaf	CH	16.6			20	2	78	36	83	36	47								
DH-3	5	658.0	Qaf	CL	29.9																	
DH-3	15	648.0	Qaf	CL	34.5	72	71															
DH-3	19	644.0	Qols	CL															8.1	51	200	270
DH-3	20	643.0	Qols	CL	37.5	62	59															
DH-3	25	638.0	Qols	ML	23.6	84	64															
DH-3	30	633.0	Qols	ML	28.5	81	73															
DH-3	35	628.0	Qols	ML	35.8	63	58															
DH-3	40	623.0	Qols	ML	37.5	72	76															
DH-3	45	618.0	Qols	ML	43.1	70	83															
DH-3	50	613.0	Qols	ML	41.5	66	72															
DH-4	2.5	400.5	Qal	MH	27.4																	
DH-4	3	400.0	Qal	MH	45.6			22	25	53	29	69	41	28					8.1	110	290	480
DH-4	7.5	395.5	Qal	CH	36.1	83	97															
DH-4	12.5	390.5	Qal	CH	31.6	84	87															
DH-4	17.5	385.5	Qal	CH	37.6	76	85															
DH-4	20	383.0	Qal	CH	35.1			7	20	73	46	72	29	43								
DH-4	22.5	380.5	Qal	CH	40.3	74	87															
DH-4	27.5	375.5	Qal	CH	22.7																	
DH-4	32.5	370.5	Qols	CH	28.8	81	73															
DH-4	37.5	365.5	Qols	SC	32.5	89	99															
DH-4	38	365.0	Qols	SC	34.8	83	92															
DH-4	42.5	360.5	Qols	SC	41.7	80	104															
DH-4	43	360.0	Qols	SC	33.5	80	83															

GMU_TABLE_SOIL_LAB_DATA 10-036-00.GPJ FNC AB GWGN01.GDT 9/29/10

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.



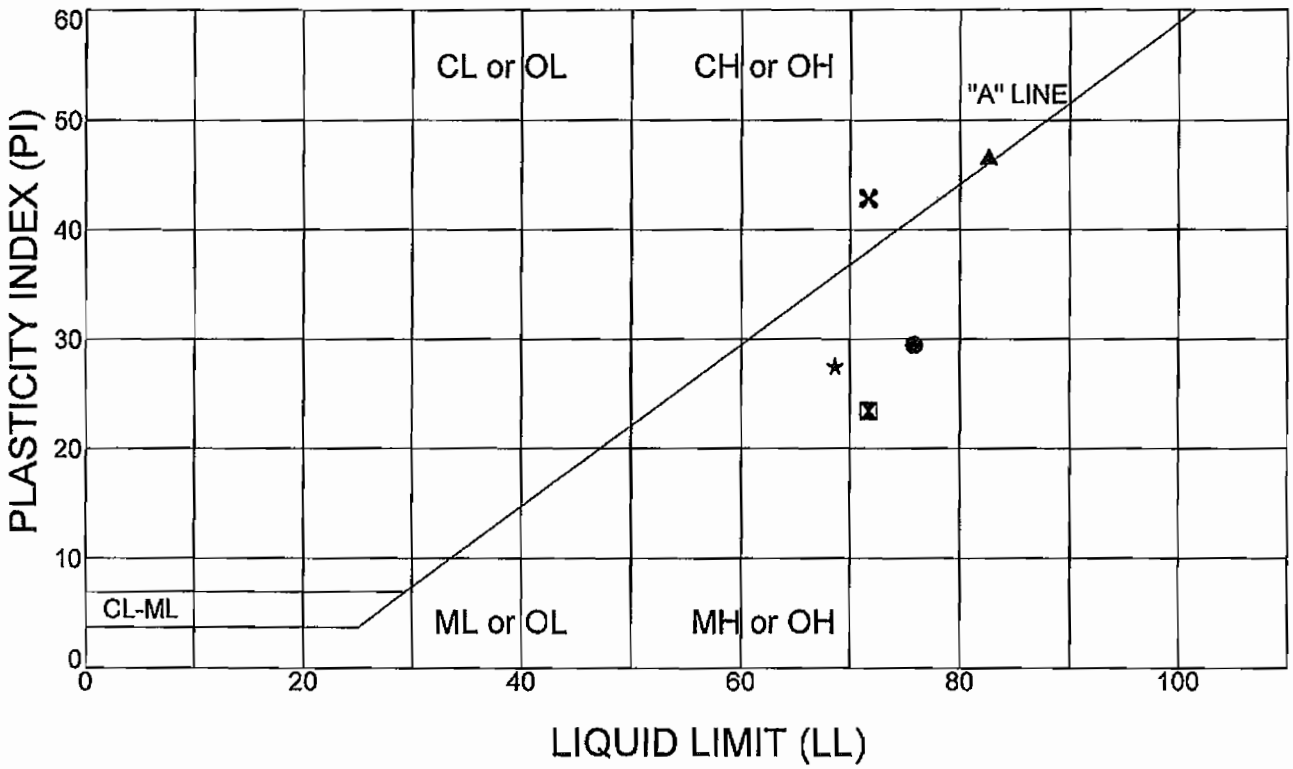
Boring Number	Depth (feet)	Geologic Unit	Symbol	LL	PI	Classification
DH-2	1.0	Qols	●	76	30	Silty Sand (SM)
DH-2	35.0	Qols	⊠	72	24	Silt (ML)
DH-3	3.0	Qaf	▲	83	47	Fat Clay w/Gravel (CH)
DH-4	3.0	Qal	★	69	28	Fat Clay w/Sand (CH)
DH-4	20.0	Qal	✕	72	43	Fat Clay w/Sand (CH)

GMU_GRAIN_SIZE 10-036-00.GPJ 8/30/10

PARTICLE SIZE DISTRIBUTION

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.



Boring Number	Depth (feet)	Geologic Unit	Test Symbol	Insitu Water Content (%)	LL	PL	PI	Classification
DH-2	1.0	Qols	●	36	76	46	30	Silty Sand (SM)
DH-2	35.0	Qols	⊠	29	72	48	24	Silt (ML)
DH-3	3.0	Qaf	▲	17	83	36	47	Fat Clay w/Gravel (CH)
DH-4	3.0	Qal	★	46	69	41	28	Sandy Silt (MH)
DH-4	20.0	Qal	✕	35	72	29	43	Fat Clay w/Sand (CH)

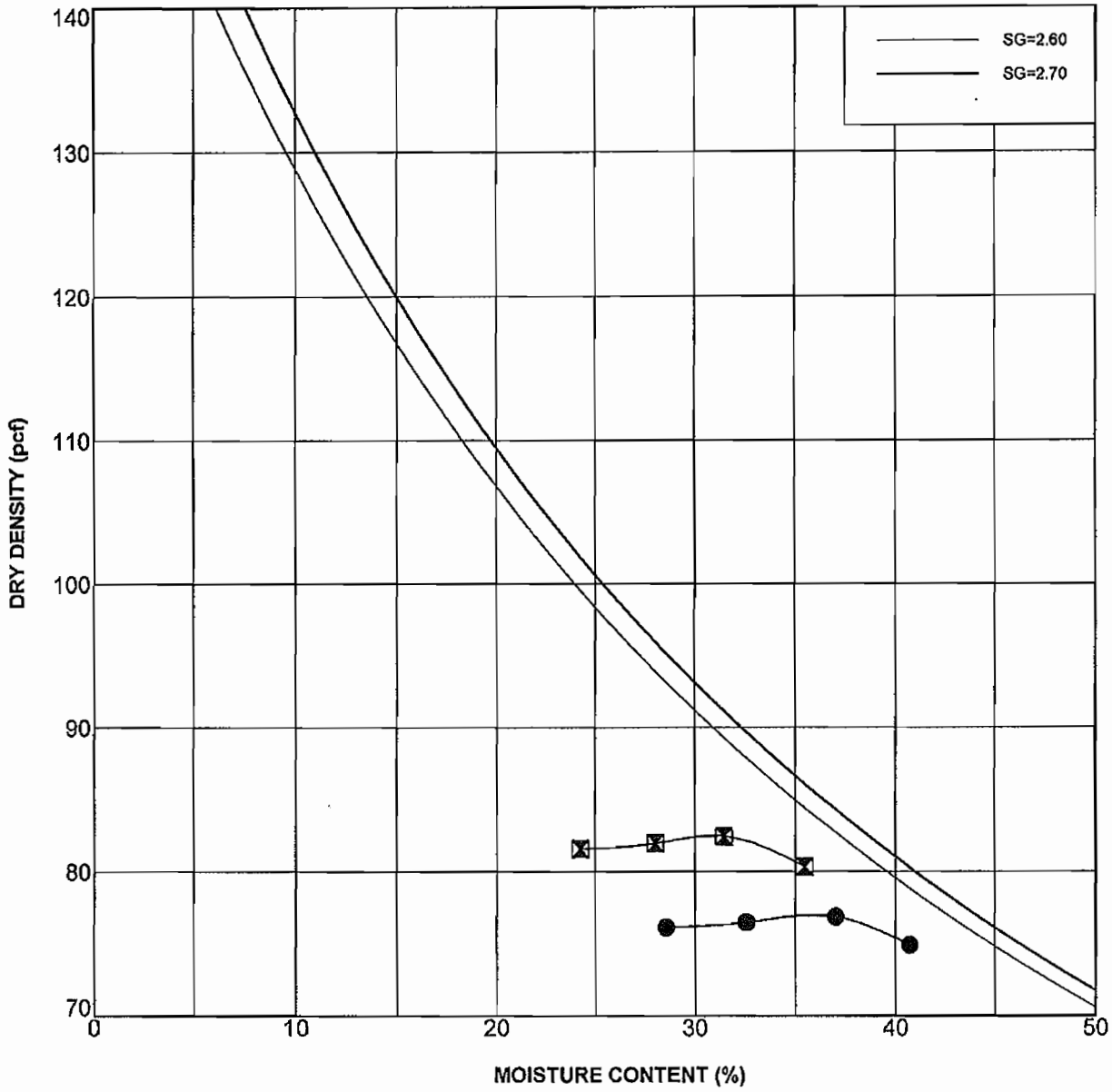
LIMITS 10-036-00.GPJ 9/29/10

ATTERBERG LIMITS

Project: San Ramon Canyon

Project No. 10-036-00

GMU GEOTECHNICAL, INC.



Boring Number	Depth (feet)	Geologic Unit	Symbol	Maximum Dry Density, pcf	Optimum Moisture Content, %	Classification
DH-2	1.0	Qols	●	77	37	Silty Sand (SM)
DH-2	35.0	Qols	⊠	87.8	28	Silt (ML)

DVTCOMP 10-036-00.GPJ 8/30/10

COMPACTION TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

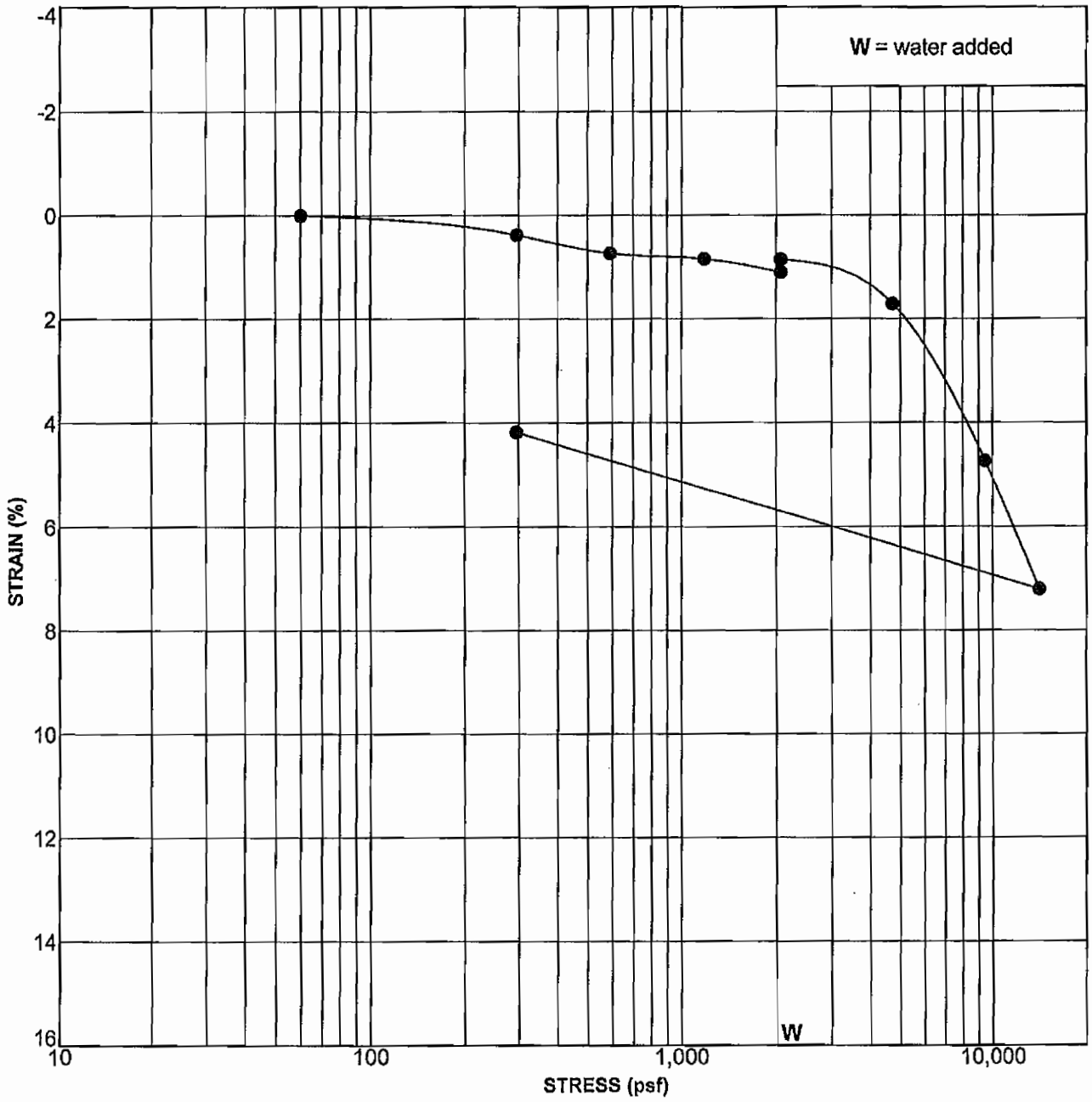
CHEMICAL TEST RESULTS

BORING	DEPTH (FT.)	Ph	SOLUBLE SULFATES (ppm)	SOLUBLE CHLORIDES (ppm)	MINIMUM RESISTIVITY ohm-cm
DH-1	15-17'	8.0	430	160	360
DH-1	62-64'	7.0	563	390	170
DH-2	35-37'	7.8	4	230	300
DH-3	19-21'	8.1	51	200	270
DH-4	3-5'	8.1	110	290	480

PERFORMED IN GENERAL ACCORDANCE WITH CALTRANS TEST METHODS 417/422/643

GMU GEOTECHNICAL, INC.

San Ramon Canyon/Palos Verdes
10-036-00
August 2010



Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-4	12.5	Qal	●	In Situ	-0.25	Fat Clay w/Sand (CH)

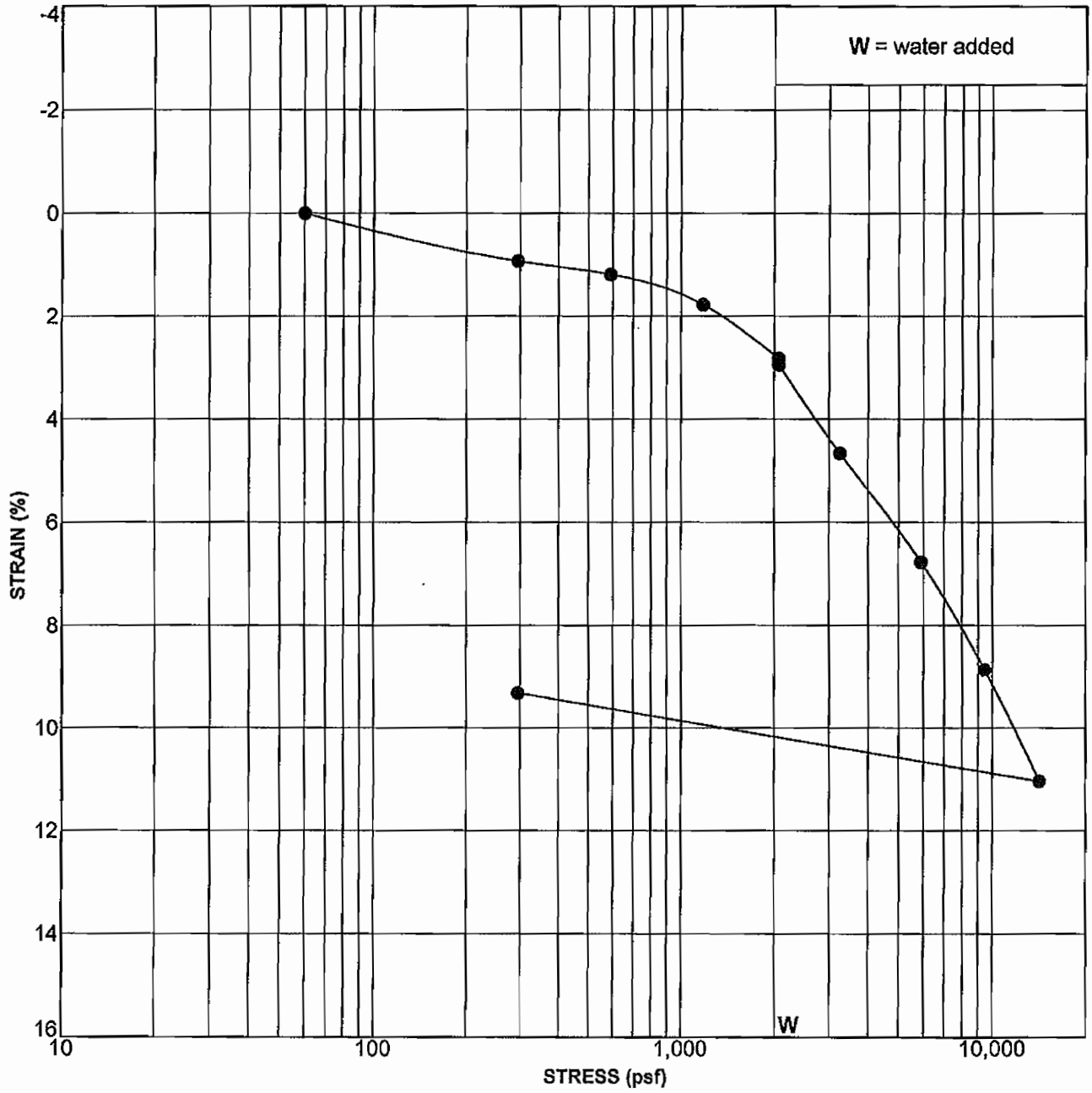
GMU_CONSOL 10-036-00.GPJ GM&U.GDT 9/29/10

CONSOLIDATION TEST DATA

Project: San Ramon Canyon

Project No. 10-036-00

GMU GEOTECHNICAL, INC.



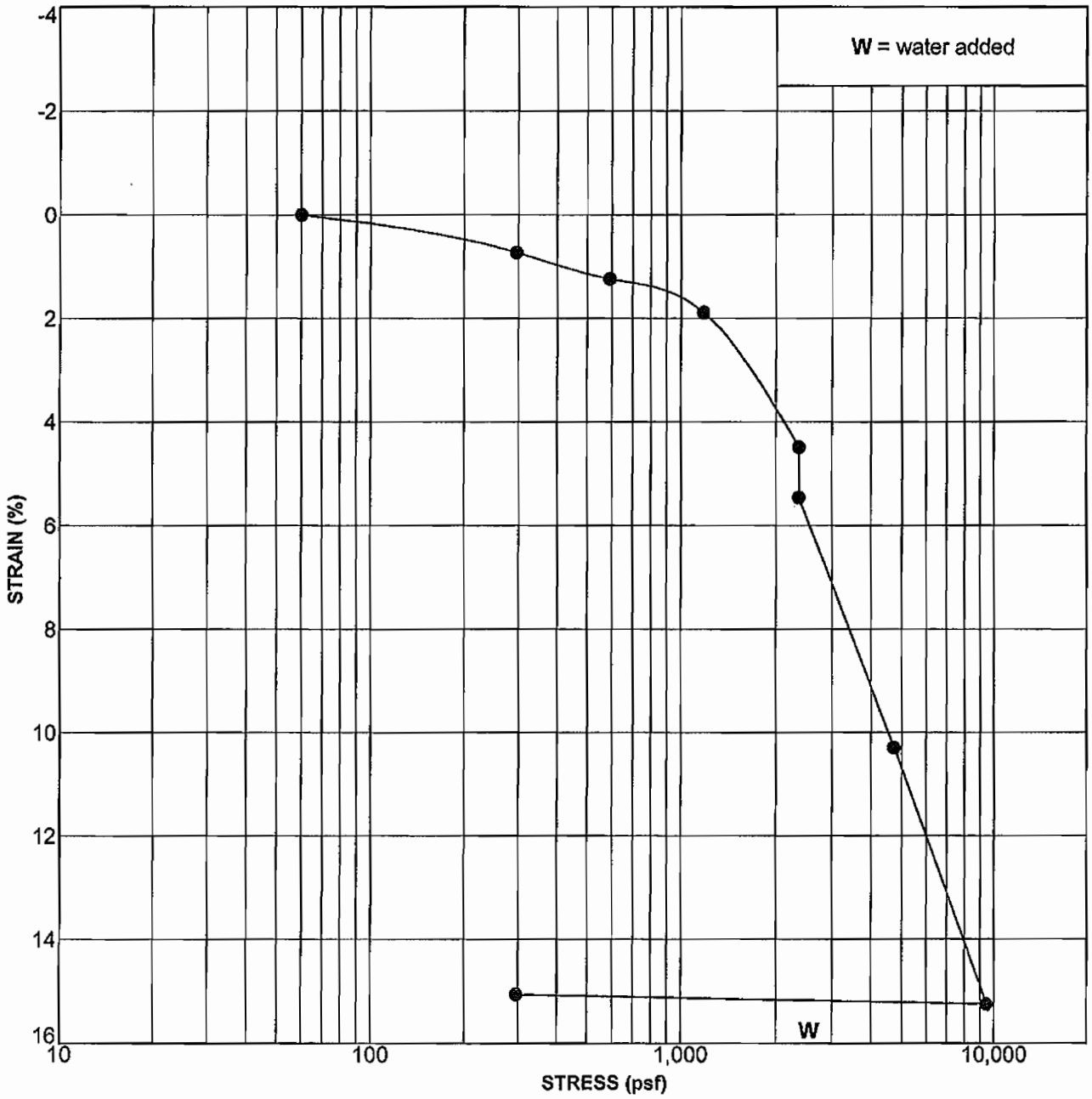
Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-4	17.5	Qal	●	In Situ	0.13	Fat Clay w/Sand (CH)

CONSOLIDATION TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_CONSOL 10-036-00.GPJ GMU.GDT 9/29/10



Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-4	22.5	Qal	●	In Situ	0.97	Fat Clay w/Sand (CH)

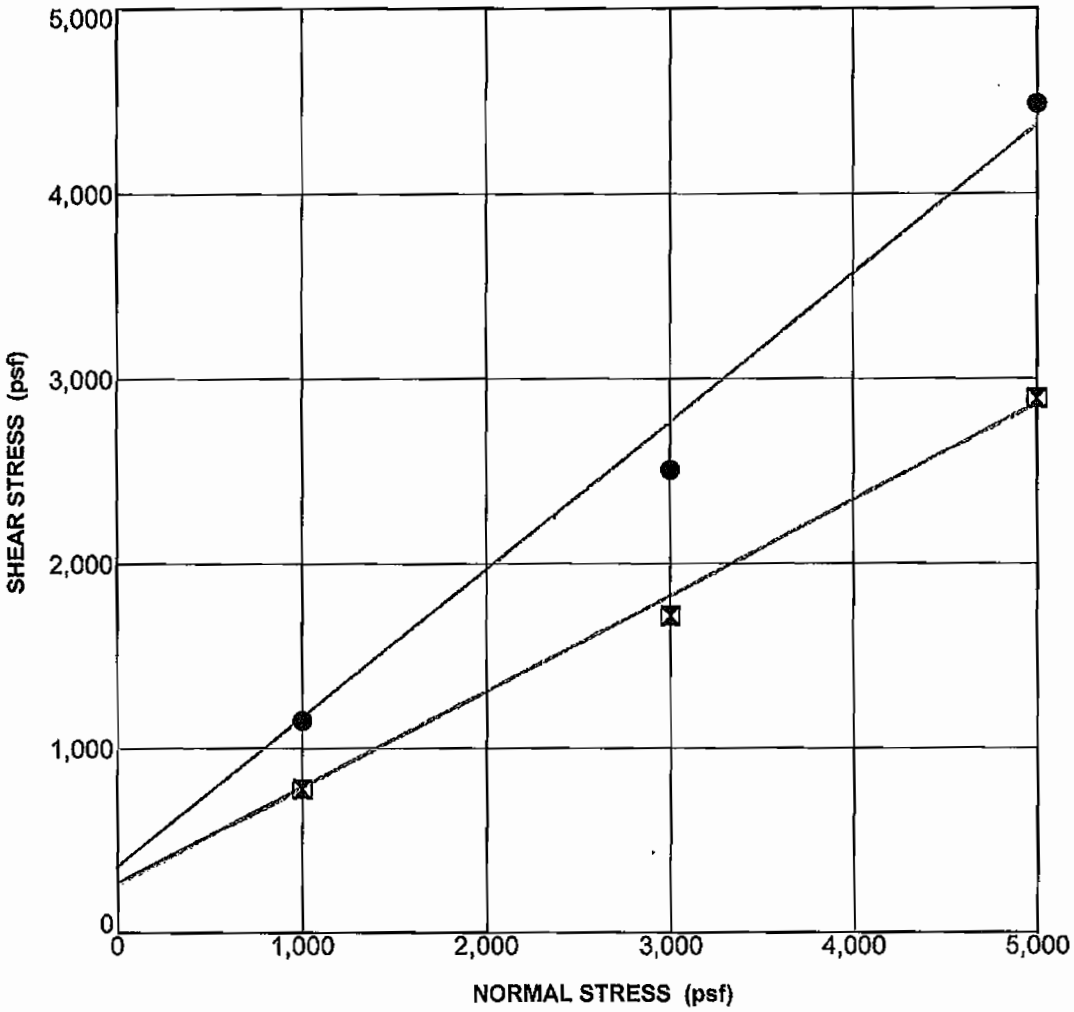
GMU_CONSOL 10-036-00.GPJ GM&U.GDT 9/29/10

CONSOLIDATION TEST DATA

Project: San Ramon Canyon

Project No. 10-036-00

GMU GEOTECHNICAL INC.



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-1 @ 25.0 ft **Geologic Unit:** Qols **Classification:** Clayey Silt (ML) **Strain Rate (in/min):** 0.002 **Sample Preparation:** Undisturbed **Notes:** Bluff

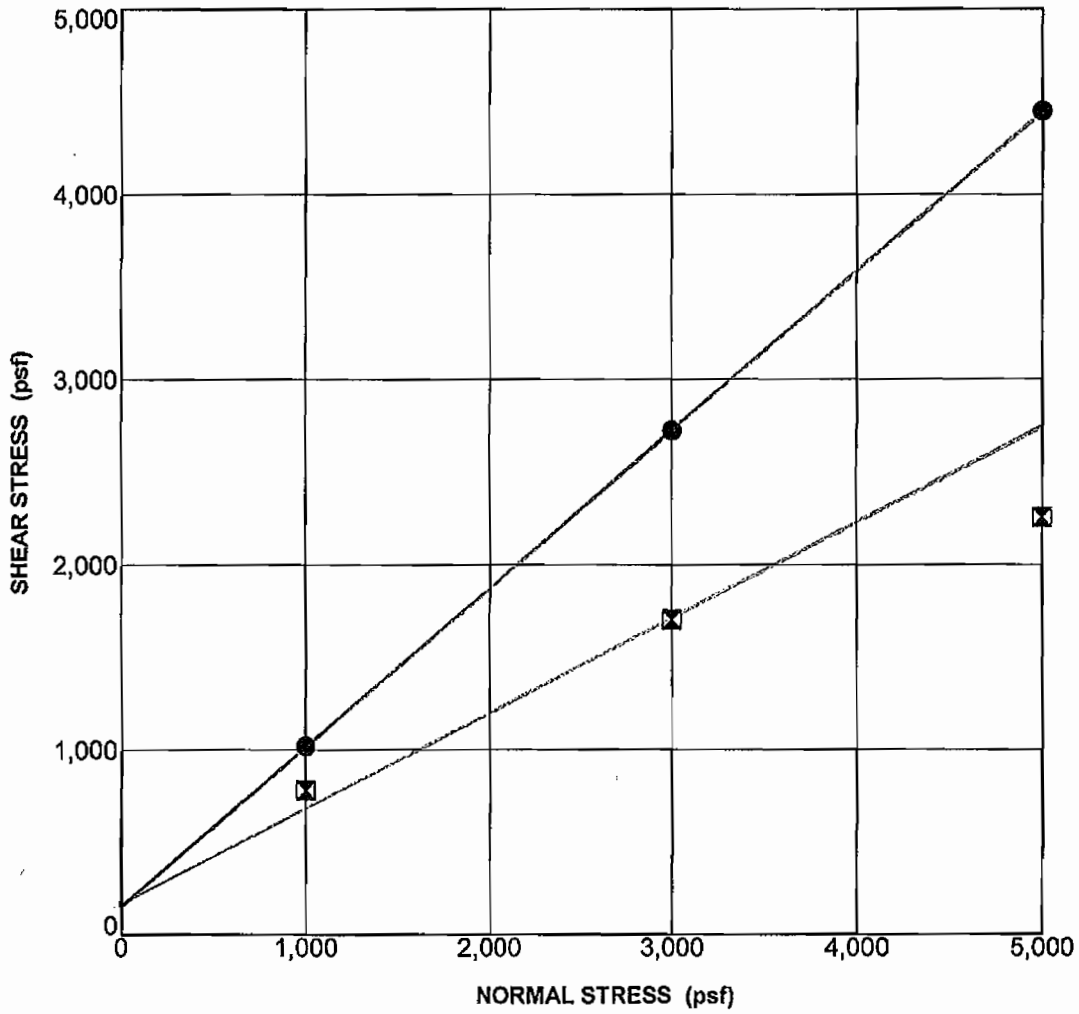
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	360	38.0
⊠ Ultimate Strength	280	27.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM&U.GDT 9/29/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-1 @ 75.0 ft **Geologic Unit:** Qols **Classification:** Silt (ML)
Strain Rate (in/min): 0.002 **Sample Preparation:** Undisturbed
Notes: Bluff

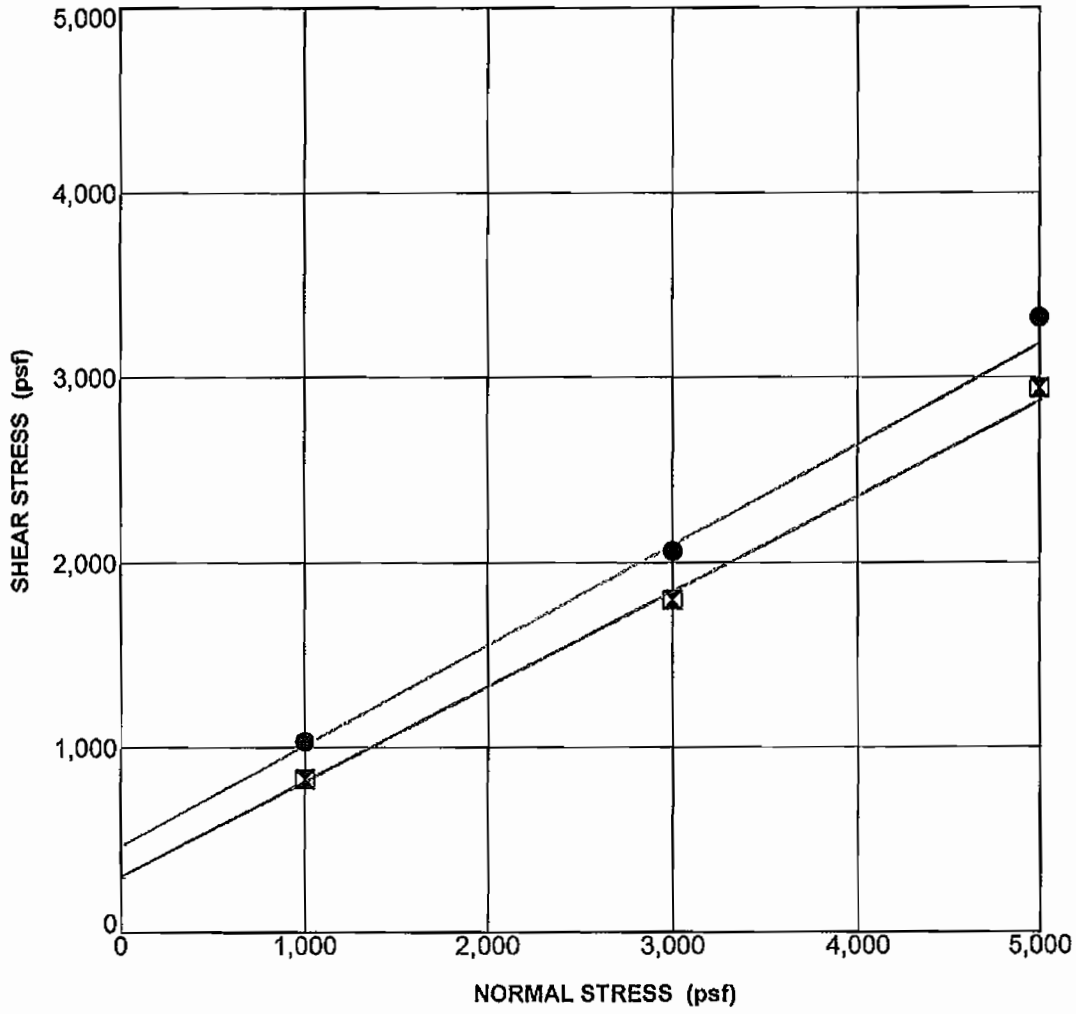
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	160	40.0
⊠ Ultimate Strength	160	27.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM8U.GDT 9/29/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-2 @ 1.0 ft **Geologic Unit:** Qols **Classification:** Silty Sand (SM)
Strain Rate (in/min): 0.002 **Sample Preparation:** Remolded
Notes:

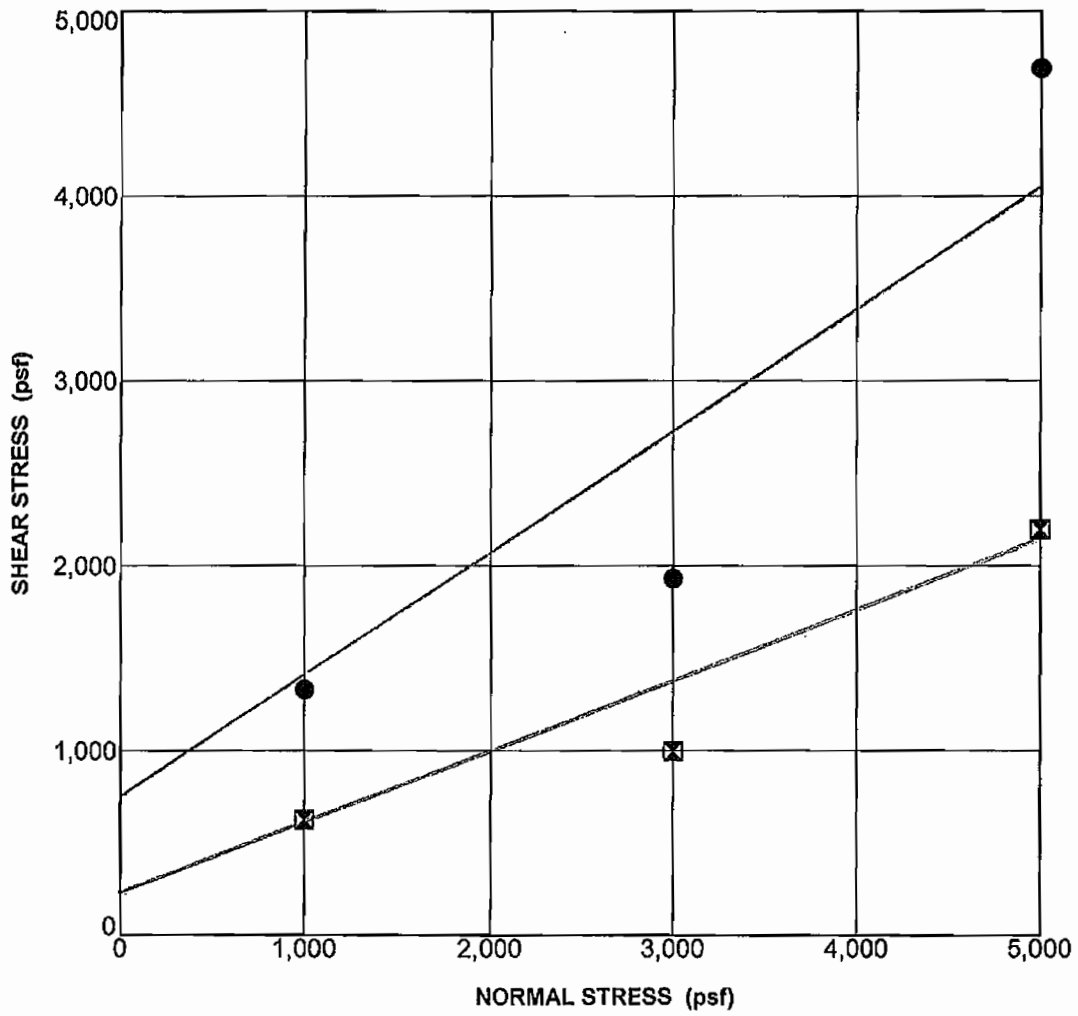
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	480	28.0
⊠ Ultimate Strength	300	27.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM&U.GDT 8/30/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-2 @ 15.0 ft **Geologic Unit:** Qols **Classification:** Silt (ML) **Strain Rate (in/min):** 0.002 **Sample Preparation:** Undisturbed **Notes:**

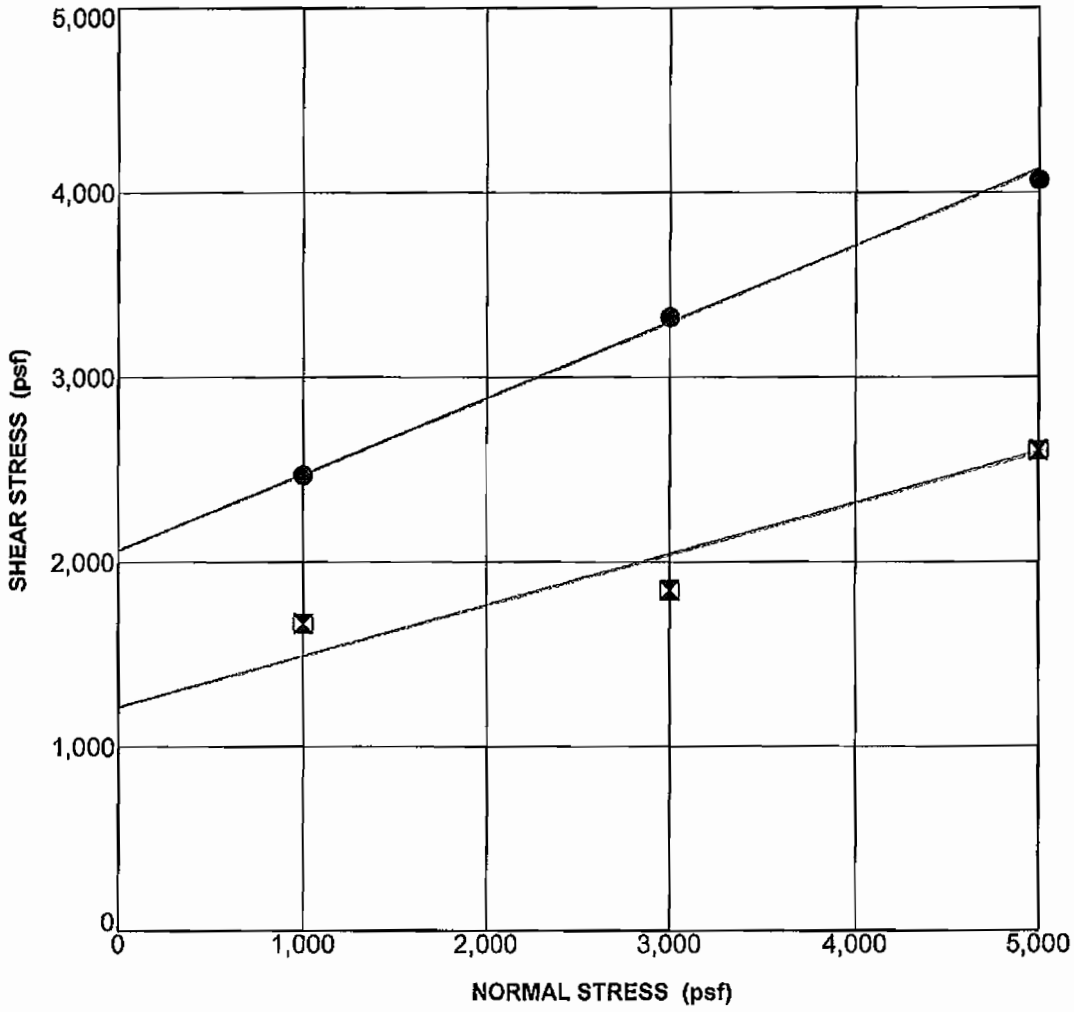
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	760	33.0
⊠ Ultimate Strength	220	21.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GMUJ.GDT 8/30/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-2 @ 30.0 ft **Geologic Unit:** Qols **Classification:** Clayey Silt (ML)
Strain Rate (in/min): 0.001 **Sample Preparation:** Undisturbed
Notes:

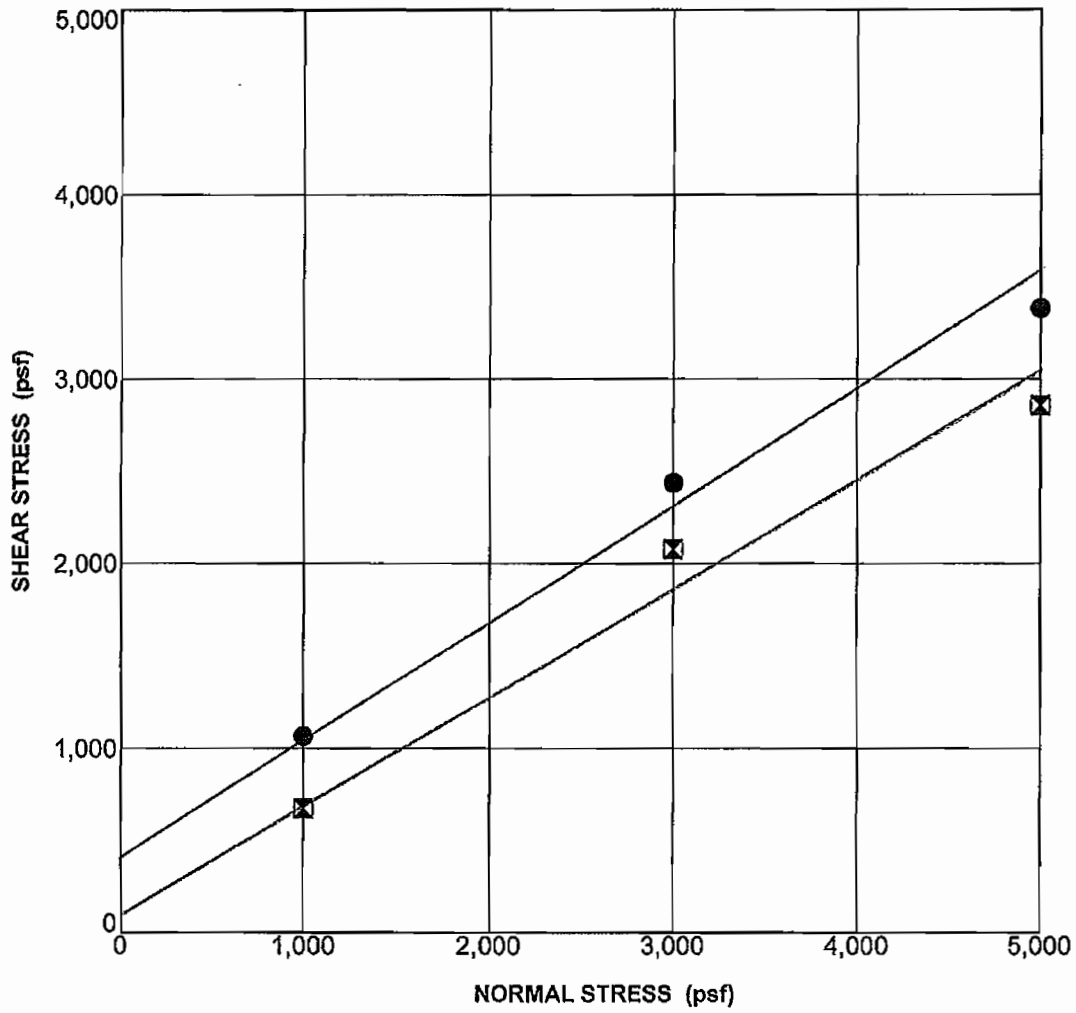
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	2060	22.0
⊠ Ultimate Strength	1200	15.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM&U.GDT 8/30/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-2 @ 35.0 ft **Geologic Unit:** Qols **Classification:** Silt (ML)
Strain Rate (in/min): 0.002 **Sample Preparation:** Remolded
Notes:

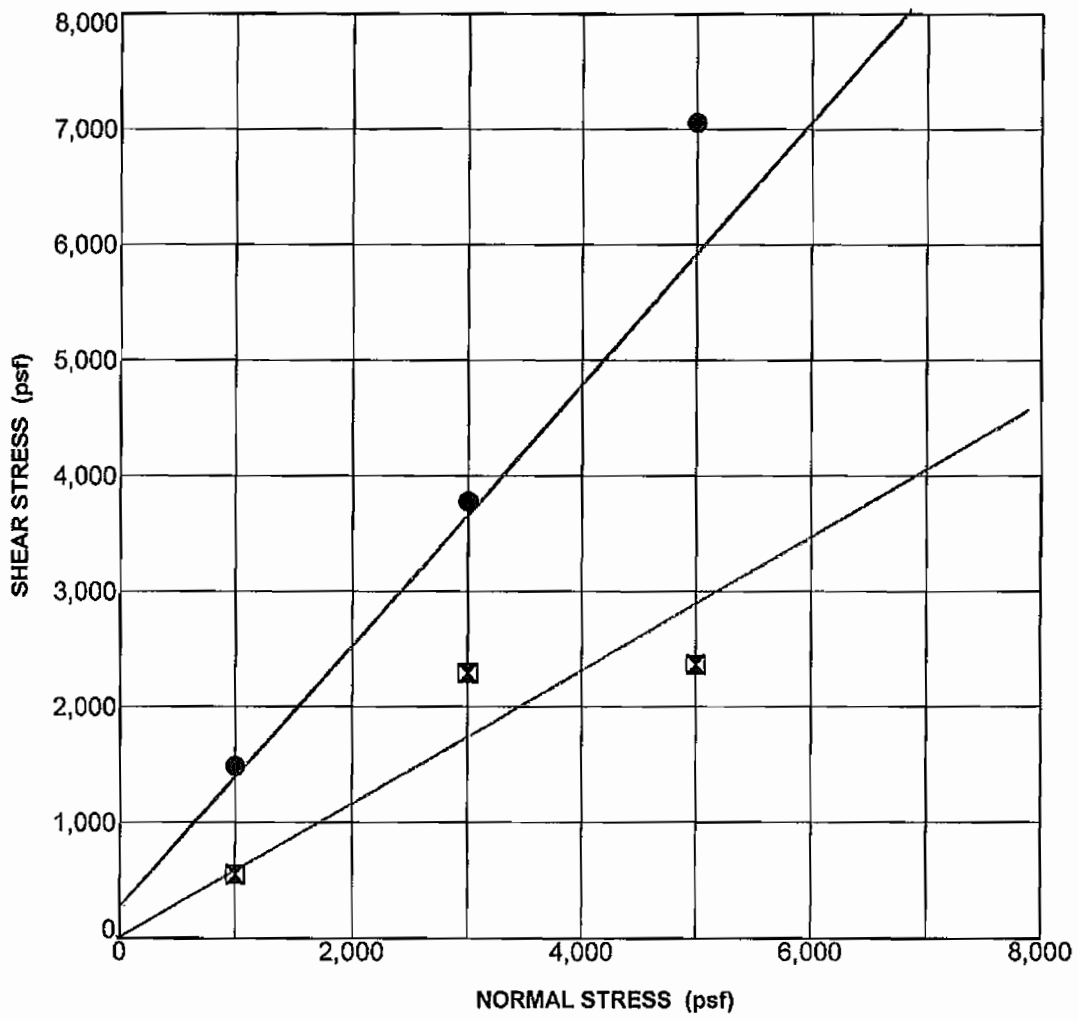
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	400	32.0
⊠ Ultimate Strength	100	30.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM&U.GDT 8/30/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-2 @ 60.0 ft **Geologic Unit:** Qols **Classification:** Silt (ML)
Strain Rate (in/min): 0.002 **Sample Preparation:** Undisturbed
Notes:

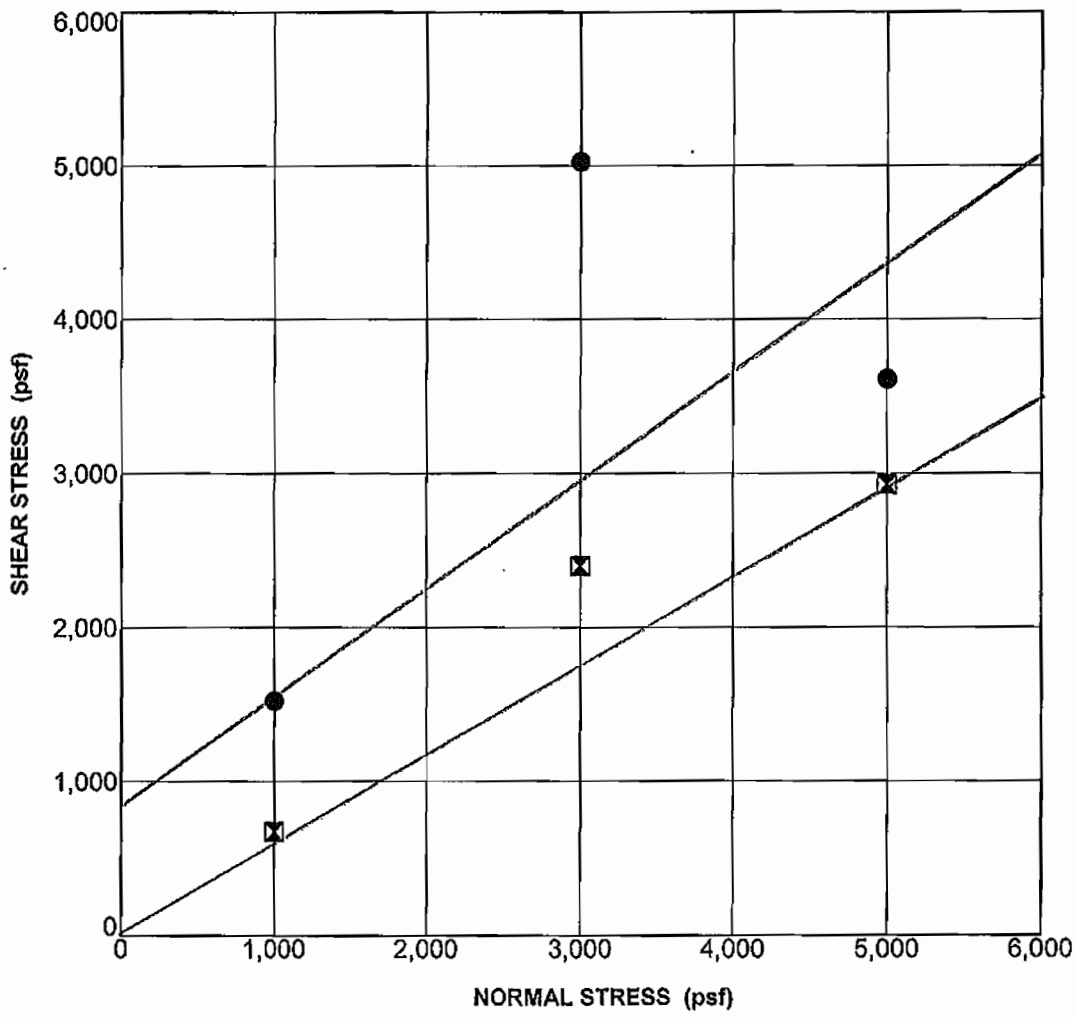
STRENGTH PARAMETERS		
STRENGTH TYPE	**COHESION (psf)**	**FRICTION ANGLE (degrees)**
● Peak Strength	400	48.0
⊠ Ultimate Strength	0	30.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM&U.GDT 8/30/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-3 @ 20.0 ft **Geologic Unit:** Qols **Classification:** Sandy Clay w/Silt (SC) **Strain Rate (in/min):** 0.002 **Sample Preparation:** Undisturbed **Notes:**

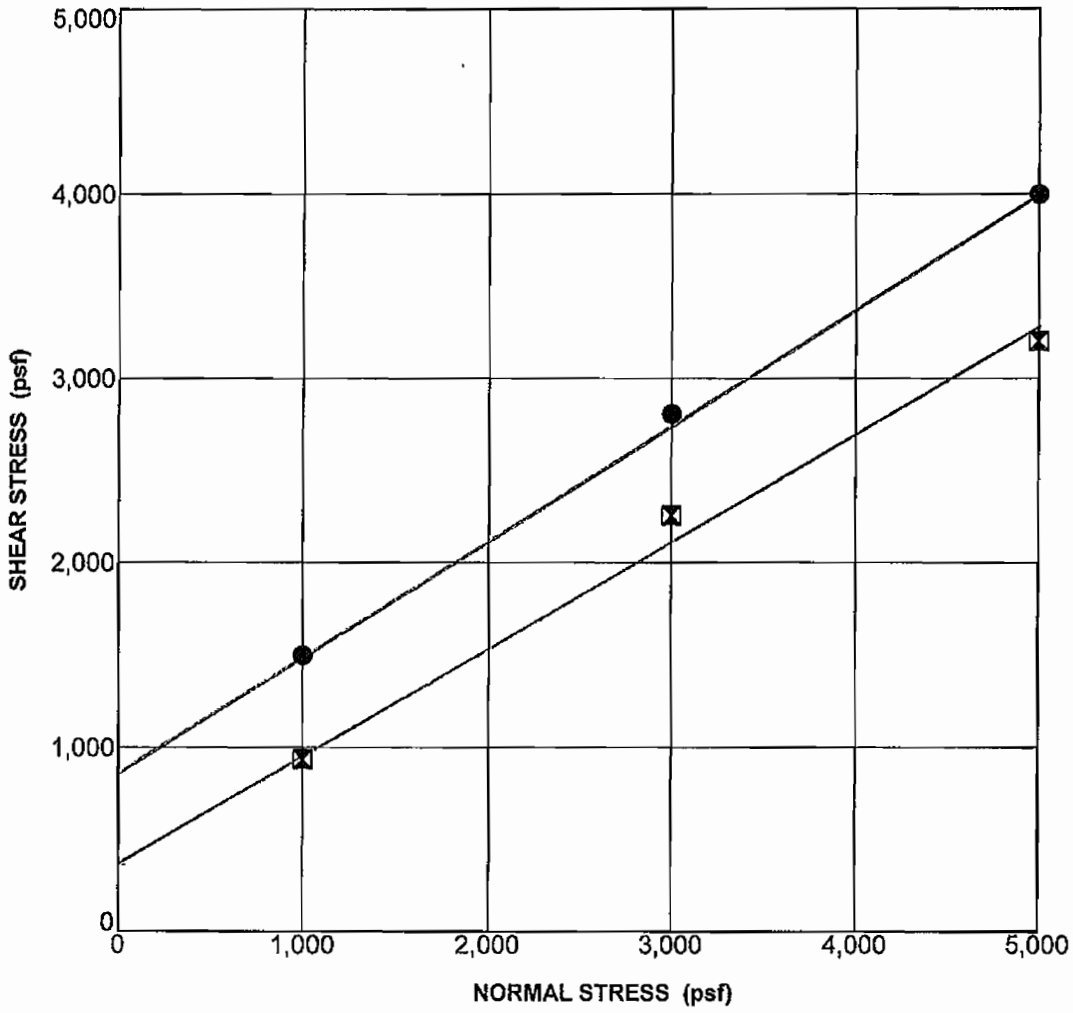
STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	830	35.0
⊠ Ultimate Strength	0	33.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GM&U.GDT 8/30/10



SAMPLE AND TEST DESCRIPTION
Sample Location: DH-3 @ 30.0 ft **Geologic Unit:** Qols **Classification:** Clayey Silt (ML)
Strain Rate (in/min): 0.001 **Sample Preparation:** Undisturbed
Notes:

STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	860	32.0
⊠ Ultimate Strength	360	30.0

SHEAR TEST DATA

Project: San Ramon Canyon
Project No. 10-036-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 10-036-00.GPJ GMAU.GDT 8/30/10

APPENDIX C

Stability Analysis

GMU
GEOTECHNICAL, INC.

APPENDIX C

SLOPE STABILITY ANALYSES

SHEAR STRENGTH PARAMETERS

Altamira Shale Member, Monterey Formation (Intact and Landslide Affected)

Published Strength for South Shores Landslide Basal Rupture Surface (Bentonite)

The article entitled "Geologic Investigation, Grading Stabilization Measures, and Development of the South Shores Landslide" by Ray (1982), indicates a strength of phi = 8 degrees and c = 100psf for samples "considered representative of the slide plane". Given that the basal rupture surface is thought to be composed of bentonite, this strength is considered representative of bentonite-lined surfaces.

Published Strength for Altamira Shale Member, Monterey Formation

We have reviewed the geotechnical report prepared by SWN Soiltech Consultants, Inc. (1996) for the proposed residence at 30764 Tarapaca Road. More specifically, we have reviewed SWN's laboratory testing results and slope stability analyses and find the shear strengths used for this adjacent property are generally consistent with the shear strengths used in our analyses, as discussed below.

Back-Calculation of Strength Along Rupture Surface – Tarapaca Landslide

Back-calculation analyses were performed on the portions of Cross-Sections 2-2' and 3-3' that go through the Tarapaca landslide. Because seepage was not seen at the toe of the landslide during geologic reconnaissances and mapping exercises, no groundwater was assumed in the analyses. This assumption will yield the most conservative value.

The results of the analyses indicate a strength of phi = 21 to 24 degrees for Cross Sections 2 and 3, respectively. Assuming a symmetrical weighting, an average residual phi angle of 22.5 degrees can be assumed.

Direct Shear Testing Results

Several shear strength tests were performed on samples retrieved from bucket-auger borings drilled in the switchback and bluff face areas (DH-2 and DH-3). The shear strength data from the switchback area was separated from those obtained from the bluff area and are summarized below:

Switchback Area		
Strength Type	Phi	C (psf)
Peak (average)	37	960
Ultimate/Fully Softened (average)	23	570
Bluff Area		
Strength Type	Phi	C (psf)
Peak (average)	39	520
Ultimate/Fully Softened (average)	27	220

Stark Correlations

Liquid limit and grain size data were utilized to determine strengths via correlations from Stark (2005). Based on a liquid limit of 72 and a clay fines fraction of 26%, the following strength correlations were determined. An average value between residual and fully softened was calculated as first time slides usually occur at strengths between fully softened and residual.

Strength Type	Strength (no correction) Degrees	Strength (w/ ball mill correction) Degrees
Residual	17	12
Ultimate/Fully Softened	28	26
Average	22.5	19

Back-Calculation to Evaluate Cross Bedding Strength in Bluff Area

A circular failure search was performed to evaluate the cross bedding strength in the bluff area. Both ultimate/fully softened and peak strength values were utilized from the direct shear testing results of samples from Boring DH-1. Safety factors of 0.8 and 1.3 were obtained for both ultimate and peak strengths, respectively.

Conclusions

The following conclusions can be reached from the above strength testing results:

1. The Tarapaca landslide failed along continuous bedding planes that were not bentonite lined.
2. The average uncorrected strength from the Stark method correlates well with the overall back-calculated strength. This suggests the ball mill correction factors should not be applied at this site.
3. Cross bedding strength in the bluff area appears to be close to the peak strength determined from the direct shear testing.

Engineered Fill

The following average strengths were determined from direct shear testing on remolded samples of representative on-site soil and bedrock materials.

Engineered Fill		
Strength Type	Phi	C (psf)
Peak (average)	30	490
Ultimate/Fully Softened (average)	28	250

STRENGTH AND STABILITY MODELS

Based on the above strength test results and back-calculations, the following strength models were assigned to each cross-section based on the local geologic conditions.

Cross Section 3-3' (Lower Switchback PVDE)

Geologic Description Relating to Stability

- Highly contorted older landslide debris.
- Bottom part of slope contains no continuous planar bedding or sheared surface.
- Upper portion of slope contains possible along bedding conditions.

Strength Model

- Bottom portion of slope contains no continuous plane of weakness.
- Upper portion of slope contains possible along bedding conditions.

Stability Model

- Fully softened/Ultimate strength from direct shear testing in lower portion of slope (phi =23; c = 570 psf).
- Residual strength along bedding in upper portion of slope (phi = 17).
- Translation and rotational critical failure searches.
- No groundwater.

Cross Section 1-1' (Upper Switchback PVDE)

Geologic Description

- Highly folded bedding throughout slope section.
- No continuous planar bedding condition.
- Approximate 50/50 mix of across and along bedding conditions (phi =23; c = 570 psf).

Strength Model

- Fully softened/Ultimate strengths from direct shear testing was utilized.

Stability Model

- Circular failure search was performed to obtain safety factors.
- No groundwater.

Cross Sections 2-2' and 3-3' (Tarapaca Landslide)

Geologic Description

- The Tarapaca landslide is an actively moving landslide.

Strength Model

- Back-calculated strengths were used for each cross section (phi = 21 and 24 degrees).
- Ultimate remolded fill strengths were utilized for postulated fill to be placed in the canyon (phi = 28 and c = 250 psf).

Stability Model

- Failure surface confined to basal rupture surface and allowed to search through passively through a toe buttress composed of engineered fill.

Cross Section 6-6' (Bluff Stability)

Geologic Description

- The bluff is composed of relatively intact and less weathered Altamira Shale member, Monterey Formation bedrock.
- Planar continuous bedding planes are currently interpreted in this area.

Strength Model

- Cross bedding strength was modeled using peak strengths as determined from the direct shear testing in the bluff area (phi = 39 and c = 520 psf).
- A residual strength of phi = 17 degrees was assumed for along bedding conditions.

Stability Model

- Translational failure searches along bedding at various heights above the toe of slope were performed.

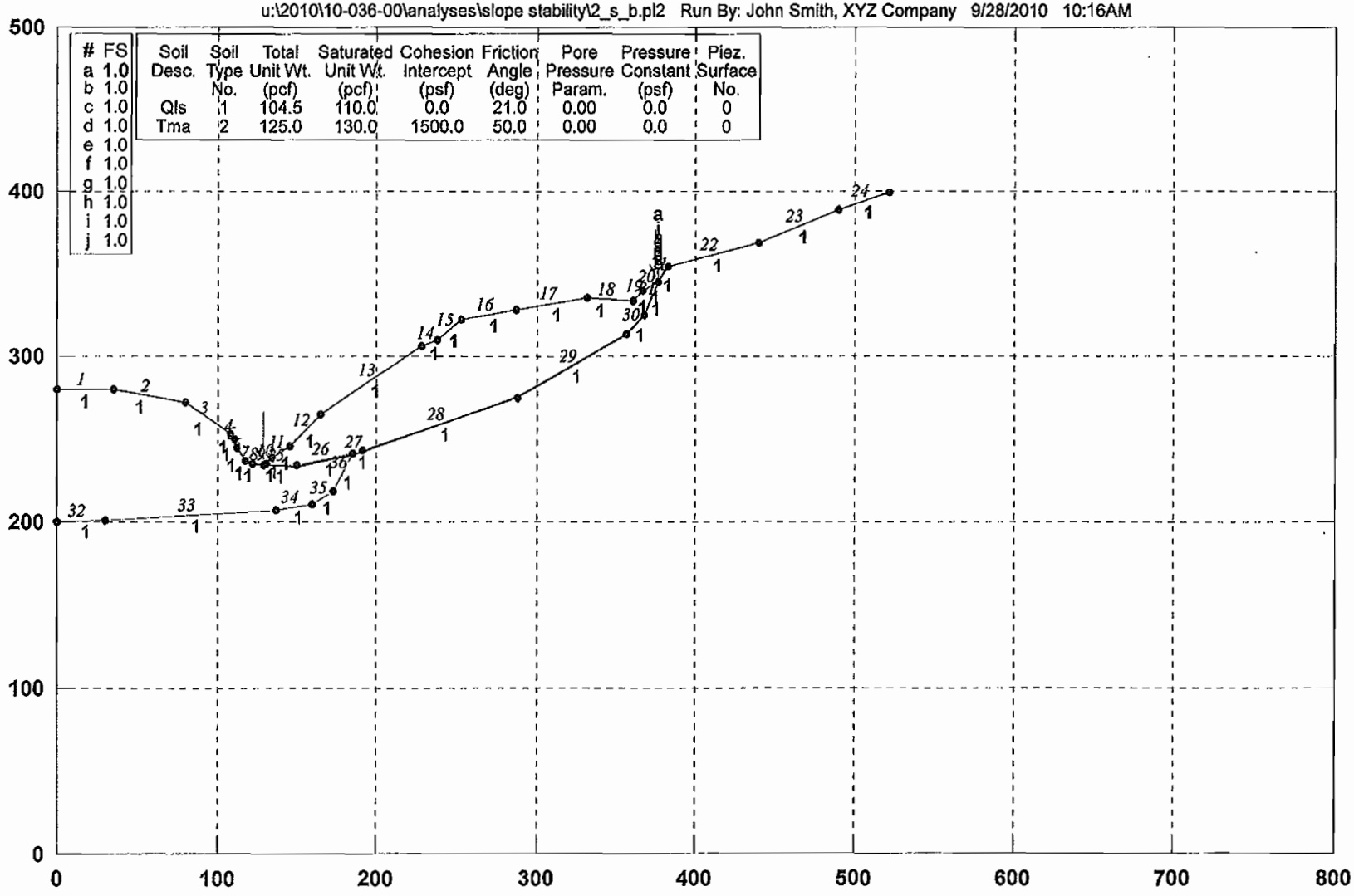
SUMMARY OF STABILITY ANALYSES RESULTS

Analysis Description	Cross Section	Strengths	Static Factor of Safety
Back-Calculation of Tarapaca Landslide	2	Phi = 21 deg.	1.0
Back-Calculation of Tarapaca Landslide	3	Phi = 24 deg.	1.0
Back-Calculation of Cross Bedding Strength for Bluff Slope	6	Phi = 27 c = 220	1.3
Back-Calculation of Cross Bedding Strength for Bluff Slope	6	Phi = 39 c = 520	0.8
Lower Switch Back – Existing Condition Stability (Translation Search at Road)	3	Phi = 17 along bedding – upper slope Phi = 23; c=570 - Lower slope	1.9
Lower Switch Back – Existing Condition Stability (Circular Search at Road)	3	Phi = 17 along bedding – upper slope Phi = 23; c=570 - Lower slope	1.6
Lower Switch Back – Existing Condition Stability (Circular Search at Bluff Face)	3	Phi = 23; c = 570	1.4

Lower Switchback – Amount of Bluff Face Erosion for Failure	3	Phi = 23; c = 570	1.01 (for 35' of bluff face erosion)
Upper Switch Back – Existing Condition Stability (Circular Failure Search at Bluff Face)	1	Phi = 23; c = 570	1.4
Upper Switch Back – Existing Condition Stability (Circular Failure Search at Road)	1	Phi = 23; c = 570	1.3
Upper Switchback – Amount of Bluff Face Erosion for Failure	1	Phi = 23; c = 570	1.02 (for 40' of bluff face erosion)
Tarapaca Landslide – Fill Height at Toe for Approx. 1.25 Safety Factor	2	Slide: Phi = 21 deg. Fill Butt.: Phi =28; c=250	1.3 (for fill height = 20 feet)
Tarapaca Landslide – Fill Height at Toe for Approx. 1.5 Safety Factor	2	Slide: Phi = 21 deg. Fill Butt.: Phi =28; c=250	1.5 (for fill height = 30 feet)
Tarapaca Landslide – Fill Height at Toe for Approx. 1.25 Safety Factor	3	Slide: Phi = 24 deg. Fill Butt.: Phi =28; c=250	1.2 (for fill height = 10 feet)
Tarapaca Landslide – Fill Height at Toe for Approx. 1.5 Safety Factor	3	Slide: Phi = 24 deg. Fill Butt.: Phi =28; c=250	1.5 (for fill height = 16.5 feet)

Sect 2, Static, Back-calculation of Terrapaca Landslide

u:\2010\10-036-00\analyses\slope stability\2_s_b.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:16AM



#	FS
a	1.0
b	1.0
c	1.0
d	1.0
e	1.0
f	1.0
g	1.0
h	1.0
i	1.0
j	1.0

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	0.0	21.0	0.00	0.0	0
Tma	2	125.0	130.0	1500.0	50.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:16AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_b.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_b.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_b.PLT
PROBLEM DESCRIPTION: Sect 2, Static, Back-calculation
of Terrapaca Landslide

BOUNDARY COORDINATES
24 Top Boundaries
36 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	280.00	35.00	280.00	1
2	35.00	280.00	80.00	272.00	1
3	80.00	272.00	108.00	254.00	1
4	108.00	254.00	111.00	250.00	1
5	111.00	250.00	112.00	245.00	1
6	112.00	245.00	118.00	237.00	1
7	118.00	237.00	122.00	235.00	1
8	122.00	235.00	129.00	234.00	1
9	129.00	234.00	131.00	235.00	1
10	131.00	235.00	134.00	239.00	1
11	134.00	239.00	146.00	246.00	1
12	146.00	246.00	165.00	265.00	1
13	165.00	265.00	228.00	306.00	1
14	228.00	306.00	238.00	310.00	1
15	238.00	310.00	253.00	322.00	1
16	253.00	322.00	287.00	328.00	1
17	287.00	328.00	332.00	335.00	1
18	332.00	335.00	361.00	334.00	1
19	361.00	334.00	367.00	340.00	1
20	367.00	340.00	377.00	345.00	1
21	377.00	345.00	383.00	355.00	1
22	383.00	355.00	440.00	369.00	1
23	440.00	369.00	490.00	389.00	1
24	490.00	389.00	521.00	399.00	1
25	129.00	234.00	150.00	234.00	1
26	150.00	234.00	185.00	241.00	1
27	185.00	241.00	191.00	243.00	1
28	191.00	243.00	288.00	275.00	1
29	288.00	275.00	356.00	313.00	1
30	356.00	313.00	368.00	325.00	1
31	368.00	325.00	377.00	345.00	1
32	0.00	200.00	30.00	201.00	1
33	30.00	201.00	137.00	207.00	1
34	137.00	207.00	160.00	211.00	1
35	160.00	211.00	173.00	219.00	1
36	173.00	219.00	185.00	241.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	0.0	21.0	0.00	0.0	0
2	125.0	130.0	1500.0	50.0	0.00	0.0	0

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
10 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	130.00	234.00	130.00	234.00	0.10
2	150.00	234.00	150.00	234.00	1.00
3	185.00	241.00	185.00	241.00	1.00
4	191.00	243.00	191.00	243.00	1.00
5	288.00	275.00	288.00	275.00	1.00
6	356.00	313.00	356.00	313.00	1.00
7	368.00	325.00	368.00	325.00	1.00
8	377.00	345.00	377.00	345.00	0.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 10
Number of Trial Surfaces With Valid FS = 10
Statistical Data On All Valid FS Values:
FS Max = 1.011 FS Min = 1.003 FS Ave = 1.007
Standard Deviation = 0.002 Coefficient of Variation = 0.23 %
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.367	234.183
2	130.000	233.955
3	150.000	233.750
4	185.000	240.840
5	191.000	242.534
6	288.000	275.303
7	356.000	313.365
8	368.000	324.689
9	377.000	345.000

Factor of Safety
*** 1.003 ***
Individual data on the 23 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.5	11.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	0.1	6.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.0	83.6	0.0	0.0	0.	0.	0.0	0.0	0.0
4	3.0	962.7	0.0	0.0	0.	0.	0.0	0.0	0.0
5	12.0	10844.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	4.0	5947.9	0.0	0.0	0.	0.	0.0	0.0	0.0
7	15.0	34846.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	19.9	67948.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.1	382.0	0.0	0.0	0.	0.	0.0	0.0	0.0
10	6.0	24002.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	37.0	174673.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	10.0	53584.4	0.0	0.0	0.	0.	0.0	0.0	0.0
13	11.7	66565.3	0.0	0.0	0.	0.	0.0	0.0	0.0
14	3.3	19732.0	0.0	0.0	0.	0.	0.0	0.0	0.0
15	34.0	198177.2	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.0	5532.6	0.0	0.0	0.	0.	0.0	0.0	0.0
17	44.0	202129.0	0.0	0.0	0.	0.	0.0	0.0	0.0

18	24.0	70067.6	0.0	0.0	0.	0.	0.0	0.0	0.0
19	5.0	9594.0	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.5	2474.9	0.0	0.0	0.	0.	0.0	0.0	0.0
21	4.5	7610.6	0.0	0.0	0.	0.	0.0	0.0	0.0
22	1.0	1675.4	0.0	0.0	0.	0.	0.0	0.0	0.0
23	9.0	7435.1	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.367	234.183
2	130.000	233.986
3	150.000	233.772
4	185.000	241.465
5	191.000	243.279
6	288.000	275.308
7	356.000	313.395
8	368.000	325.135
9	377.000	345.000

Factor of Safety
*** 1.005 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.436	234.218
2	130.000	234.026
3	150.000	233.847
4	185.000	240.997
5	191.000	243.299
6	288.000	275.097
7	356.000	313.485
8	368.000	325.307
9	377.000	345.000

Factor of Safety
*** 1.006 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.613	234.306
2	130.000	234.007
3	150.000	234.263
4	185.000	240.667
5	191.000	243.129
6	288.000	275.244
7	356.000	313.355
8	368.000	324.556
9	377.000	345.000

Factor of Safety
*** 1.007 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.651	234.326
2	130.000	233.989
3	150.000	233.769
4	185.000	241.271
5	191.000	243.487
6	288.000	275.262
7	356.000	313.189
8	368.000	324.613
9	377.000	345.000

Factor of Safety
*** 1.007 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.498	234.249
2	130.000	233.989
3	150.000	233.979

4	185.000	240.584
5	191.000	243.419
6	288.000	274.954
7	356.000	313.406
8	368.000	324.746
9	377.000	345.000

Factor of Safety
*** 1.008 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.310	234.155
2	130.000	233.988
3	150.000	234.427
4	185.000	240.655
5	191.000	243.160
6	288.000	275.287
7	356.000	313.128
8	368.000	324.528
9	377.000	345.000

Factor of Safety
*** 1.008 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.359	234.180
2	130.000	233.981
3	150.000	234.357
4	185.000	240.630
5	191.000	243.102
6	288.000	274.992
7	356.000	313.269
8	368.000	324.652
9	377.000	345.000

Factor of Safety
*** 1.009 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.581	234.290
2	130.000	234.013
3	150.000	233.841
4	185.000	241.251
5	191.000	242.578
6	288.000	274.793
7	356.000	312.612
8	368.000	324.507
9	377.000	345.000

Factor of Safety
*** 1.010 ***

Failure Surface Specified By 9 Coordinate Points

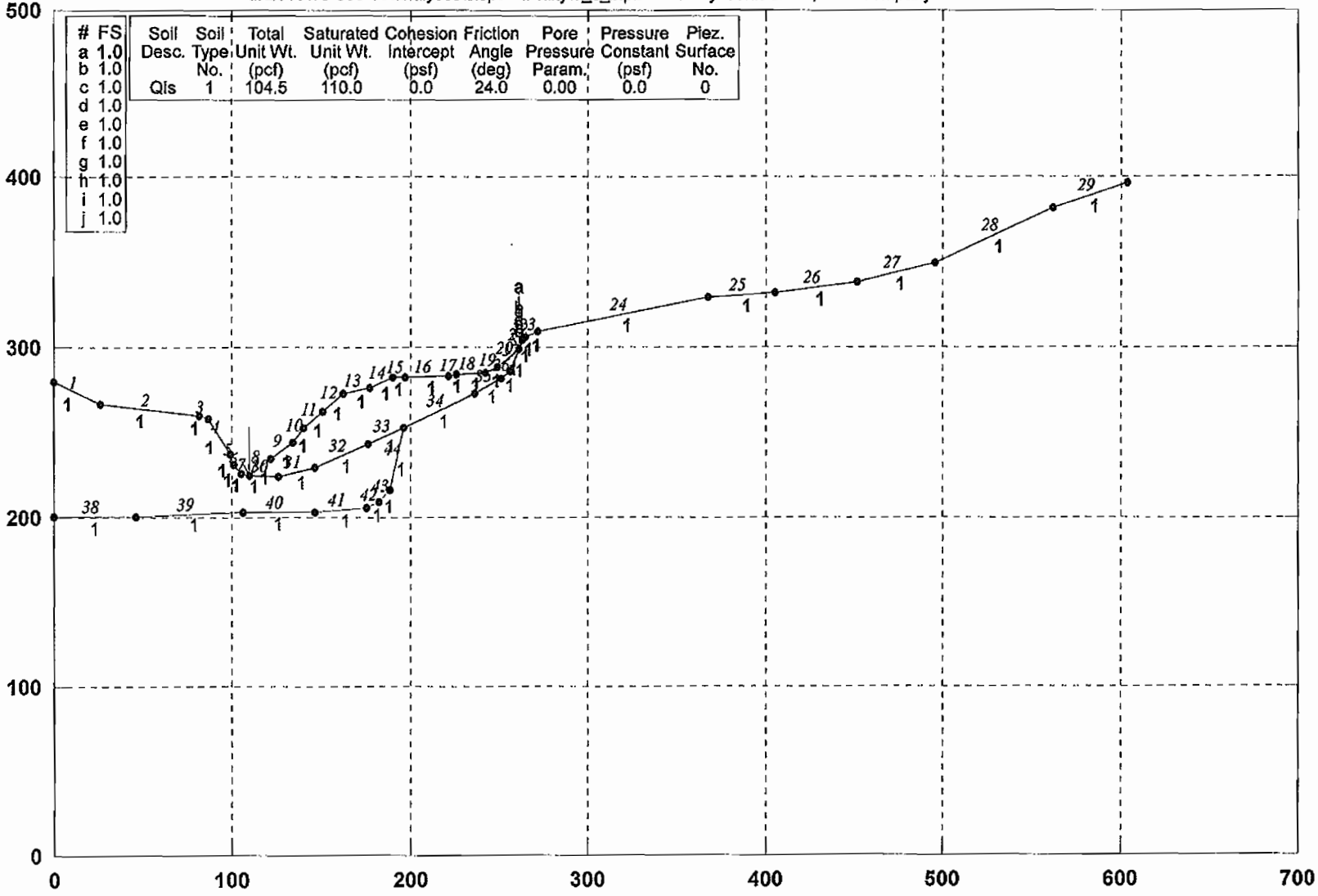
Point No.	X-Surf (ft)	Y-Surf (ft)
1	129.273	234.137
2	130.000	234.005
3	150.000	234.399
4	185.000	241.164
5	191.000	243.316
6	288.000	274.573
7	356.000	313.405
8	368.000	325.029
9	377.000	345.000

Factor of Safety
*** 1.011 ***

**** END OF GSTABL7 OUTPUT ****

Sect 3, Static, Back-calculation of Terrapaca Landslide

u:\2010\10-036-00\analyses\slope stability\3_s_b.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:18AM



#	FS
a	1.0
b	1.0
c	1.0
d	1.0
e	1.0
f	1.0
g	1.0
h	1.0
i	1.0
j	1.0

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	0.0	24.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **
(All Rights Reserved-Unauthorized Use Prohibited)

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 9/28/2010
Time of Run: 10:18AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_b.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_b.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_b.PLT
PROBLEM DESCRIPTION: Sect 3, Static, Back-calculation
of Terrapaca Landslide

BOUNDARY COORDINATES
29 Top Boundaries
44 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	280.00	26.00	267.00	1
2	26.00	267.00	82.00	260.00	1
3	82.00	260.00	87.00	258.00	1
4	87.00	258.00	99.00	237.00	1
5	99.00	237.00	101.00	231.00	1
6	101.00	231.00	105.00	226.00	1
7	105.00	226.00	110.00	225.00	1
8	110.00	225.00	122.00	234.00	1
9	122.00	234.00	134.00	244.00	1
10	134.00	244.00	140.00	253.00	1
11	140.00	253.00	151.00	262.00	1
12	151.00	262.00	162.00	273.00	1
13	162.00	273.00	177.00	276.00	1
14	177.00	276.00	190.00	282.00	1
15	190.00	282.00	197.00	282.00	1
16	197.00	282.00	221.00	283.00	1
17	221.00	283.00	226.00	284.00	1
18	226.00	284.00	242.00	285.00	1
19	242.00	285.00	249.00	288.00	1
20	249.00	288.00	261.00	299.00	1
21	261.00	299.00	263.00	304.00	1
22	263.00	304.00	265.00	306.00	1
23	265.00	306.00	272.00	309.00	1
24	272.00	309.00	368.00	329.00	1
25	368.00	329.00	405.00	332.00	1
26	405.00	332.00	451.00	338.00	1
27	451.00	338.00	496.00	349.00	1
28	496.00	349.00	562.00	382.00	1
29	562.00	382.00	604.00	396.00	1
30	110.00	225.00	126.00	224.00	1
31	126.00	224.00	146.00	229.00	1
32	146.00	229.00	176.00	243.00	1
33	176.00	243.00	196.00	253.00	1
34	196.00	253.00	236.00	273.00	1
35	236.00	273.00	251.00	281.00	1
36	251.00	281.00	256.00	286.00	1
37	256.00	286.00	261.00	299.00	1
38	0.00	200.00	46.00	200.00	1
39	46.00	200.00	106.00	203.00	1
40	106.00	203.00	146.00	203.00	1
41	146.00	203.00	175.00	206.00	1

42	175.00	206.00	182.00	209.00	1
43	182.00	209.00	188.00	216.00	1
44	188.00	216.00	196.00	253.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	0.0	24.0	0.00	0.0	0

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
10 Trial Surfaces Have Been Generated.
9 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 15.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	110.00	225.00	110.00	225.00	0.00
2	126.00	224.00	126.00	224.00	0.00
3	146.00	229.00	146.00	229.00	0.00
4	176.00	243.00	176.00	243.00	0.00
5	196.00	253.00	196.00	253.00	0.00
6	236.00	273.00	236.00	273.00	0.00
7	251.00	281.00	251.00	281.00	0.00
8	256.00	286.00	256.00	286.00	0.00
9	261.00	299.00	261.00	299.00	0.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 10
Number of Trial Surfaces With Valid FS = 10
Statistical Data On All Valid FS Values:
FS Max = 1.020 FS Min = 1.020 FS Ave = 1.020
Standard Deviation = 0.000 Coefficient of Variation = 0.00 %
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.000	225.000
2	126.000	224.000
3	146.000	229.000
4	176.000	243.000
5	196.000	253.000
6	236.000	273.000
7	251.000	281.000
8	256.000	286.000
9	261.000	299.000

Factor of Safety
*** 1.020 ***
Individual data on the 20 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.0	6113.2	0.0	0.0	0.	0.	0.0	0.0	0.0
2	4.0	4824.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	8.0	13097.3	0.0	0.0	0.	0.	0.0	0.0	0.0
4	6.0	13637.2	0.0	0.0	0.	0.	0.0	0.0	0.0
5	6.0	17057.2	0.0	0.0	0.	0.	0.0	0.0	0.0
6	5.0	15564.2	0.0	0.0	0.	0.	0.0	0.0	0.0
7	11.0	38623.2	0.0	0.0	0.	0.	0.0	0.0	0.0
8	14.0	50717.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.0	3411.9	0.0	0.0	0.	0.	0.0	0.0	0.0

10	13.0	43811.6	0.0	0.0	0.	0.	0.0	0.0	0.0
11	6.0	19123.5	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.0	3004.4	0.0	0.0	0.	0.	0.0	0.0	0.0
13	24.0	57684.0	0.0	0.0	0.	0.	0.0	0.0	0.0
14	5.0	8751.9	0.0	0.0	0.	0.	0.0	0.0	0.0
15	10.0	14434.1	0.0	0.0	0.	0.	0.0	0.0	0.0
16	6.0	6403.2	0.0	0.0	0.	0.	0.0	0.0	0.0
17	7.0	6169.0	0.0	0.0	0.	0.	0.0	0.0	0.0
18	2.0	1766.0	0.0	0.0	0.	0.	0.0	0.0	0.0
19	5.0	4506.6	0.0	0.0	0.	0.	0.0	0.0	0.0
20	5.0	2198.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.000	225.000
2	126.000	224.000
3	146.000	229.000
4	176.000	243.000
5	196.000	253.000
6	236.000	273.000
7	251.000	281.000
8	256.000	286.000
9	261.000	299.000

Factor of Safety
*** 1.020 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.000	225.000
2	126.000	224.000
3	146.000	229.000
4	176.000	243.000
5	196.000	253.000
6	236.000	273.000
7	251.000	281.000
8	256.000	286.000
9	261.000	299.000

Factor of Safety
*** 1.020 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.000	225.000
2	126.000	224.000
3	146.000	229.000
4	176.000	243.000
5	196.000	253.000
6	236.000	273.000
7	251.000	281.000
8	256.000	286.000
9	261.000	299.000

Factor of Safety
*** 1.020 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.000	225.000
2	126.000	224.000
3	146.000	229.000
4	176.000	243.000
5	196.000	253.000
6	236.000	273.000
7	251.000	281.000
8	256.000	286.000
9	261.000	299.000

Factor of Safety
*** 1.020 ***

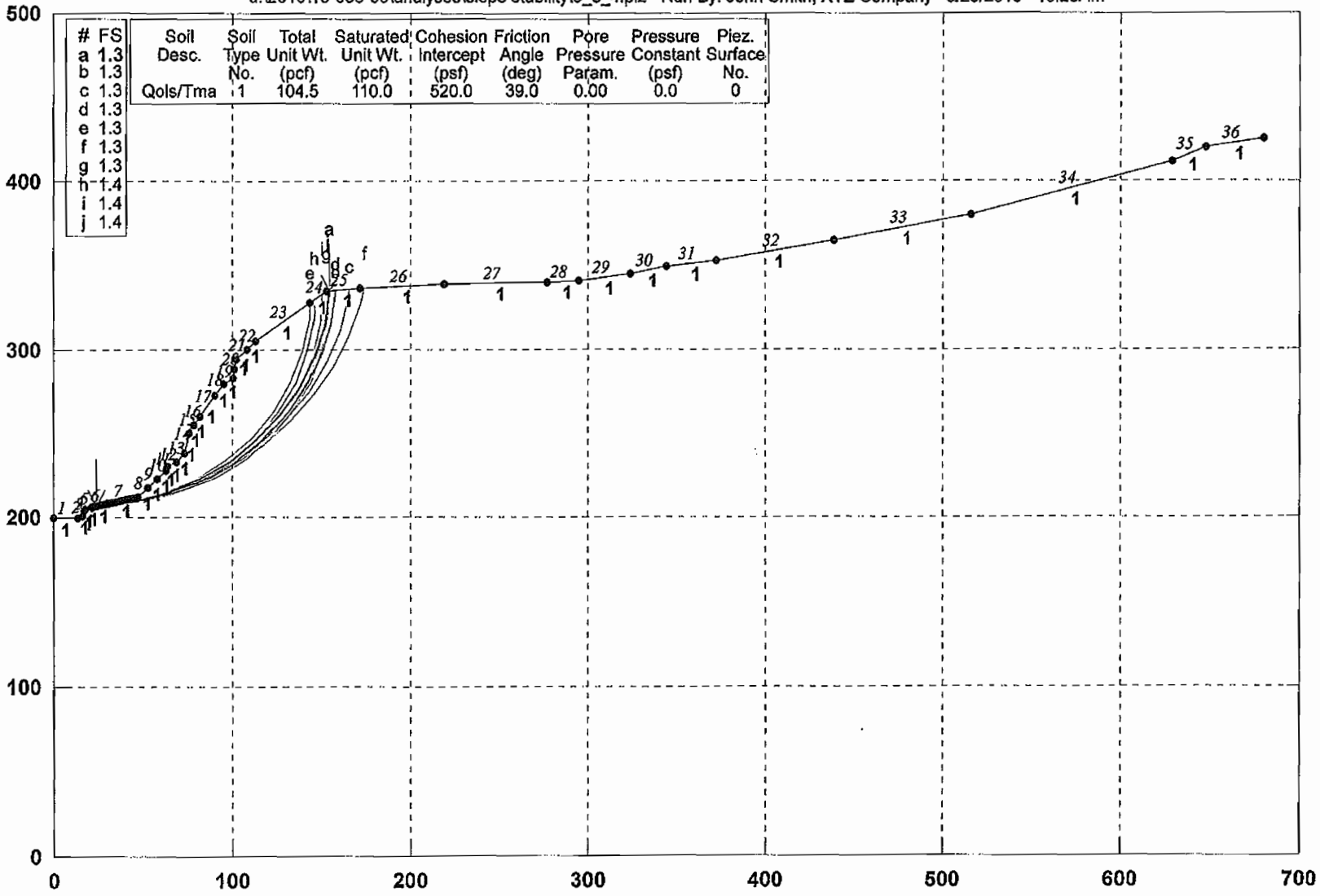
Failure Surface Specified By 9 Coordinate Points

```
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        110.000      225.000
    2        126.000      224.000
    3        146.000      229.000
    4        176.000      243.000
    5        196.000      253.000
    6        236.000      273.000
    7        251.000      281.000
    8        256.000      286.000
    9        261.000      299.000
       Factor of Safety
      ***     1.020    ***
Failure Surface Specified By  9 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        110.000      225.000
    2        126.000      224.000
    3        146.000      229.000
    4        176.000      243.000
    5        196.000      253.000
    6        236.000      273.000
    7        251.000      281.000
    8        256.000      286.000
    9        261.000      299.000
       Factor of Safety
      ***     1.020    ***
Failure Surface Specified By  9 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        110.000      225.000
    2        126.000      224.000
    3        146.000      229.000
    4        176.000      243.000
    5        196.000      253.000
    6        236.000      273.000
    7        251.000      281.000
    8        256.000      286.000
    9        261.000      299.000
       Factor of Safety
      ***     1.020    ***
Failure Surface Specified By  9 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        110.000      225.000
    2        126.000      224.000
    3        146.000      229.000
    4        176.000      243.000
    5        196.000      253.000
    6        236.000      273.000
    7        251.000      281.000
    8        256.000      286.000
    9        261.000      299.000
       Factor of Safety
      ***     1.020    ***
Failure Surface Specified By  9 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        110.000      225.000
    2        126.000      224.000
    3        146.000      229.000
    4        176.000      243.000
    5        196.000      253.000
    6        236.000      273.000
    7        251.000      281.000
    8        256.000      286.000
    9        261.000      299.000
       Factor of Safety
```

```
***     1.020    ***
     **** END OF GSTABL7 OUTPUT ****
```

Sect 6, Back-calculation of the cross- bedding Strength for Bluff Slope

u:\2010\10-036-00\analyses\slope stability\6_s_4.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:25AM



#	FS
a	1.3
b	1.3
c	1.3
d	1.3
e	1.3
f	1.3
g	1.3
h	1.4
i	1.4
j	1.4

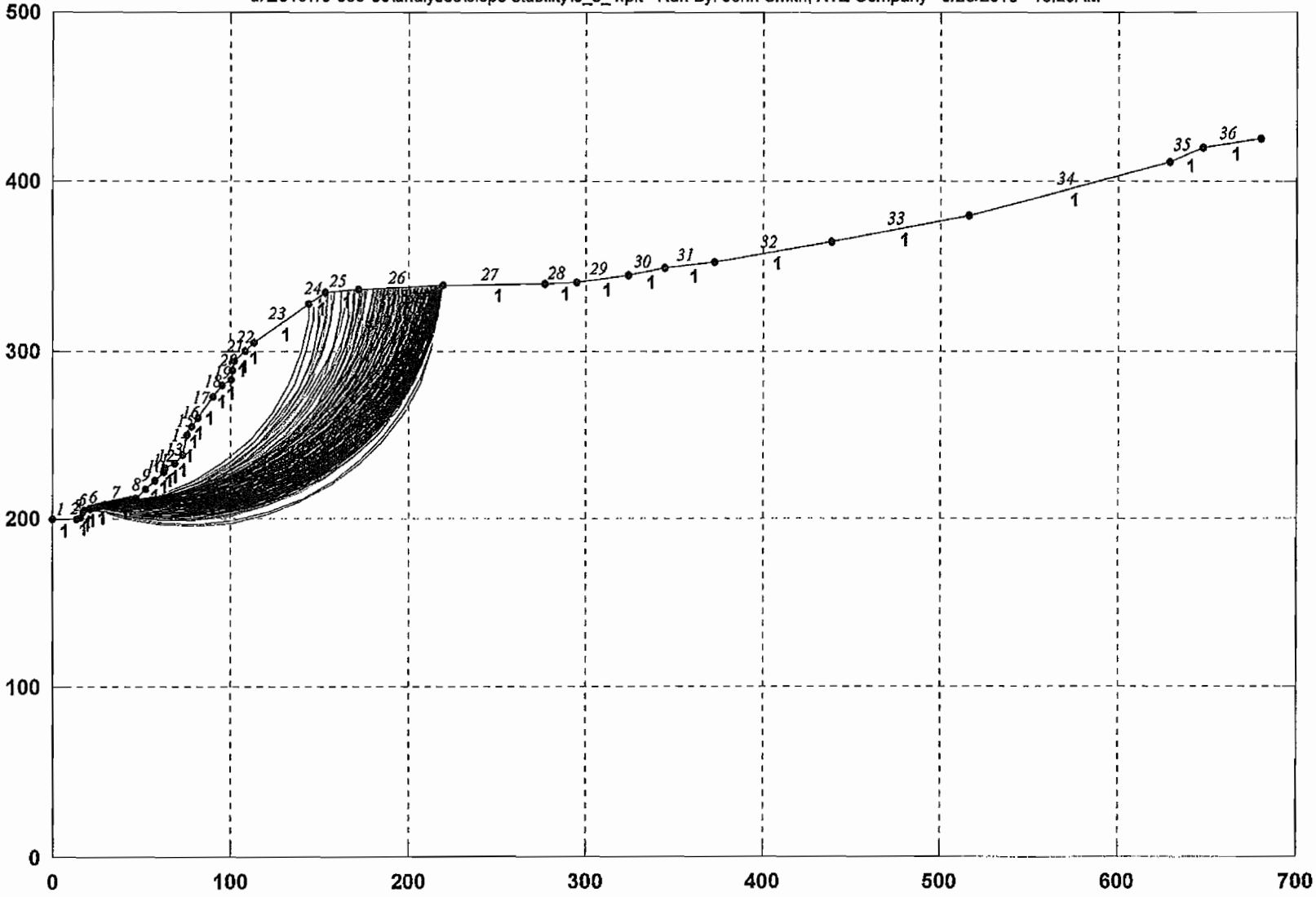
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qols/Tma	1	104.5	110.0	520.0	39.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

Sect 6, Back-calculation of the cross- bedding Strength for Bluff Slope

u:\2010\10-036-00\analyses\slope stability\6_s_4.plt Run By: John Smith, XYZ Company 9/28/2010 10:25AM



*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:25AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\6_s_4.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\6_s_4.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\6_s_4.PLT
PROBLEM DESCRIPTION: Sect 6, Back-calculation of the cross-bedding Strength for Bluff Slope

BOUNDARY COORDINATES
36 Top Boundaries
36 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	200.00	14.00	200.00	1
2	14.00	200.00	16.00	201.00	1
3	16.00	201.00	17.00	204.00	1
4	17.00	204.00	18.00	205.00	1
5	18.00	205.00	21.00	206.00	1
6	21.00	206.00	30.00	208.00	1
7	30.00	208.00	47.00	212.00	1
8	47.00	212.00	53.00	218.00	1
9	53.00	218.00	58.00	223.00	1
10	58.00	223.00	63.00	228.00	1
11	63.00	228.00	64.00	230.00	1
12	64.00	230.00	69.00	233.00	1
13	69.00	233.00	73.00	238.00	1
14	73.00	238.00	76.00	250.00	1
15	76.00	250.00	78.00	255.00	1
16	78.00	255.00	82.00	260.00	1
17	82.00	260.00	90.00	273.00	1
18	90.00	273.00	95.00	280.00	1
19	95.00	280.00	100.00	283.00	1
20	100.00	283.00	102.00	294.00	1
21	102.00	294.00	108.00	300.00	1
22	108.00	300.00	113.00	305.00	1
23	113.00	305.00	144.00	328.00	1
24	144.00	328.00	153.00	335.00	1
25	153.00	335.00	172.00	337.00	1
26	172.00	337.00	219.00	339.00	1
27	219.00	339.00	277.00	340.00	1
28	277.00	340.00	295.00	341.00	1
29	295.00	341.00	324.00	345.00	1
30	324.00	345.00	344.00	349.00	1
31	344.00	349.00	372.00	353.00	1
32	372.00	353.00	439.00	365.00	1
33	439.00	365.00	516.00	380.00	1
34	516.00	380.00	629.00	411.00	1
35	629.00	411.00	648.00	420.00	1
36	648.00	420.00	680.00	425.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	520.0	39.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 21.00(ft)
and X = 47.00(ft)
Each Surface Terminates Between X = 101.00(ft)
and X = 219.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 2.052 FS Min = 1.334 FS Ave = 1.709
Standard Deviation = 0.160 Coefficient of Variation = 9.37 %
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.737	206.608
2	43.586	209.058
3	62.876	214.341
4	81.203	222.348
5	98.187	232.910
6	113.472	245.809
7	126.740	260.774
8	137.714	277.494
9	146.165	295.621
10	151.918	314.775
11	154.852	334.559
12	154.854	335.195

Circle Center At X = 16.778 ; Y = 344.846 ; and Radius = 138.413
Factor of Safety
*** 1.334 ***
Individual data on the 30 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.3	202.5	0.0	0.0	0.	0.	0.0	0.0	0.0
2	13.6	1957.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	3.4	739.4	0.0	0.0	0.	0.	0.0	0.0	0.0
4	6.0	2624.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	5.0	4273.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	4.9	5994.1	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.1	176.1	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.0	1503.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	5.0	8138.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.0	7360.8	0.0	0.0	0.	0.	0.0	0.0	0.0
11	3.0	7706.0	0.0	0.0	0.	0.	0.0	0.0	0.0
12	2.0	6685.6	0.0	0.0	0.	0.	0.0	0.0	0.0
13	3.2	11834.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	0.8	3072.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	8.0	34417.4	0.0	0.0	0.	0.	0.0	0.0	0.0
16	5.0	24623.6	0.0	0.0	0.	0.	0.0	0.0	0.0
17	3.2	16329.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.8	9243.6	0.0	0.0	0.	0.	0.0	0.0	0.0
19	2.0	11122.1	0.0	0.0	0.	0.	0.0	0.0	0.0
20	6.0	36579.4	0.0	0.0	0.	0.	0.0	0.0	0.0
21	5.0	30931.5	0.0	0.0	0.	0.	0.0	0.0	0.0

22	0.5	2935.9	0.0	0.0	0.	0.	0.0	0.0	0.0
23	13.3	79003.5	0.0	0.0	0.	0.	0.0	0.0	0.0
24	11.0	57490.2	0.0	0.0	0.	0.	0.0	0.0	0.0
25	6.3	27217.5	0.0	0.0	0.	0.	0.0	0.0	0.0
26	2.2	8043.0	0.0	0.0	0.	0.	0.0	0.0	0.0
27	5.8	16065.3	0.0	0.0	0.	0.	0.0	0.0	0.0
28	1.1	1826.5	0.0	0.0	0.	0.	0.0	0.0	0.0
29	1.9	1313.0	0.0	0.0	0.	0.	0.0	0.0	0.0
30	0.0	0.1	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.211	207.825
2	49.060	210.271
3	68.335	215.610
4	86.614	223.726
5	103.500	234.443
6	118.627	247.527
7	131.664	262.693
8	142.328	279.613
9	150.388	297.917
10	155.668	317.207
11	157.867	335.512

Circle Center At X = 22.597 ; Y = 343.261 ; and Radius = 135.598

Factor of Safety

*** 1.337 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.318	209.705
3	65.654	214.818
4	84.135	222.463
5	101.431	232.505
6	117.234	244.763
7	131.261	259.020
8	143.261	275.019
9	153.021	292.476
10	160.366	311.079
11	165.164	330.495
12	165.801	336.348

Circle Center At X = 18.059 ; Y = 356.026 ; and Radius = 149.048

Factor of Safety

*** 1.337 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.339	209.533
3	65.663	214.691
4	84.040	222.581
5	101.088	233.039
6	116.449	245.847
7	129.802	260.736
8	140.869	277.396
9	149.417	295.477
10	155.268	314.602
11	158.299	334.371
12	158.308	335.559

Circle Center At X = 20.494 ; Y = 345.241 ; and Radius = 138.154

Factor of Safety

*** 1.338 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	206.304
2	42.239	208.573
3	61.502	213.954

4	79.671	222.313
5	96.292	233.438
6	110.944	247.051
7	123.261	262.808
8	132.932	280.314
9	139.714	299.129
10	143.437	318.780
11	143.694	327.773

Circle Center At X = 18.040 ; Y = 332.360 ; and Radius = 126.131

Factor of Safety

*** 1.346 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.303	209.822
3	65.661	214.849
4	84.252	222.223
5	101.794	231.829
6	118.019	243.523
7	132.680	257.126
8	145.555	272.431
9	156.447	289.206
10	165.190	307.193
11	171.651	326.121
12	173.936	337.082

Circle Center At X = 15.587 ; Y = 368.232 ; and Radius = 161.383

Factor of Safety

*** 1.348 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	31.947	208.458
2	51.833	210.591
3	71.122	215.877
4	89.318	224.178
5	105.952	235.283
6	120.597	248.904
7	132.874	264.692
8	142.470	282.239
9	149.136	301.096
10	152.701	320.775
11	152.966	334.973

Circle Center At X = 28.637 ; Y = 333.088 ; and Radius = 124.674

Factor of Safety

*** 1.349 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.105	206.912
2	45.010	208.864
3	64.337	214.009
4	82.576	222.214
5	99.249	233.261
6	113.914	246.859
7	126.187	262.651
8	135.743	280.220
9	142.332	299.104
10	145.779	318.805
11	145.893	329.472

Circle Center At X = 23.074 ; Y = 330.121 ; and Radius = 123.226

Factor of Safety

*** 1.350 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.412	208.792

3	65.835	213.559
4	84.237	221.393
5	101.136	232.090
6	116.090	245.370
7	128.710	260.886
8	138.665	278.233
9	145.694	296.956
10	149.615	316.568
11	150.192	332.816

Circle Center At X = 26.730 ; Y = 330.939 ; and Radius = 123.723

Factor of Safety

*** 1.360 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.316	208.780
2	53.238	210.546
3	72.602	215.548
4	90.887	223.650
5	107.601	234.635
6	122.292	248.206
7	134.565	263.997
8	144.089	281.584
9	150.608	300.492
10	153.945	320.211
11	153.995	335.105

Circle Center At X = 32.554 ; Y = 330.614 ; and Radius = 121.837

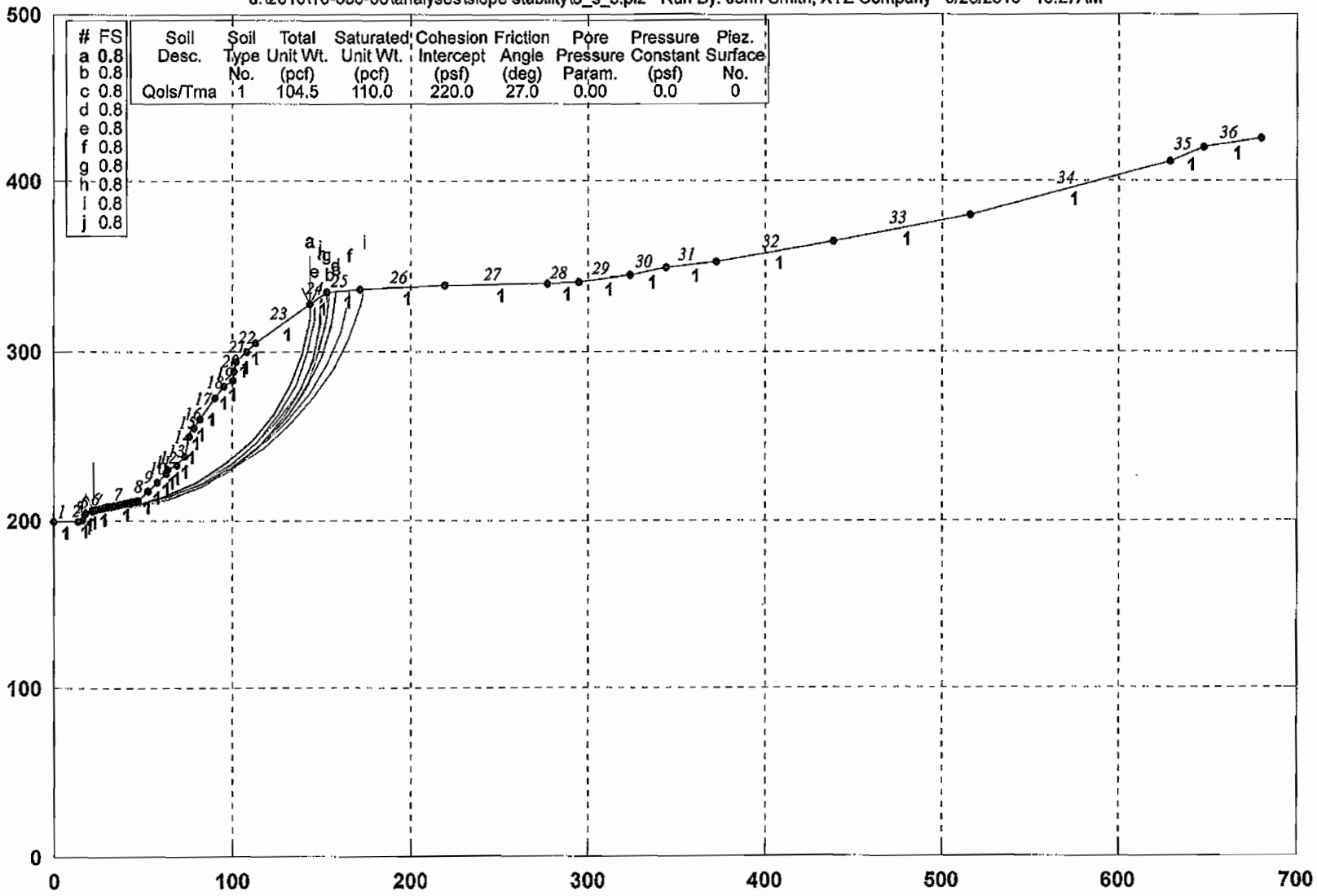
Factor of Safety

*** 1.365 ***

**** END OF GSTABL7 OUTPUT ****

Sect 6, Back-calculation of the cross- bedding strength for Bluff Slope

u:\2010\10-036-00\analyses\slope stability\6_s_3.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:27AM

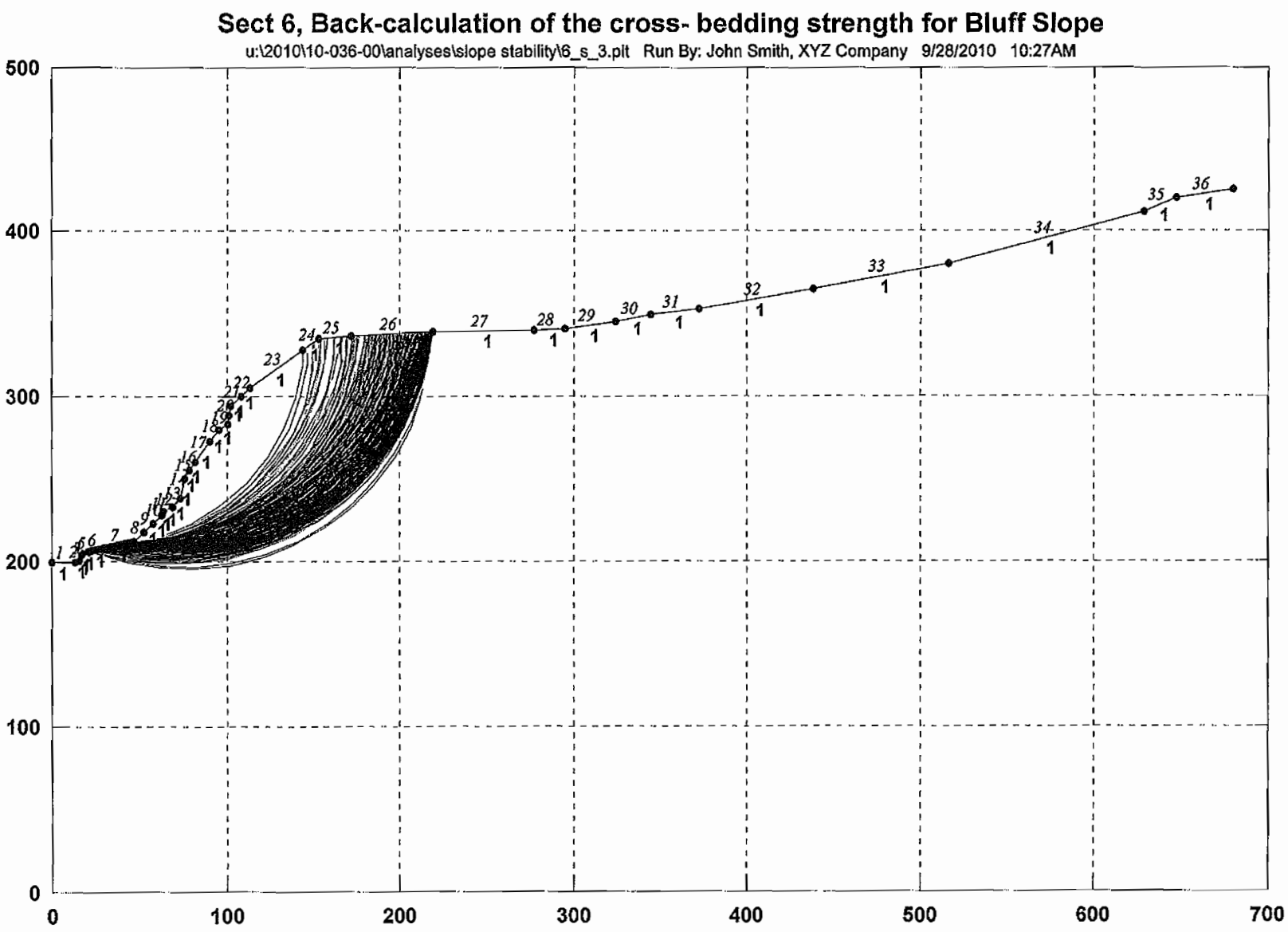


#	FS
a	0.8
b	0.8
c	0.8
d	0.8
e	0.8
f	0.8
g	0.8
h	0.8
i	0.8
j	0.8

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qols/Tma	1	104.5	110.0	220.0	27.0	0.00	0.0	0

GSTABL7 v.2 FSmin=0.8

Safety Factors Are Calculated By The Modified Bishop Method


Sect 6, Back-calculation of the cross- bedding strength for Bluff Slope
u:\2010\10-036-00\analyses\slope stability\6_s_3.plt Run By: John Smith, XYZ Company 9/28/2010 10:27AM
500
400
300
200
100
0
0
100
200
300
400
500
600
700

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:27AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\6_s_3.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\6_s_3.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\6_s_3.PLT
PROBLEM DESCRIPTION: Sect 6, Back-calculation of the cross-bedding strength for Bluff Slope

BOUNDARY COORDINATES
36 Top Boundaries
36 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	200.00	14.00	200.00	1
2	14.00	200.00	16.00	201.00	1
3	16.00	201.00	17.00	204.00	1
4	17.00	204.00	18.00	205.00	1
5	18.00	205.00	21.00	206.00	1
6	21.00	206.00	30.00	208.00	1
7	30.00	208.00	47.00	212.00	1
8	47.00	212.00	53.00	218.00	1
9	53.00	218.00	58.00	223.00	1
10	58.00	223.00	63.00	228.00	1
11	63.00	228.00	64.00	230.00	1
12	64.00	230.00	69.00	233.00	1
13	69.00	233.00	73.00	238.00	1
14	73.00	238.00	76.00	250.00	1
15	76.00	250.00	78.00	255.00	1
16	78.00	255.00	82.00	260.00	1
17	82.00	260.00	90.00	273.00	1
18	90.00	273.00	95.00	280.00	1
19	95.00	280.00	100.00	283.00	1
20	100.00	283.00	102.00	294.00	1
21	102.00	294.00	108.00	300.00	1
22	108.00	300.00	113.00	305.00	1
23	113.00	305.00	144.00	328.00	1
24	144.00	328.00	153.00	335.00	1
25	153.00	335.00	172.00	337.00	1
26	172.00	337.00	219.00	339.00	1
27	219.00	339.00	277.00	340.00	1
28	277.00	340.00	295.00	341.00	1
29	295.00	341.00	324.00	345.00	1
30	324.00	345.00	344.00	349.00	1
31	344.00	349.00	372.00	353.00	1
32	372.00	353.00	439.00	365.00	1
33	439.00	365.00	516.00	380.00	1
34	516.00	380.00	629.00	411.00	1
35	629.00	411.00	648.00	420.00	1
36	648.00	420.00	680.00	425.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	220.0	27.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 21.00(ft)
and X = 47.00(ft)
Each Surface Terminates Between X = 101.00(ft)
and X = 219.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 1.249 FS Min = 0.765 FS Ave = 1.030
Standard Deviation = 0.105 Coefficient of Variation = 10.17 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	206.304
2	42.239	208.573
3	61.502	213.954
4	79.671	222.313
5	96.292	233.438
6	110.944	247.051
7	123.261	262.808
8	132.932	280.314
9	139.714	299.129
10	143.437	318.780
11	143.694	327.773

Circle Center At X = 18.040 ; Y = 332.360 ; and Radius = 126.131
Factor of Safety
*** 0.765 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.6	328.8	0.0	0.0	0.	0.	0.0	0.0	0.0
2	12.2	2002.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	4.8	1095.4	0.0	0.0	0.	0.	0.0	0.0	0.0
4	6.0	2670.4	0.0	0.0	0.	0.	0.0	0.0	0.0
5	5.0	4296.2	0.0	0.0	0.	0.	0.0	0.0	0.0
6	3.5	4129.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.5	2027.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.0	1476.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	5.0	7966.3	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.0	7179.7	0.0	0.0	0.	0.	0.0	0.0	0.0
11	3.0	7544.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	2.0	6566.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.7	5958.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	2.3	8626.9	0.0	0.0	0.	0.	0.0	0.0	0.0
15	8.0	33399.1	0.0	0.0	0.	0.	0.0	0.0	0.0
16	5.0	23826.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.3	6394.8	0.0	0.0	0.	0.	0.0	0.0	0.0
18	3.7	18108.4	0.0	0.0	0.	0.	0.0	0.0	0.0
19	2.0	10593.7	0.0	0.0	0.	0.	0.0	0.0	0.0
20	6.0	34780.7	0.0	0.0	0.	0.	0.0	0.0	0.0
21	2.9	17164.0	0.0	0.0	0.	0.	0.0	0.0	0.0
22	2.1	11946.5	0.0	0.0	0.	0.	0.0	0.0	0.0

23	10.3	56359.8	0.0	0.0	0.	0.	0.0	0.0	0.0
24	9.7	45114.0	0.0	0.0	0.	0.	0.0	0.0	0.0
25	6.8	23093.1	0.0	0.0	0.	0.	0.0	0.0	0.0
26	3.7	6710.2	0.0	0.0	0.	0.	0.0	0.0	0.0
27	0.3	118.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.737	206.608
2	43.586	209.058
3	62.876	214.341
4	81.203	222.348
5	98.187	232.910
6	113.472	245.809
7	126.740	260.774
8	137.714	277.494
9	146.165	295.621
10	151.918	314.775
11	154.852	334.559
12	154.854	335.195

Circle Center At X = 16.778 ; Y = 344.846 ; and Radius = 138.413

Factor of Safety
*** 0.765 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.339	209.533
3	65.663	214.691
4	84.040	222.581
5	101.088	233.039
6	116.449	245.847
7	129.802	260.736
8	140.869	277.396
9	149.417	295.477
10	155.268	314.602
11	158.299	334.371
12	158.308	335.559

Circle Center At X = 20.494 ; Y = 345.241 ; and Radius = 138.154

Factor of Safety
*** 0.773 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.211	207.825
2	49.060	210.271
3	68.335	215.610
4	86.614	223.726
5	103.500	234.443
6	118.627	247.527
7	131.664	262.693
8	142.328	279.613
9	150.388	297.917
10	155.668	317.207
11	157.867	335.512

Circle Center At X = 22.597 ; Y = 343.261 ; and Radius = 135.598

Factor of Safety
*** 0.774 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.105	206.912
2	45.010	208.864
3	64.337	214.009
4	82.576	222.214
5	99.249	233.261
6	113.914	246.859
7	126.187	262.651

8	135.743	280.220
9	142.332	299.104
10	145.779	318.805
11	145.893	329.472

Circle Center At X = 23.074 ; Y = 330.121 ; and Radius = 123.226

Factor of Safety

*** 0.774 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.318	209.705
3	65.654	214.818
4	84.135	222.463
5	101.431	232.505
6	117.234	244.763
7	131.261	259.020
8	143.261	275.019
9	153.021	292.476
10	160.366	311.079
11	165.164	330.495
12	165.801	336.348

Circle Center At X = 18.059 ; Y = 356.026 ; and Radius = 149.048

Factor of Safety

*** 0.778 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	31.947	208.458
2	51.833	210.591
3	71.122	215.877
4	89.318	224.178
5	105.952	235.283
6	120.597	248.904
7	132.874	264.692
8	142.470	282.239
9	149.136	301.096
10	152.701	320.775
11	152.966	334.973

Circle Center At X = 28.637 ; Y = 333.088 ; and Radius = 124.674

Factor of Safety

*** 0.783 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.412	208.792
3	65.835	213.559
4	84.237	221.393
5	101.136	232.090
6	116.090	245.370
7	128.710	260.886
8	138.665	278.233
9	145.694	296.956
10	149.615	316.568
11	150.192	332.816

Circle Center At X = 26.730 ; Y = 330.939 ; and Radius = 123.723

Factor of Safety

*** 0.787 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.474	207.216
2	46.303	209.822
3	65.661	214.849
4	84.252	222.223
5	101.794	231.829
6	118.019	243.523

7	132.680	257.126
8	145.555	272.431
9	156.447	289.206
10	165.190	307.193
11	171.651	326.121
12	173.936	337.082

Circle Center At X = 15.587 ; Y = 368.232 ; and Radius = 161.383

Factor of Safety

*** 0.787 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.105	206.912
2	45.067	208.145
3	64.561	212.615
4	83.065	220.204
5	100.085	230.709
6	115.164	243.848
7	127.898	259.269
8	137.948	276.561
9	145.045	295.259
10	148.997	314.865
11	149.613	332.366

Circle Center At X = 27.579 ; Y = 329.142 ; and Radius = 122.255

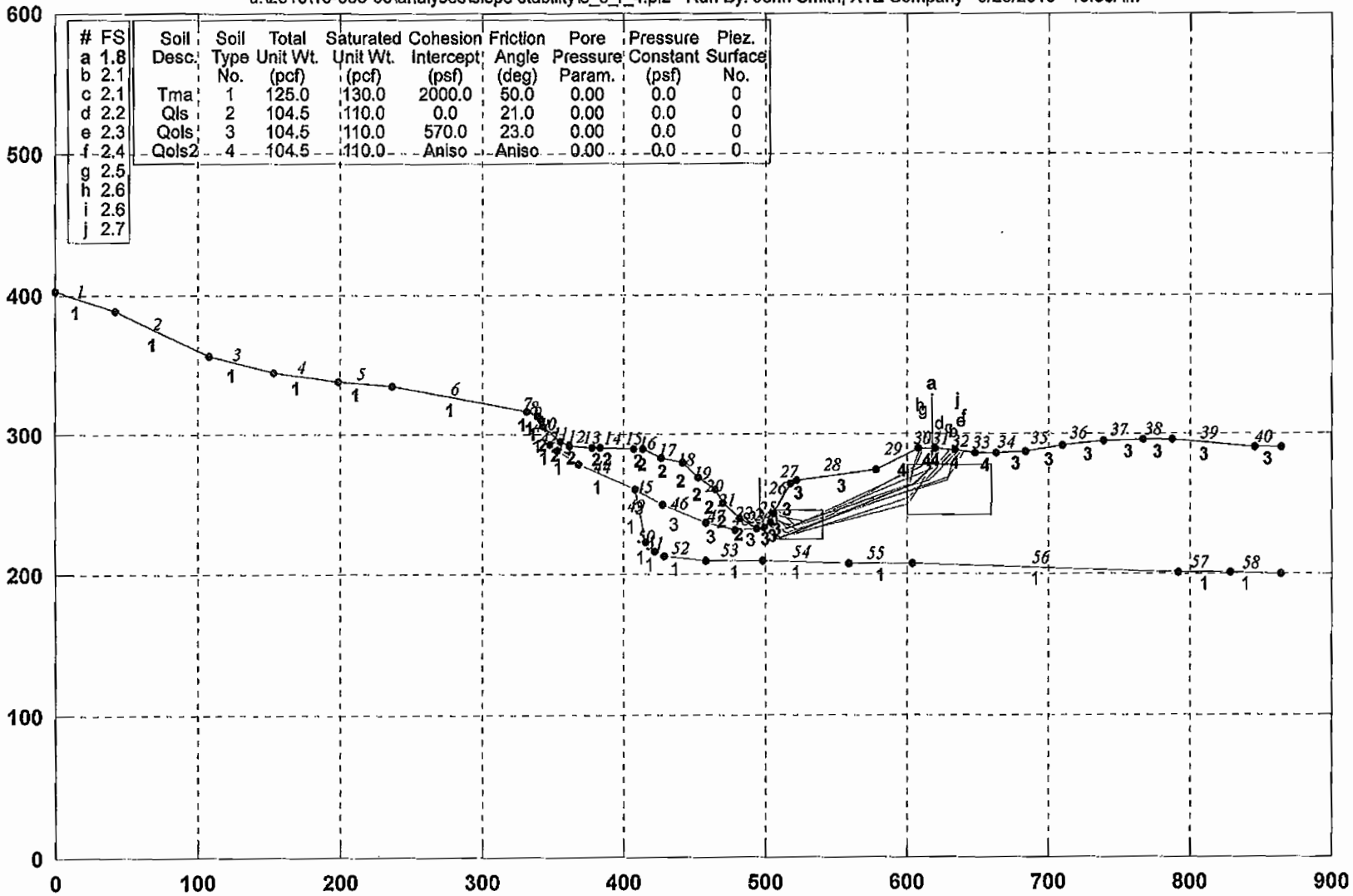
Factor of Safety

*** 0.793 ***

**** END OF GSTABL7 OUTPUT ****

Sect 3, Lower switch back, Existing condstability, Translation search at road

u:\2010\10-036-00\analyses\slope stability\3_s_r_4.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:38AM



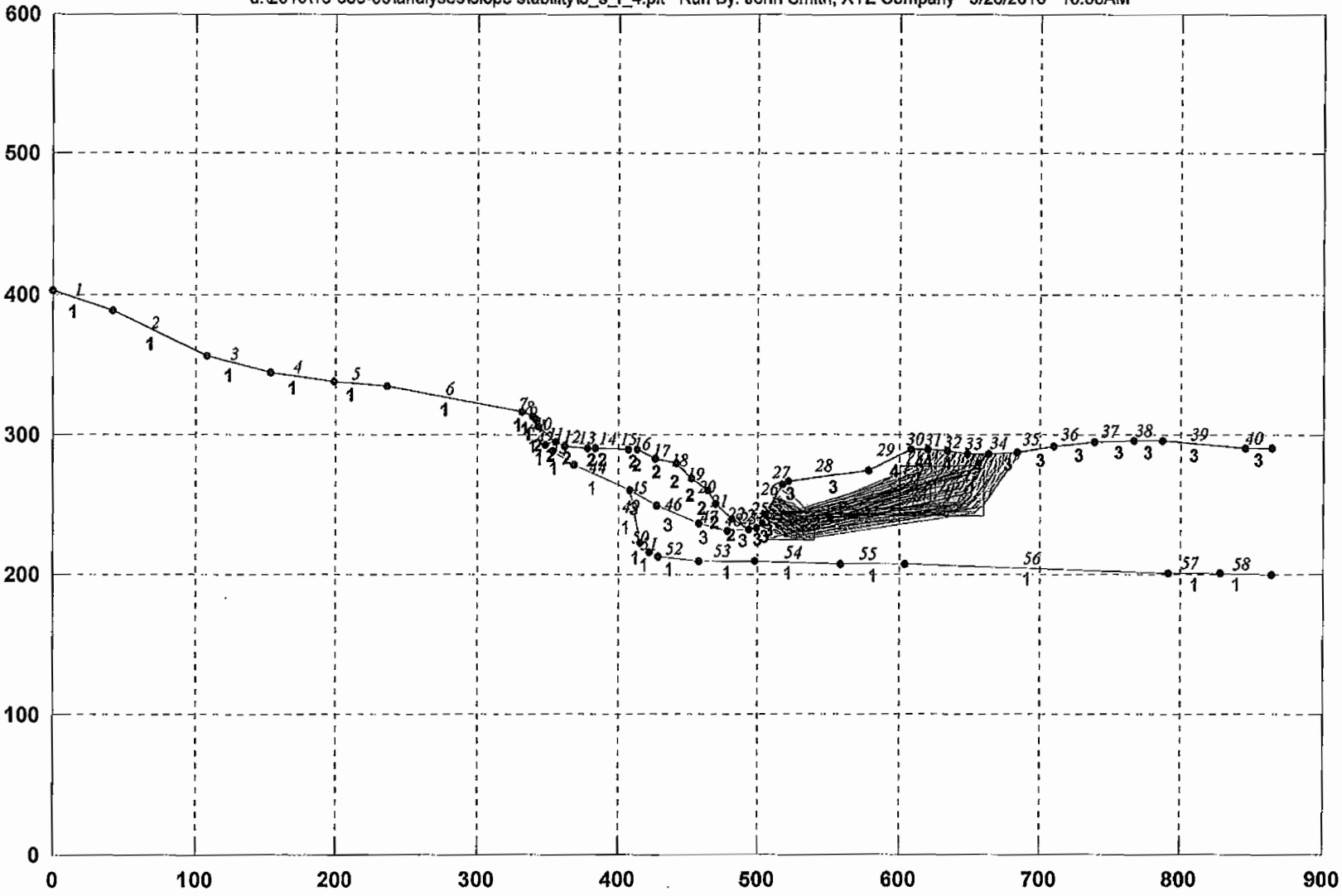
#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
a	1.8									
b	2.1									
c	2.1	Tma	1	125.0	130.0	2000.0	50.0	0.00	0.0	0
d	2.2	Qls	2	104.5	110.0	0.0	21.0	0.00	0.0	0
e	2.3	Qols	3	104.5	110.0	570.0	23.0	0.00	0.0	0
f	2.4	Qols2	4	104.5	110.0	Aniso	Aniso	0.00	0.0	0
g	2.5									
h	2.6									
i	2.6									
j	2.7									

GSTABL7 v.2 FSmin=1.8

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

Sect 3, Lower switch back, Existing condstability, Translation search at road

u:\2010\10-036-00\analyses\slope stability\3_s_r_4.plt Run By: John Smith, XYZ Company 9/28/2010 10:38AM



*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:38AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_4.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_4.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_4.PLT
PROBLEM DESCRIPTION: Sect 3, Lower switch back, Existing cond
stability, Translation search at road

BOUNDARY COORDINATES
40 Top Boundaries
58 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	403.00	42.00	389.00	1
2	42.00	389.00	108.00	356.00	1
3	108.00	356.00	153.00	345.00	1
4	153.00	345.00	199.00	338.00	1
5	199.00	338.00	236.00	335.00	1
6	236.00	335.00	332.00	316.00	1
7	332.00	316.00	339.00	313.00	1
8	339.00	313.00	341.00	311.00	1
9	341.00	311.00	343.00	306.00	1
10	343.00	306.00	355.00	295.00	2
11	355.00	295.00	362.00	292.00	2
12	362.00	292.00	378.00	291.00	2
13	378.00	291.00	383.00	291.00	2
14	383.00	291.00	407.00	289.00	2
15	407.00	289.00	414.00	289.00	2
16	414.00	289.00	427.00	283.00	2
17	427.00	283.00	442.00	280.00	2
18	442.00	280.00	453.00	269.00	2
19	453.00	269.00	464.00	260.00	2
20	464.00	260.00	470.00	251.00	2
21	470.00	251.00	482.00	240.00	2
22	482.00	240.00	494.00	232.00	2
23	494.00	232.00	499.00	233.00	3
24	499.00	233.00	503.00	237.00	3
25	503.00	237.00	505.00	243.00	3
26	505.00	243.00	517.00	265.00	3
27	517.00	265.00	522.00	267.00	3
28	522.00	267.00	578.00	274.00	3
29	578.00	274.00	608.00	289.00	4
30	608.00	289.00	620.00	289.00	4
31	620.00	289.00	634.00	288.00	4
32	634.00	288.00	648.00	286.00	4
33	648.00	286.00	663.00	286.00	4
34	663.00	286.00	684.00	287.00	3
35	684.00	287.00	710.00	292.00	3
36	710.00	292.00	739.00	295.00	3
37	739.00	295.00	767.00	296.00	3
38	767.00	296.00	787.00	296.00	3
39	787.00	296.00	846.00	291.00	3
40	846.00	291.00	864.00	291.00	3
41	343.00	306.00	348.00	293.00	1

42	348.00	293.00	353.00	288.00	1
43	353.00	288.00	368.00	279.00	1
44	368.00	279.00	408.00	260.00	1
45	408.00	260.00	428.00	250.00	3
46	428.00	250.00	458.00	236.00	3
47	458.00	236.00	478.00	231.00	3
48	478.00	231.00	494.00	232.00	3
49	408.00	260.00	416.00	223.00	1
50	416.00	223.00	422.00	216.00	1
51	422.00	216.00	429.00	213.00	1
52	429.00	213.00	458.00	210.00	1
53	458.00	210.00	498.00	210.00	1
54	498.00	210.00	558.00	207.00	1
55	558.00	207.00	604.00	207.00	1
56	604.00	207.00	792.00	201.00	1
57	792.00	201.00	828.00	201.00	1
58	828.00	201.00	864.00	200.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	130.0	2000.0	50.0	0.00	0.0	0
2	104.5	110.0	0.0	21.0	0.00	0.0	0
3	104.5	110.0	570.0	23.0	0.00	0.0	0
4	104.5	110.0	0.0	17.0	0.00	0.0	0

ANISOTROPIC STRENGTH PARAMETERS

1 soil type(s)

Soil Type 4 Is Anisotropic
Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	22.0	570.00	23.00
2	28.0	0.00	17.00
3	90.0	570.00	23.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
100 Trial Surfaces Have Been Generated.
2 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 15.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	508.00	235.00	540.00	235.00	20.00
2	600.00	260.00	660.00	260.00	36.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 100
Number of Trial Surfaces With Valid FS = 100
Statistical Data On All Valid FS Values:
FS Max = 12.841 FS Min = 1.794 FS Ave = 3.988
Standard Deviation = 1.402 Coefficient of Variation = 35.16 %
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	495.296	232.259
2	496.986	230.664
3	510.951	225.189
4	605.856	264.542
5	616.427	275.184
6	617.980	289.000

Factor of Safety
*** 1.794 ***

Individual data on the 12 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.7	170.7	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.0	532.2	0.0	0.0	0.	0.	0.0	0.0	0.0
3	4.0	2470.1	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.0	2525.9	0.0	0.0	0.	0.	0.0	0.0	0.0
5	6.0	13743.6	0.0	0.0	0.	0.	0.0	0.0	0.0
6	6.0	20866.9	0.0	0.0	0.	0.	0.0	0.0	0.0
7	5.0	19471.5	0.0	0.0	0.	0.	0.0	0.0	0.0
8	56.0	170404.7	0.0	0.0	0.	0.	0.0	0.0	0.0
9	27.9	64615.0	0.0	0.0	0.	0.	0.0	0.0	0.0
10	2.1	5118.6	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.4	15901.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.6	1121.7	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.504	235.504
2	505.068	232.378
3	519.256	227.509
4	600.216	254.021
5	610.751	264.699
6	621.300	275.363
7	631.508	286.354
8	632.552	288.103

Factor of Safety
*** 2.117 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	504.860	242.581
2	515.350	232.645
3	618.673	275.361
4	629.078	286.165
5	629.637	288.312

Factor of Safety
*** 2.137 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	502.117	236.117
2	511.600	227.177
3	600.392	249.767
4	608.663	262.281
5	615.341	275.712
6	622.879	288.681
7	622.984	288.787

Factor of Safety
*** 2.232 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.632	234.632
2	511.303	231.327
3	628.195	266.941

4	632.663	281.260
5	638.146	287.408

Factor of Safety
*** 2.340 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	503.438	238.315
2	514.053	228.671
3	629.601	268.910
4	637.668	281.556
5	640.246	287.108

Factor of Safety
*** 2.435 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	503.795	239.385
2	511.213	237.016
3	524.693	230.438
4	605.724	276.732
5	611.657	289.000

Factor of Safety
*** 2.542 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	503.645	238.936
2	504.443	238.145
3	518.865	234.022
4	602.062	263.355
5	605.000	278.065
6	609.048	289.000

Factor of Safety
*** 2.592 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	506.753	246.213
2	510.023	244.478
3	521.100	234.364
4	610.704	276.205
5	618.295	289.000

Factor of Safety
*** 2.638 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	505.820	244.504
2	511.272	241.248
3	525.686	237.094
4	615.436	266.704
5	626.035	277.318
6	635.838	287.737

Factor of Safety
*** 2.712 ***

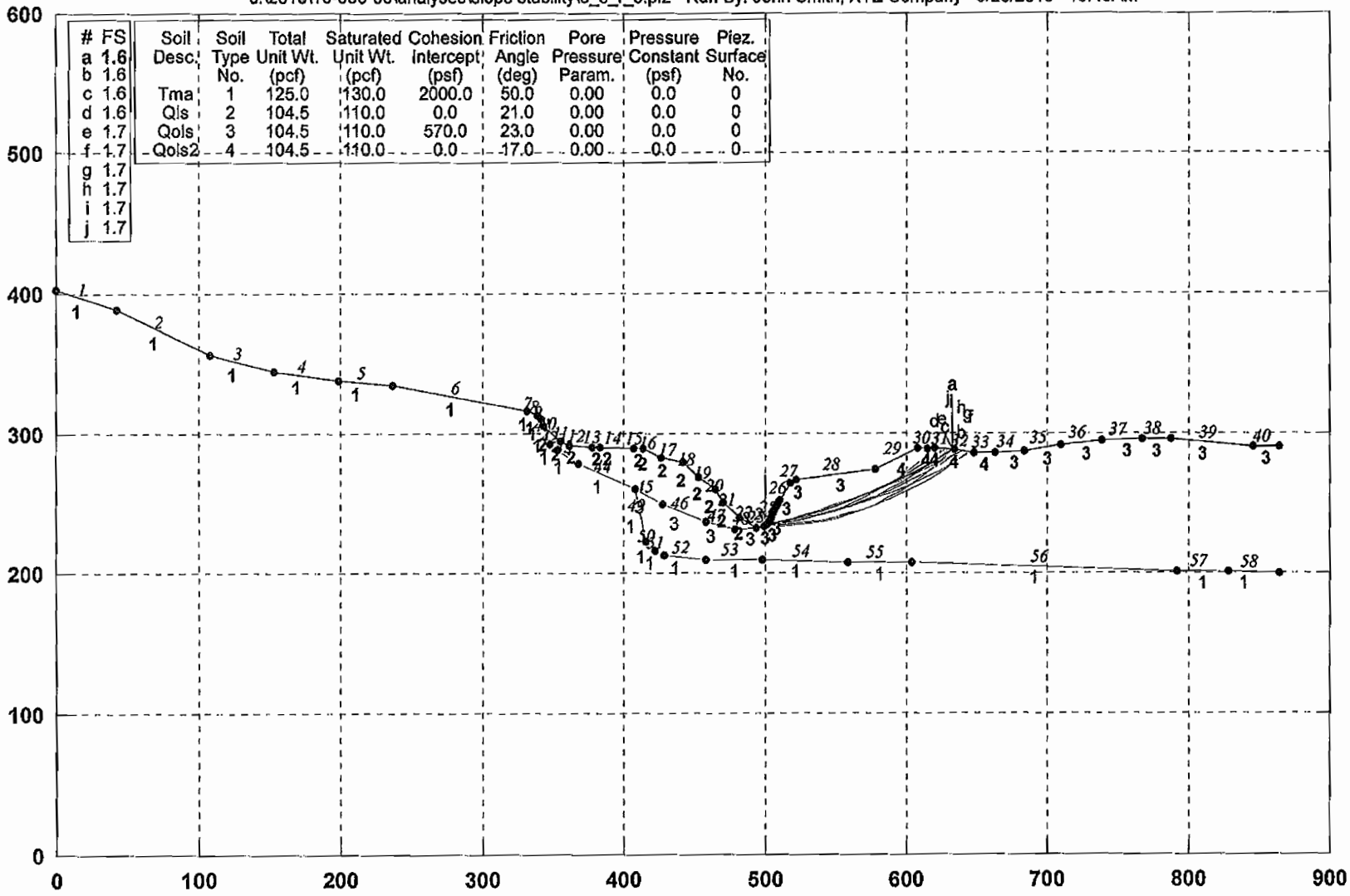
**** END OF GSTABL7 OUTPUT ****

Sect 3, Lower switch back, Existing condstability, Circular search at road

u:\2010\10-036-00\analyses\slope stability\3_s_r_5.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:40AM

#	FS
a	1.6
b	1.6
c	1.6
d	1.6
e	1.7
f	1.7
g	1.7
h	1.7
i	1.7
j	1.7

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Tma	1	125.0	130.0	2000.0	50.0	0.00	0.0	0
Qls	2	104.5	110.0	0.0	21.0	0.00	0.0	0
Qols	3	104.5	110.0	570.0	23.0	0.00	0.0	0
Qols2	4	104.5	110.0	0.0	17.0	0.00	0.0	0

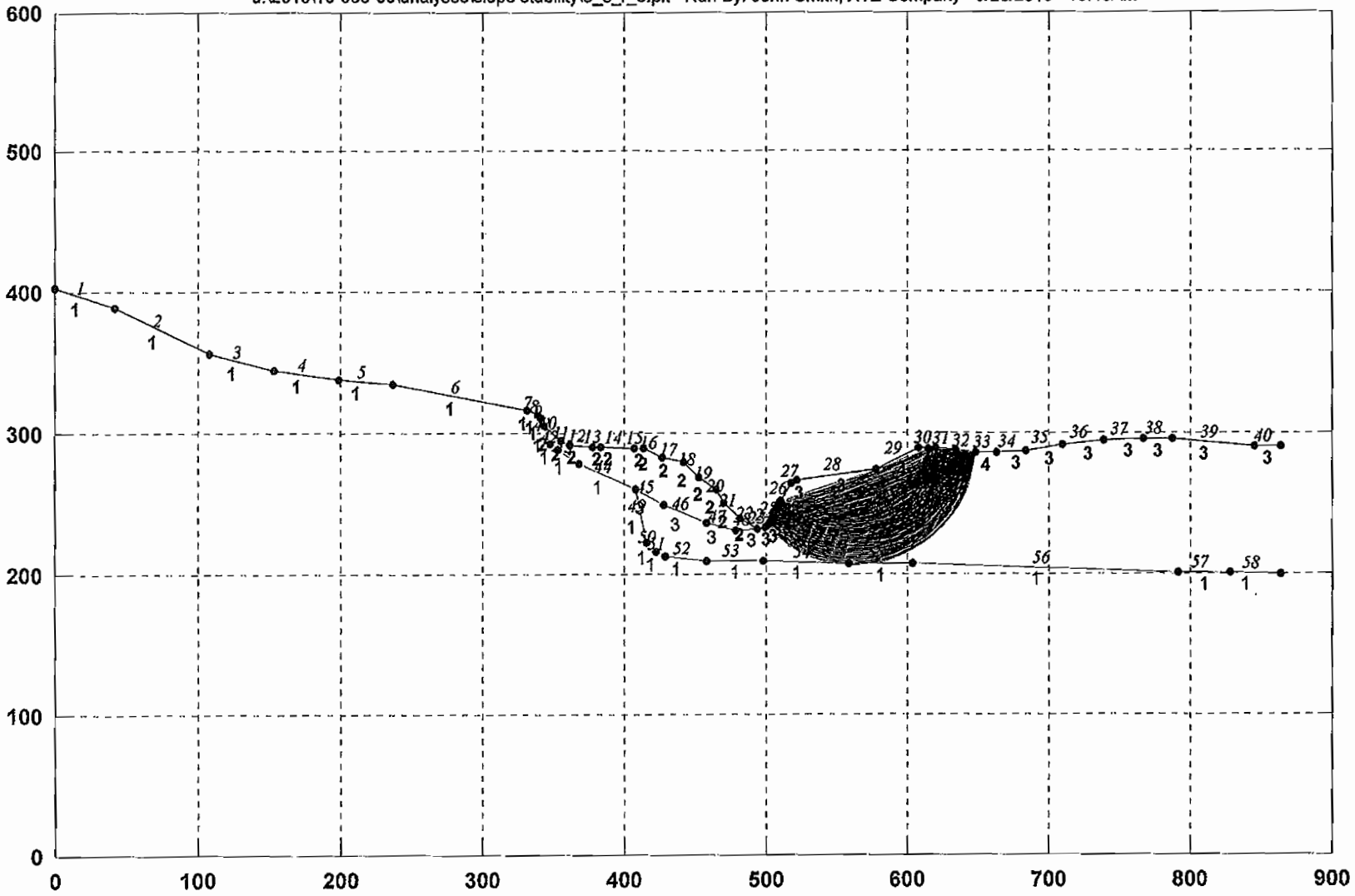


GSTABL7 v.2 FSmin=1.6

Safety Factors Are Calculated By The Modified Bishop Method

Sect 3, Lower switch back, Existing condstability, Circular search at road

u:\2010\10-036-00\analyses\slope stability\3_s_r_5.plt Run By: John Smith, XYZ Company 9/28/2010 10:40AM



*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:40AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_5.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_5.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_5.PLT
PROBLEM DESCRIPTION: Sect 3, Lower switch back, Existing cond
stability, Circular search at road

BOUNDARY COORDINATES
40 Top Boundaries
58 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	403.00	42.00	389.00	1
2	42.00	389.00	108.00	356.00	1
3	108.00	356.00	153.00	345.00	1
4	153.00	345.00	199.00	338.00	1
5	199.00	338.00	236.00	335.00	1
6	236.00	335.00	332.00	316.00	1
7	332.00	316.00	339.00	313.00	1
8	339.00	313.00	341.00	311.00	1
9	341.00	311.00	343.00	306.00	1
10	343.00	306.00	355.00	295.00	2
11	355.00	295.00	362.00	292.00	2
12	362.00	292.00	378.00	291.00	2
13	378.00	291.00	383.00	291.00	2
14	383.00	291.00	407.00	289.00	2
15	407.00	289.00	414.00	289.00	2
16	414.00	289.00	427.00	283.00	2
17	427.00	283.00	442.00	280.00	2
18	442.00	280.00	453.00	269.00	2
19	453.00	269.00	464.00	260.00	2
20	464.00	260.00	470.00	251.00	2
21	470.00	251.00	482.00	240.00	2
22	482.00	240.00	494.00	232.00	2
23	494.00	232.00	499.00	233.00	3
24	499.00	233.00	503.00	237.00	3
25	503.00	237.00	505.00	243.00	3
26	505.00	243.00	517.00	265.00	3
27	517.00	265.00	522.00	267.00	3
28	522.00	267.00	578.00	274.00	3
29	578.00	274.00	608.00	289.00	4
30	608.00	289.00	620.00	289.00	4
31	620.00	289.00	634.00	288.00	4
32	634.00	288.00	648.00	286.00	4
33	648.00	286.00	663.00	286.00	4
34	663.00	286.00	684.00	287.00	3
35	684.00	287.00	710.00	292.00	3
36	710.00	292.00	739.00	295.00	3
37	739.00	295.00	767.00	296.00	3
38	767.00	296.00	787.00	296.00	3
39	787.00	296.00	846.00	291.00	3
40	846.00	291.00	864.00	291.00	3
41	343.00	306.00	348.00	293.00	1

42	348.00	293.00	353.00	288.00	1
43	353.00	288.00	368.00	279.00	1
44	368.00	279.00	408.00	260.00	1
45	408.00	260.00	428.00	250.00	3
46	428.00	250.00	458.00	236.00	3
47	458.00	236.00	478.00	231.00	3
48	478.00	231.00	494.00	232.00	3
49	408.00	260.00	416.00	223.00	1
50	416.00	223.00	422.00	216.00	1
51	422.00	216.00	429.00	213.00	1
52	429.00	213.00	458.00	210.00	1
53	458.00	210.00	498.00	210.00	1
54	498.00	210.00	558.00	207.00	1
55	558.00	207.00	604.00	207.00	1
56	604.00	207.00	792.00	201.00	1
57	792.00	201.00	828.00	201.00	1
58	828.00	201.00	864.00	200.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	130.0	2000.0	50.0	0.00	0.0	0
2	104.5	110.0	0.0	21.0	0.00	0.0	0
3	104.5	110.0	570.0	23.0	0.00	0.0	0
4	104.5	110.0	0.0	17.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 500.00(ft)
and X = 510.00(ft)
Each Surface Terminates Between X = 615.00(ft)
and X = 648.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 4.140 FS Min = 1.618 FS Ave = 2.547
Standard Deviation = 0.543 Coefficient of Variation = 21.31 %
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	509.744	236.248
3	519.432	238.728
4	529.058	241.438
5	538.616	244.376
6	548.102	247.542
7	557.509	250.933
8	566.833	254.548
9	576.068	258.383
10	585.209	262.438
11	594.251	266.710
12	603.188	271.196
13	612.016	275.894
14	620.729	280.801
15	629.323	285.915
16	632.783	288.087

Circle Center At X = 410.896 ; Y = 642.784 ; and Radius = 418.382

Factor of Safety

*** 1.618 ***

Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.0	361.8	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.0	1061.1	0.0	0.0	0.	0.	0.0	0.0	0.0
3	4.7	5774.6	0.0	0.0	0.	0.	0.0	0.0	0.0
4	7.3	16053.7	0.0	0.0	0.	0.	0.0	0.0	0.0
5	2.4	6879.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.6	7352.9	0.0	0.0	0.	0.	0.0	0.0	0.0
7	7.1	19910.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	9.6	25543.6	0.0	0.0	0.	0.	0.0	0.0	0.0
9	9.5	23503.3	0.0	0.0	0.	0.	0.0	0.0	0.0
10	9.4	21247.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	9.3	18786.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	9.2	16131.9	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.9	3041.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	7.2	11272.5	0.0	0.0	0.	0.	0.0	0.0	0.0
15	9.0	14447.7	0.0	0.0	0.	0.	0.0	0.0	0.0
16	8.9	14389.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	4.8	7703.8	0.0	0.0	0.	0.	0.0	0.0	0.0
18	4.0	5948.5	0.0	0.0	0.	0.	0.0	0.0	0.0
19	8.0	9059.0	0.0	0.0	0.	0.	0.0	0.0	0.0
20	0.7	638.3	0.0	0.0	0.	0.	0.0	0.0	0.0
21	8.6	4744.5	0.0	0.0	0.	0.	0.0	0.0	0.0
22	3.5	437.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	509.675	236.529
3	519.310	239.207
4	528.902	242.035
5	538.448	245.011
6	547.948	248.134
7	557.398	251.405
8	566.796	254.821
9	576.141	258.383
10	585.428	262.089
11	594.658	265.939
12	603.826	269.932
13	612.931	274.066
14	621.971	278.341
15	630.944	282.756
16	639.627	287.196

Circle Center At X = 341.796 ; Y = 859.089 ; and Radius = 644.799

Factor of Safety

*** 1.632 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.526	234.526
2	510.341	236.442
3	520.089	238.675
4	529.758	241.223
5	539.341	244.084
6	548.825	247.254
7	558.201	250.729
8	567.460	254.508
9	576.592	258.584
10	585.586	262.955
11	594.434	267.615
12	603.126	272.560
13	611.653	277.784

14	620.006	283.282
15	627.363	288.474

Circle Center At X = 446.395 ; Y = 537.954 ; and Radius = 308.219

Factor of Safety

*** 1.633 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	509.937	235.118
3	519.805	236.741
4	529.576	238.867
5	539.227	241.488
6	548.730	244.598
7	558.063	248.190
8	567.200	252.253
9	576.118	256.778
10	584.794	261.752
11	593.204	267.162
12	601.327	272.995
13	609.141	279.234
14	616.627	285.865
15	619.822	289.000

Circle Center At X = 483.088 ; Y = 429.090 ; and Radius = 195.821

Factor of Safety

*** 1.649 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.053	235.053
2	510.878	236.911
3	520.635	239.105
4	530.310	241.633
5	539.893	244.492
6	549.371	247.679
7	558.735	251.189
8	567.973	255.018
9	577.073	259.163
10	586.026	263.617
11	594.821	268.377
12	603.447	273.436
13	611.895	278.788
14	620.153	284.426
15	625.815	288.585

Circle Center At X = 451.880 ; Y = 522.003 ; and Radius = 291.133

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.526	234.526
2	510.427	235.933
3	520.284	237.616
4	530.091	239.572
5	539.840	241.801
6	549.522	244.300
7	559.131	247.068
8	568.660	250.103
9	578.100	253.402
10	587.445	256.962
11	596.687	260.782
12	605.818	264.857
13	614.833	269.185
14	623.724	273.762
15	632.484	278.586
16	641.106	283.651
17	645.444	286.365

Circle Center At X = 454.965 ; Y = 590.617 ; and Radius = 358.993

Factor of Safety
*** 1.657 ***
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	509.993	234.387
3	519.959	235.201
4	529.882	236.442
5	539.742	238.107
6	549.523	240.192
7	559.204	242.694
8	568.770	245.609
9	578.202	248.931
10	587.484	252.654
11	596.597	256.771
12	605.525	261.274
13	614.253	266.156
14	622.763	271.407
15	631.040	277.018
16	639.070	282.979
17	643.575	286.632

Circle Center At X = 495.969 ; Y = 467.371 ; and Radius = 233.406

Factor of Safety
*** 1.661 ***
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.579	235.579
2	511.482	236.966
3	521.337	238.667
4	531.132	240.678
5	540.859	242.999
6	550.508	245.627
7	560.068	248.559
8	569.531	251.793
9	578.886	255.325
10	588.125	259.151
11	597.239	263.268
12	606.217	267.672
13	615.051	272.357
14	623.733	277.320
15	632.252	282.556
16	639.352	287.235

Circle Center At X = 462.822 ; Y = 548.505 ; and Radius = 315.317

Factor of Safety
*** 1.663 ***
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	509.998	233.809
3	519.990	234.213
4	529.940	235.209
5	539.814	236.795
6	549.576	238.964
7	559.192	241.709
8	568.627	245.021
9	577.850	248.886
10	586.827	253.293
11	595.526	258.226
12	603.916	263.666
13	611.969	269.595
14	619.656	275.991
15	626.949	282.833
16	631.976	288.145

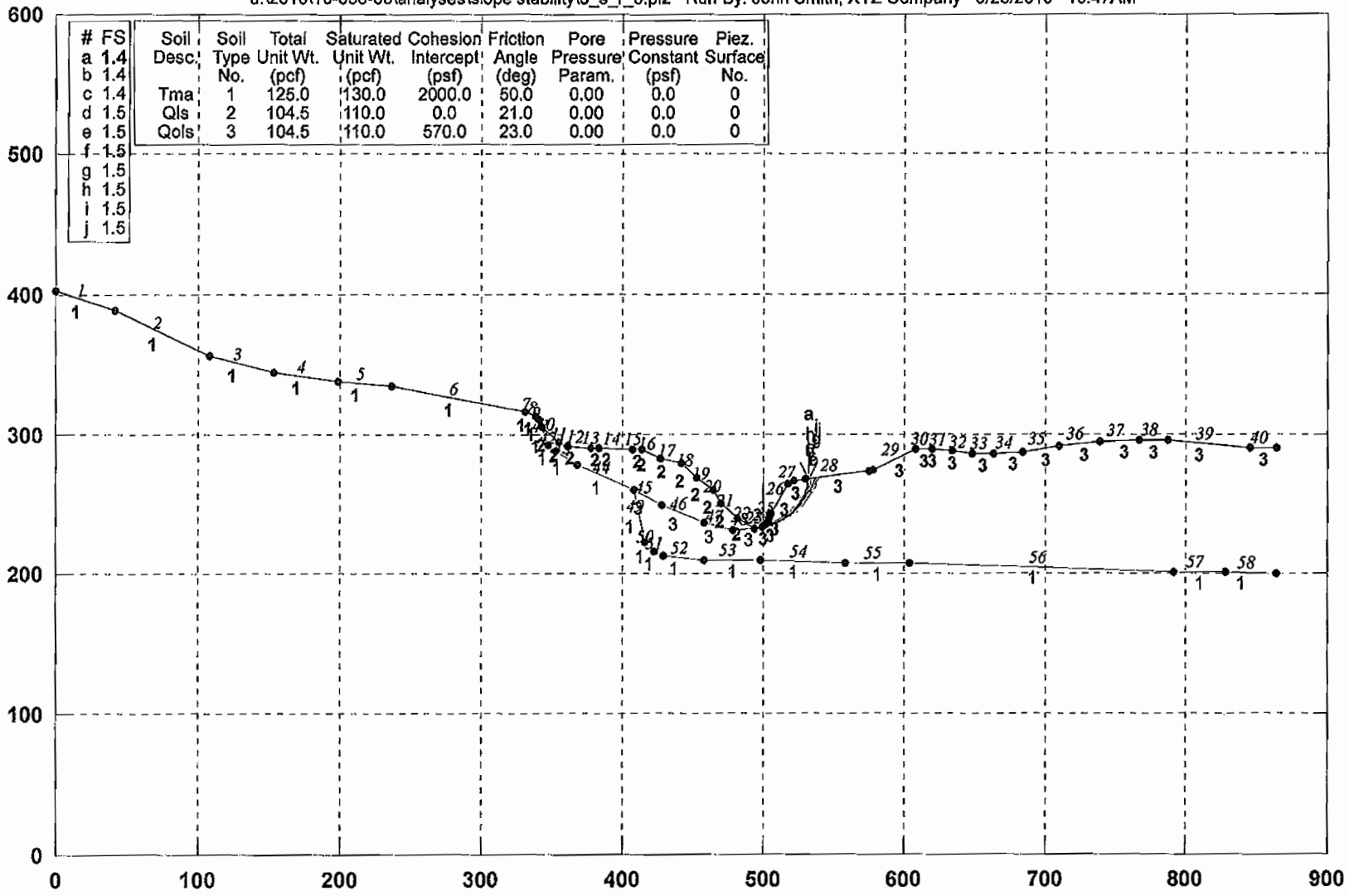
Circle Center At X = 508.252 ; Y = 401.801 ; and Radius = 168.003

Factor of Safety

```
     ***    1.664   ***
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        501.579      235.579
    2        511.537      236.492
    3        521.443      237.858
    4        531.277      239.675
    5        541.017      241.939
    6        550.644      244.645
    7        560.138      247.788
    8        569.478      251.361
    9        578.645      255.356
   10        587.620      259.765
   11        596.385      264.580
   12        604.921      269.789
   13        613.210      275.383
   14        621.235      281.349
   15        628.980      287.675
   16        629.686      288.308
Circle Center At X =   486.612 ; Y =   453.928 ; and Radius =   218.861
      Factor of Safety
     ***    1.665   ***
         **** END OF GSTABL7 OUTPUT ****
```

Sect 3, Lower switch back, Exist. cond. stabilitity, Circ search at bluff face

u:\2010\10-036-00\analyses\slope stability\3_s_r_3.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:47AM

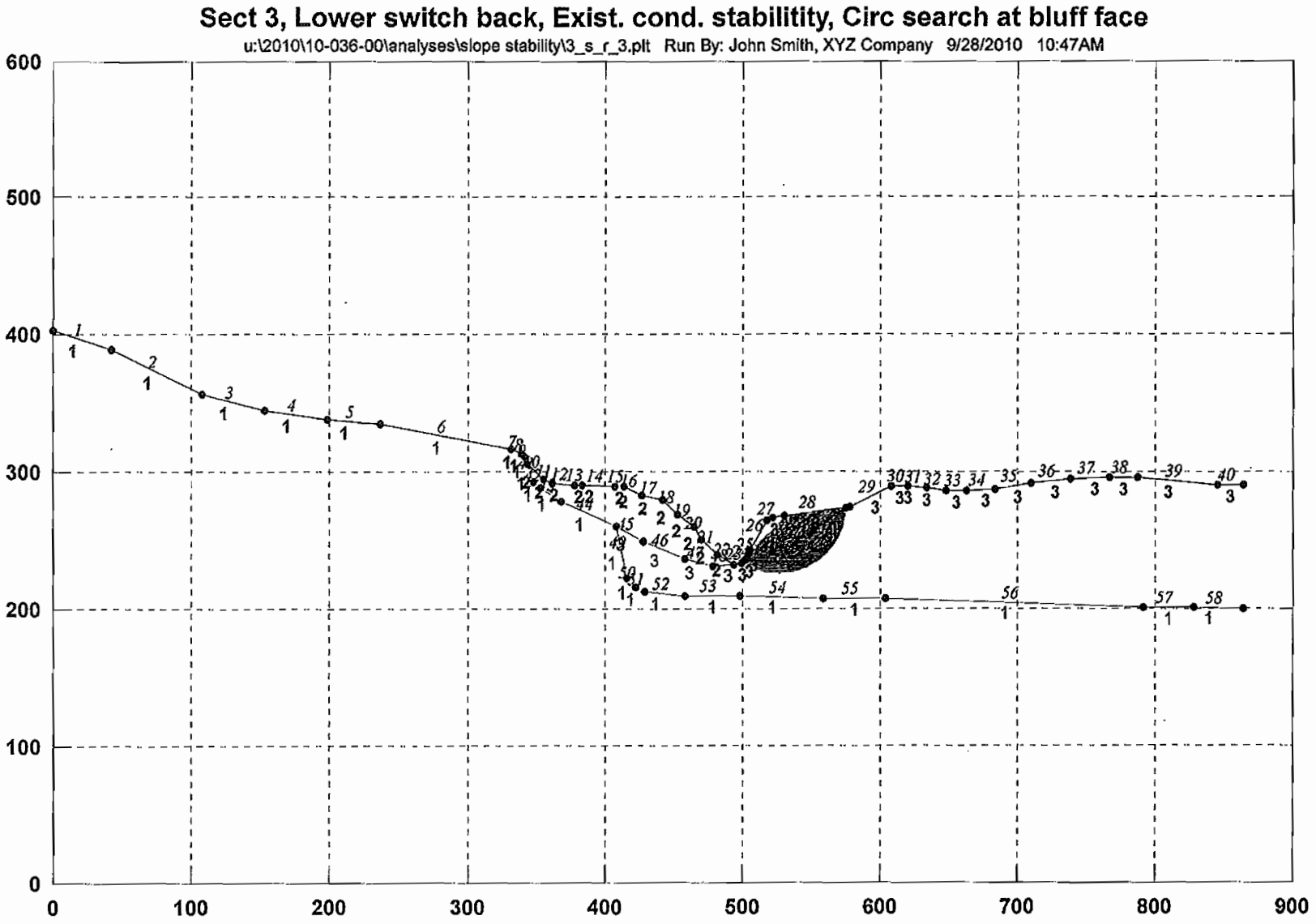


#	FS
a	1.4
b	1.4
c	1.4
d	1.5
e	1.5
f	1.5
g	1.5
h	1.5
i	1.5
j	1.5

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Tma	1	125.0	130.0	2000.0	50.0	0.00	0.0	0
Qls	2	104.5	110.0	0.0	21.0	0.00	0.0	0
Qols	3	104.5	110.0	570.0	23.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.4

Safety Factors Are Calculated By The Modified Bishop Method


Sect 3, Lower switch back, Exist. cond. stabilitity, Circ search at bluff face
u:\2010\10-036-00\analyses\slope stability\3_s_r_3.plt Run By: John Smith, XYZ Company 9/28/2010 10:47AM
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:47AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_3.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_3.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_r_3.PLT
PROBLEM DESCRIPTION: Sect 3, Lower switch back, Exist. cond.
stabilitity, Circ search at bluff face

BOUNDARY COORDINATES

40 Top Boundaries
58 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	403.00	42.00	389.00	1
2	42.00	389.00	108.00	356.00	1
3	108.00	356.00	153.00	345.00	1
4	153.00	345.00	199.00	338.00	1
5	199.00	338.00	236.00	335.00	1
6	236.00	335.00	332.00	316.00	1
7	332.00	316.00	339.00	313.00	1
8	339.00	313.00	341.00	311.00	1
9	341.00	311.00	343.00	306.00	1
10	343.00	306.00	355.00	295.00	2
11	355.00	295.00	362.00	292.00	2
12	362.00	292.00	378.00	291.00	2
13	378.00	291.00	383.00	291.00	2
14	383.00	291.00	407.00	289.00	2
15	407.00	289.00	414.00	289.00	2
16	414.00	289.00	427.00	283.00	2
17	427.00	283.00	442.00	280.00	2
18	442.00	280.00	453.00	269.00	2
19	453.00	269.00	464.00	260.00	2
20	464.00	260.00	470.00	251.00	2
21	470.00	251.00	482.00	240.00	2
22	482.00	240.00	494.00	232.00	2
23	494.00	232.00	499.00	233.00	3
24	499.00	233.00	503.00	237.00	3
25	503.00	237.00	505.00	243.00	3
26	505.00	243.00	517.00	265.00	3
27	517.00	265.00	522.00	267.00	3
28	522.00	267.00	578.00	274.00	3
29	578.00	274.00	608.00	289.00	3
30	608.00	289.00	620.00	289.00	3
31	620.00	289.00	634.00	288.00	3
32	634.00	288.00	648.00	286.00	3
33	648.00	286.00	663.00	286.00	3
34	663.00	286.00	684.00	287.00	3
35	684.00	287.00	710.00	292.00	3
36	710.00	292.00	739.00	295.00	3
37	739.00	295.00	767.00	296.00	3
38	767.00	296.00	787.00	296.00	3
39	787.00	296.00	846.00	291.00	3
40	846.00	291.00	864.00	291.00	3
41	343.00	306.00	348.00	293.00	1

42	348.00	293.00	353.00	288.00	1
43	353.00	288.00	368.00	279.00	1
44	368.00	279.00	408.00	260.00	1
45	408.00	260.00	428.00	250.00	3
46	428.00	250.00	458.00	236.00	3
47	458.00	236.00	478.00	231.00	3
48	478.00	231.00	494.00	232.00	3
49	408.00	260.00	416.00	223.00	1
50	416.00	223.00	422.00	216.00	1
51	422.00	216.00	429.00	213.00	1
52	429.00	213.00	458.00	210.00	1
53	458.00	210.00	498.00	210.00	1
54	498.00	210.00	558.00	207.00	1
55	558.00	207.00	604.00	207.00	1
56	604.00	207.00	792.00	201.00	1
57	792.00	201.00	828.00	201.00	1
58	828.00	201.00	864.00	200.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	130.0	2000.0	50.0	0.00	0.0	0
2	104.5	110.0	0.0	21.0	0.00	0.0	0
3	104.5	110.0	570.0	23.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.

40 Surface(s) Initiate(s) From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 500.00(ft)
and X = 505.00(ft)
Each Surface Terminates Between X = 530.00(ft)
and X = 575.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00(ft)

2.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Attempted = 400

Number of Trial Surfaces With Valid FS = 400

Statistical Data On All Valid FS Values:

FS Max = 4.046 FS Min = 1.438 FS Ave = 2.292

Standard Deviation = 0.599 Coefficient of Variation = 26.14 %

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	501.971	234.342
3	503.920	234.788
4	505.844	235.336
5	507.735	235.986
6	509.590	236.735
7	511.402	237.581
8	513.166	238.522
9	514.879	239.556
10	516.534	240.678
11	518.127	241.887
12	519.654	243.179
13	521.111	244.549
14	522.493	245.995
15	523.796	247.512
16	525.017	249.096
17	526.152	250.743

18	527.199	252.447
19	528.154	254.204
20	529.014	256.010
21	529.777	257.859
22	530.442	259.745
23	531.005	261.664
24	531.466	263.610
25	531.823	265.578
26	532.075	267.562
27	532.127	268.266

Circle Center At X = 494.538 ; Y = 271.328 ; and Radius = 37.726

Factor of Safety

*** 1.438 ***

Individual data on the 30 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	167.7	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.0	217.9	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.9	355.6	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.1	726.5	0.0	0.0	0.	0.	0.0	0.0	0.0
5	0.8	754.3	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.9	2099.1	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.9	2587.8	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.8	3014.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.8	3375.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.7	3668.8	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.7	3893.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	0.5	1155.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.1	2799.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.5	3706.1	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.5	3422.9	0.0	0.0	0.	0.	0.0	0.0	0.0
16	0.9	2026.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	0.5	1096.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.3	2776.9	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.2	2423.9	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.1	2079.7	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.0	1748.6	0.0	0.0	0.	0.	0.0	0.0	0.0
22	1.0	1435.0	0.0	0.0	0.	0.	0.0	0.0	0.0
23	0.9	1143.1	0.0	0.0	0.	0.	0.0	0.0	0.0
24	0.8	876.7	0.0	0.0	0.	0.	0.0	0.0	0.0
25	0.7	639.5	0.0	0.0	0.	0.	0.0	0.0	0.0
26	0.6	434.9	0.0	0.0	0.	0.	0.0	0.0	0.0
27	0.5	265.8	0.0	0.0	0.	0.	0.0	0.0	0.0
28	0.4	134.8	0.0	0.0	0.	0.	0.0	0.0	0.0
29	0.3	44.1	0.0	0.0	0.	0.	0.0	0.0	0.0
30	0.1	1.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	501.953	234.430
3	503.886	234.943
4	505.795	235.540
5	507.677	236.218
6	509.527	236.976
7	511.344	237.814
8	513.122	238.729
9	514.859	239.719
10	516.553	240.784
11	518.198	241.921
12	519.793	243.127
13	521.335	244.401
14	522.821	245.740
15	524.247	247.142
16	525.612	248.604
17	526.912	250.124

18	528.146	251.698
19	529.310	253.324
20	530.404	254.998
21	531.425	256.718
22	532.370	258.481
23	533.239	260.282
24	534.029	262.119
25	534.739	263.989
26	535.369	265.887
27	535.915	267.811
28	536.143	268.768

Circle Center At X = 491.019 ; Y = 279.507 ; and Radius = 46.385

Factor of Safety

*** 1.447 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.556	234.556
2	502.506	234.996
3	504.435	235.526
4	506.337	236.145
5	508.208	236.852
6	510.044	237.645
7	511.841	238.522
8	513.596	239.481
9	515.305	240.521
10	516.963	241.638
11	518.568	242.832
12	520.116	244.098
13	521.604	245.435
14	523.028	246.839
15	524.385	248.308
16	525.673	249.839
17	526.888	251.427
18	528.029	253.070
19	529.092	254.764
20	530.075	256.505
21	530.977	258.291
22	531.794	260.116
23	532.527	261.977
24	533.172	263.870
25	533.729	265.791
26	534.196	267.736
27	534.351	268.544

Circle Center At X = 492.037 ; Y = 276.837 ; and Radius = 43.131

Factor of Safety

*** 1.449 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.556	234.556
2	502.459	235.169
3	504.336	235.861
4	506.181	236.632
5	507.993	237.479
6	509.768	238.401
7	511.502	239.396
8	513.194	240.464
9	514.839	241.601
10	516.435	242.806
11	517.979	244.077
12	519.469	245.411
13	520.901	246.807
14	522.274	248.261
15	523.585	249.772
16	524.831	251.336
17	526.011	252.951
18	527.122	254.614

19	528.163	256.322
20	529.131	258.072
21	530.025	259.862
22	530.843	261.687
23	531.584	263.544
24	532.247	265.431
25	532.830	267.344
26	533.100	268.388

Circle Center At X = 486.889 ; Y = 280.272 ; and Radius = 47.715

Factor of Safety

*** 1.451 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.556	234.556
2	502.537	234.826
3	504.502	235.201
4	506.444	235.680
5	508.357	236.261
6	510.238	236.942
7	512.079	237.722
8	513.877	238.599
9	515.625	239.570
10	517.320	240.632
11	518.956	241.783
12	520.528	243.018
13	522.033	244.336
14	523.466	245.731
15	524.823	247.200
16	526.101	248.739
17	527.294	250.344
18	528.401	252.010
19	529.419	253.732
20	530.343	255.505
21	531.172	257.325
22	531.904	259.186
23	532.536	261.084
24	533.066	263.012
25	533.493	264.966
26	533.817	266.940
27	533.988	268.498

Circle Center At X = 496.450 ; Y = 272.046 ; and Radius = 37.714

Factor of Safety

*** 1.461 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.556	234.556
2	502.521	234.928
3	504.467	235.388
4	506.391	235.935
5	508.288	236.568
6	510.155	237.285
7	511.988	238.085
8	513.783	238.966
9	515.537	239.927
10	517.246	240.966
11	518.907	242.080
12	520.516	243.268
13	522.071	244.527
14	523.567	245.854
15	525.002	247.246
16	526.374	248.702
17	527.678	250.218
18	528.914	251.791
19	530.078	253.417
20	531.167	255.094
21	532.181	256.819

22	533.116	258.587
23	533.970	260.395
24	534.743	262.240
25	535.432	264.117
26	536.037	266.023
27	536.555	267.955
28	536.752	268.844

Circle Center At X = 493.252 ; Y = 278.514 ; and Radius = 44.561

Factor of Safety

*** 1.463 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.556	234.556
2	502.499	235.030
3	504.422	235.579
4	506.322	236.202
5	508.197	236.899
6	510.043	237.668
7	511.858	238.508
8	513.639	239.418
9	515.383	240.397
10	517.088	241.443
11	518.751	242.554
12	520.370	243.728
13	521.941	244.965
14	523.464	246.262
15	524.935	247.617
16	526.352	249.028
17	527.714	250.493
18	529.017	252.010
19	530.261	253.576
20	531.443	255.190
21	532.561	256.848
22	533.614	258.548
23	534.600	260.288
24	535.518	262.065
25	536.366	263.877
26	537.143	265.719
27	537.848	267.591
28	538.331	269.041

Circle Center At X = 489.337 ; Y = 284.777 ; and Radius = 51.459

Factor of Safety

*** 1.465 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.111	235.111
2	503.089	235.405
3	505.049	235.804
4	506.984	236.309
5	508.890	236.917
6	510.760	237.626
7	512.589	238.435
8	514.371	239.342
9	516.103	240.343
10	517.778	241.436
11	519.392	242.617
12	520.939	243.884
13	522.417	245.232
14	523.820	246.658
15	525.144	248.157
16	526.385	249.725
17	527.540	251.357
18	528.606	253.050
19	529.579	254.797
20	530.456	256.594
21	531.236	258.436

22	531.915	260.317
23	532.492	262.232
24	532.965	264.176
25	533.333	266.141
26	533.594	268.124
27	533.620	268.452

Circle Center At X = 496.650 ; Y = 271.988 ; and Radius = 37.146

Factor of Safety

*** 1.467 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.000	234.000
2	501.966	234.365
3	503.916	234.809
4	505.847	235.332
5	507.755	235.932
6	509.637	236.608
7	511.490	237.360
8	513.312	238.186
9	515.099	239.085
10	516.848	240.055
11	518.556	241.095
12	520.221	242.203
13	521.840	243.377
14	523.410	244.616
15	524.929	245.917
16	526.394	247.278
17	527.804	248.697
18	529.154	250.172
19	530.445	251.700
20	531.672	253.279
21	532.835	254.907
22	533.931	256.579
23	534.959	258.295
24	535.916	260.051
25	536.802	261.844
26	537.615	263.671
27	538.354	265.530
28	539.017	267.417
29	539.562	269.195

Circle Center At X = 491.938 ; Y = 282.900 ; and Radius = 49.560

Factor of Safety

*** 1.470 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.111	235.111
2	503.019	235.712
3	504.903	236.381
4	506.763	237.118
5	508.595	237.920
6	510.396	238.788
7	512.166	239.721
8	513.901	240.716
9	515.599	241.773
10	517.257	242.890
11	518.875	244.066
12	520.449	245.300
13	521.978	246.589
14	523.460	247.933
15	524.892	249.328
16	526.274	250.775
17	527.602	252.270
18	528.876	253.812
19	530.094	255.398
20	531.253	257.028
21	532.354	258.698

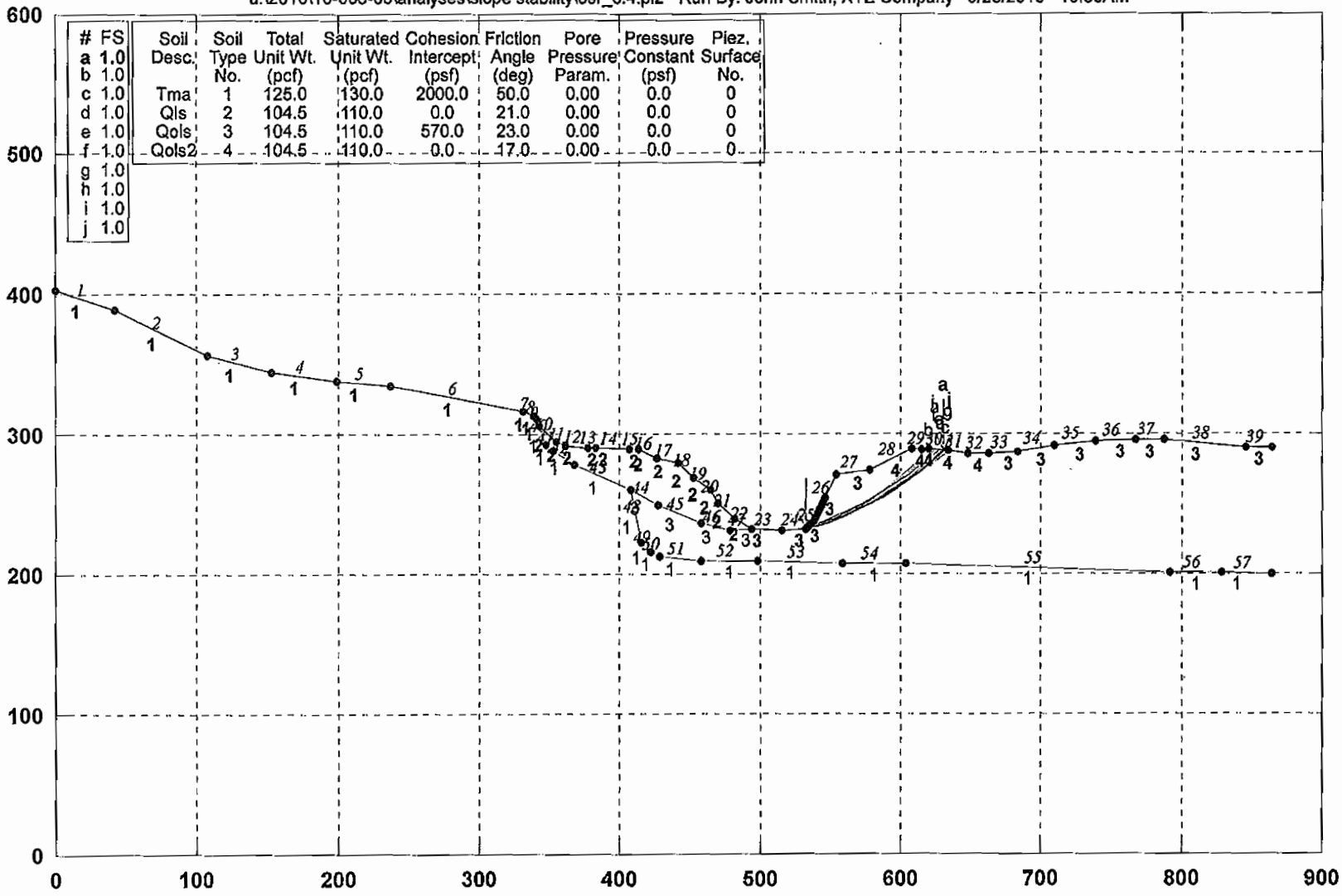
```
   22        533.394      260.406
   23        534.371      262.151
   24        535.286      263.929
   25        536.136      265.740
   26        536.920      267.580
   27        537.439      268.930
Circle Center At X =   485.346 ; Y =   288.479 ; and Radius =    55.647
      Factor of Safety
     ***    1.471   ***
         **** END OF GSTABL7 OUTPUT ****
```

Sect 3, Lower switch back, Amount of bluff face erosion for failure

u:\2010\10-036-00\analyses\slope stability\3sr_6.4.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:50AM

#	FS
a	1.0
b	1.0
c	1.0
d	1.0
e	1.0
f	1.0
g	1.0
h	1.0
i	1.0
j	1.0

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Tma	1	125.0	130.0	2000.0	50.0	0.00	0.0	0
Qls	2	104.5	110.0	0.0	21.0	0.00	0.0	0
Qols	3	104.5	110.0	570.0	23.0	0.00	0.0	0
Qols2	4	104.5	110.0	0.0	17.0	0.00	0.0	0

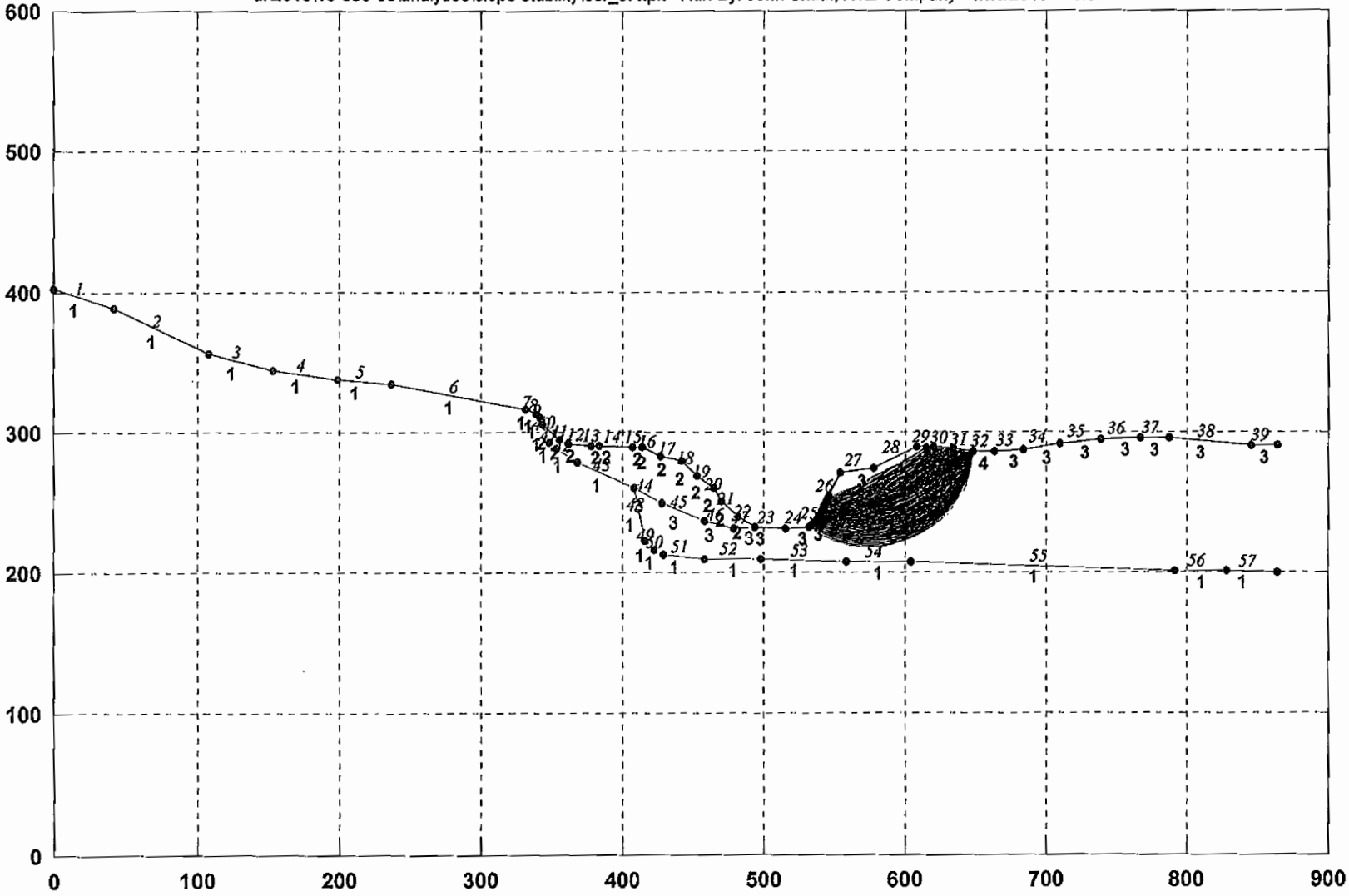


GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Sect 3, Lower switch back, Amount of bluff face erosion for failure

u:\2010\10-036-00\analyses\slope stability\3sr_6.4.plt Run By: John Smith, XYZ Company 9/28/2010 10:51AM



*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:50AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3sr_6.4.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3sr_6.4.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3sr_6.4.PLT
PROBLEM DESCRIPTION: Sect 3, Lower switch back, Amount of bluff face erosion for failure

BOUNDARY COORDINATES
39 Top Boundaries
57 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	403.00	42.00	389.00	1
2	42.00	389.00	108.00	356.00	1
3	108.00	356.00	153.00	345.00	1
4	153.00	345.00	199.00	338.00	1
5	199.00	338.00	236.00	335.00	1
6	236.00	335.00	332.00	316.00	1
7	332.00	316.00	339.00	313.00	1
8	339.00	313.00	341.00	311.00	1
9	341.00	311.00	343.00	306.00	1
10	343.00	306.00	355.00	295.00	2
11	355.00	295.00	362.00	292.00	2
12	362.00	292.00	378.00	291.00	2
13	378.00	291.00	383.00	291.00	2
14	383.00	291.00	407.00	289.00	2
15	407.00	289.00	414.00	289.00	2
16	414.00	289.00	427.00	283.00	2
17	427.00	283.00	442.00	280.00	2
18	442.00	280.00	453.00	269.00	2
19	453.00	269.00	464.00	260.00	2
20	464.00	260.00	470.00	251.00	2
21	470.00	251.00	482.00	240.00	2
22	482.00	240.00	494.00	232.00	2
23	494.00	232.00	515.00	231.00	3
24	515.00	231.00	532.00	232.00	3
25	532.00	232.00	538.00	238.00	3
26	538.00	238.00	554.00	271.00	3
27	554.00	271.00	578.00	274.00	3
28	578.00	274.00	608.00	289.00	4
29	608.00	289.00	620.00	289.00	4
30	620.00	289.00	634.00	288.00	4
31	634.00	288.00	648.00	286.00	4
32	648.00	286.00	663.00	286.00	4
33	663.00	286.00	684.00	287.00	3
34	684.00	287.00	710.00	292.00	3
35	710.00	292.00	739.00	295.00	3
36	739.00	295.00	767.00	296.00	3
37	767.00	296.00	787.00	296.00	3
38	787.00	296.00	846.00	291.00	3
39	846.00	291.00	864.00	291.00	3
40	343.00	306.00	348.00	293.00	1
41	348.00	293.00	353.00	288.00	1

42	353.00	288.00	368.00	279.00	1
43	368.00	279.00	408.00	260.00	1
44	408.00	260.00	428.00	250.00	3
45	428.00	250.00	458.00	236.00	3
46	458.00	236.00	478.00	231.00	3
47	478.00	231.00	494.00	232.00	3
48	408.00	260.00	416.00	223.00	1
49	416.00	223.00	422.00	216.00	1
50	422.00	216.00	429.00	213.00	1
51	429.00	213.00	458.00	210.00	1
52	458.00	210.00	498.00	210.00	1
53	498.00	210.00	558.00	207.00	1
54	558.00	207.00	604.00	207.00	1
55	604.00	207.00	792.00	201.00	1
56	792.00	201.00	828.00	201.00	1
57	828.00	201.00	864.00	200.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	130.0	2000.0	50.0	0.00	0.0	0
2	104.5	110.0	0.0	21.0	0.00	0.0	0
3	104.5	110.0	570.0	23.0	0.00	0.0	0
4	104.5	110.0	0.0	17.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 532.00(ft)
and X = 546.00(ft)
Each Surface Terminates Between X = 615.00(ft)
and X = 648.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 3.026 FS Min = 1.013 FS Ave = 1.633
Standard Deviation = 0.460 Coefficient of Variation = 28.15 %
Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	532.000	232.000
2	541.593	234.825
3	551.052	238.068
4	560.360	241.723
5	569.500	245.782
6	578.452	250.238
7	587.201	255.081
8	595.729	260.304
9	604.019	265.895
10	612.057	271.844
11	619.826	278.140
12	627.312	284.771
13	630.882	288.223

Circle Center At X = 472.362 ; Y = 452.177 ; and Radius = 228.111
Factor of Safety
*** 1.013 ***
Individual data on the 17 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.0	1327.0	0.0	0.0	0.	0.	0.0	0.0	0.0
2	3.6	2781.3	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.5	18502.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.9	9030.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	6.4	20553.2	0.0	0.0	0.	0.	0.0	0.0	0.0
6	9.1	27327.3	0.0	0.0	0.	0.	0.0	0.0	0.0
7	8.5	22715.1	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.5	1133.1	0.0	0.0	0.	0.	0.0	0.0	0.0
9	8.7	21716.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	8.5	20532.1	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.3	18919.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	4.0	8584.3	0.0	0.0	0.	0.	0.0	0.0	0.0
13	4.1	7910.0	0.0	0.0	0.	0.	0.0	0.0	0.0
14	7.8	11372.8	0.0	0.0	0.	0.	0.0	0.0	0.0
15	0.2	195.5	0.0	0.0	0.	0.	0.0	0.0	0.0
16	7.3	5506.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	3.6	691.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	532.000	232.000
2	541.459	235.243
3	550.739	238.970
4	559.815	243.169
5	568.661	247.831
6	577.256	252.943
7	585.576	258.491
8	593.599	264.460
9	601.304	270.835
10	608.670	277.598
11	615.678	284.732
12	619.458	289.000

Circle Center At X = 474.187 ; Y = 416.301 ; and Radius = 193.156

Factor of Safety

*** 1.014 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	532.000	232.000
2	541.510	235.090
3	550.900	238.530
4	560.156	242.316
5	569.266	246.441
6	578.216	250.900
7	586.996	255.687
8	595.592	260.796
9	603.994	266.220
10	612.189	271.951
11	620.166	277.981
12	627.915	284.302
13	632.262	288.124

Circle Center At X = 453.263 ; Y = 490.494 ; and Radius = 270.220

Factor of Safety

*** 1.016 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	533.474	233.474
2	543.055	236.335
3	552.497	239.631
4	561.778	243.354
5	570.879	247.497
6	579.782	252.051
7	588.468	257.007

8	596.918	262.353
9	605.116	268.080
10	613.044	274.175
11	620.685	280.626
12	628.025	287.418
13	628.953	288.360

Circle Center At X = 475.597 ; Y = 444.750 ; and Radius = 219.060

Factor of Safety

*** 1.021 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	533.474	233.474
2	542.868	236.901
3	552.131	240.668
4	561.250	244.772
5	570.214	249.206
6	579.009	253.964
7	587.625	259.040
8	596.050	264.427
9	604.273	270.118
10	612.282	276.106
11	620.067	282.382
12	627.105	288.493

Circle Center At X = 444.454 ; Y = 492.147 ; and Radius = 273.563

Factor of Safety

*** 1.022 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	533.474	233.474
2	543.256	235.550
3	552.873	238.289
4	562.281	241.679
5	571.435	245.704
6	580.294	250.344
7	588.814	255.579
8	596.957	261.383
9	604.685	267.730
10	611.961	274.590
11	618.752	281.931
12	624.205	288.700

Circle Center At X = 508.090 ; Y = 377.322 ; and Radius = 146.070

Factor of Safety

*** 1.027 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	532.737	232.737
2	542.125	236.180
3	551.415	239.882
4	560.599	243.839
5	569.670	248.047
6	578.621	252.505
7	587.446	257.209
8	596.138	262.154
9	604.690	267.337
10	613.095	272.755
11	621.347	278.403
12	629.441	284.276
13	634.240	287.966

Circle Center At X = 412.779 ; Y = 574.307 ; and Radius = 362.022

Factor of Safety

*** 1.028 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	534.947	234.947

2	544.492	237.931
3	553.875	241.390
4	563.073	245.313
5	572.063	249.693
6	580.822	254.517
7	589.329	259.773
8	597.562	265.449
9	605.501	271.531
10	613.125	278.002
11	620.415	284.846
12	624.133	288.705

Circle Center At X = 480.499 ; Y = 426.140 ; and Radius = 198.794

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	534.947	234.947
2	544.492	237.931
3	553.871	241.400
4	563.060	245.345
5	572.035	249.755
6	580.772	254.619
7	589.249	259.925
8	597.442	265.658
9	605.331	271.803
10	612.895	278.344
11	620.114	285.264
12	623.403	288.757

Circle Center At X = 481.854 ; Y = 421.833 ; and Radius = 194.281

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	532.737	232.737
2	542.147	236.120
3	551.461	239.760
4	560.671	243.655
5	569.771	247.802
6	578.754	252.197
7	587.612	256.836
8	596.340	261.718
9	604.930	266.837
10	613.376	272.191
11	621.673	277.774
12	629.812	283.583
13	635.392	287.801

Circle Center At X = 414.295 ; Y = 576.958 ; and Radius = 364.028

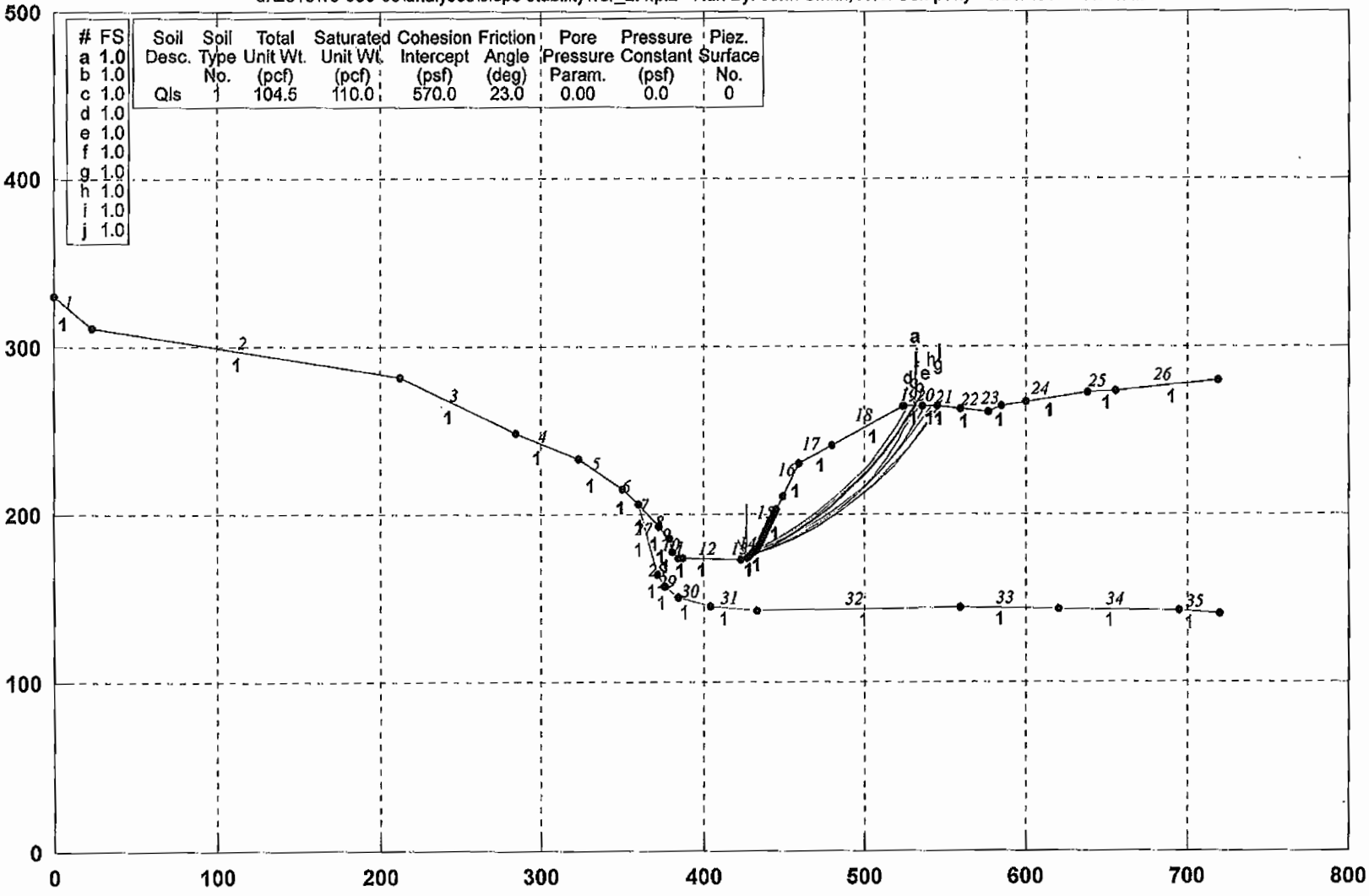
Factor of Safety

*** 1.031 ***

**** END OF GSTABL7 OUTPUT ****

Sect 1, Upper switch back, Amount of bluff face erosion for failure

u:\2010\10-036-00\analyses\slope stability\1sr_2.4.pl2 Run By: John Smith, XYZ Company 9/28/2010 11:03AM



#	FS
a	1.0
b	1.0
c	1.0
d	1.0
e	1.0
f	1.0
g	1.0
h	1.0
i	1.0
j	1.0

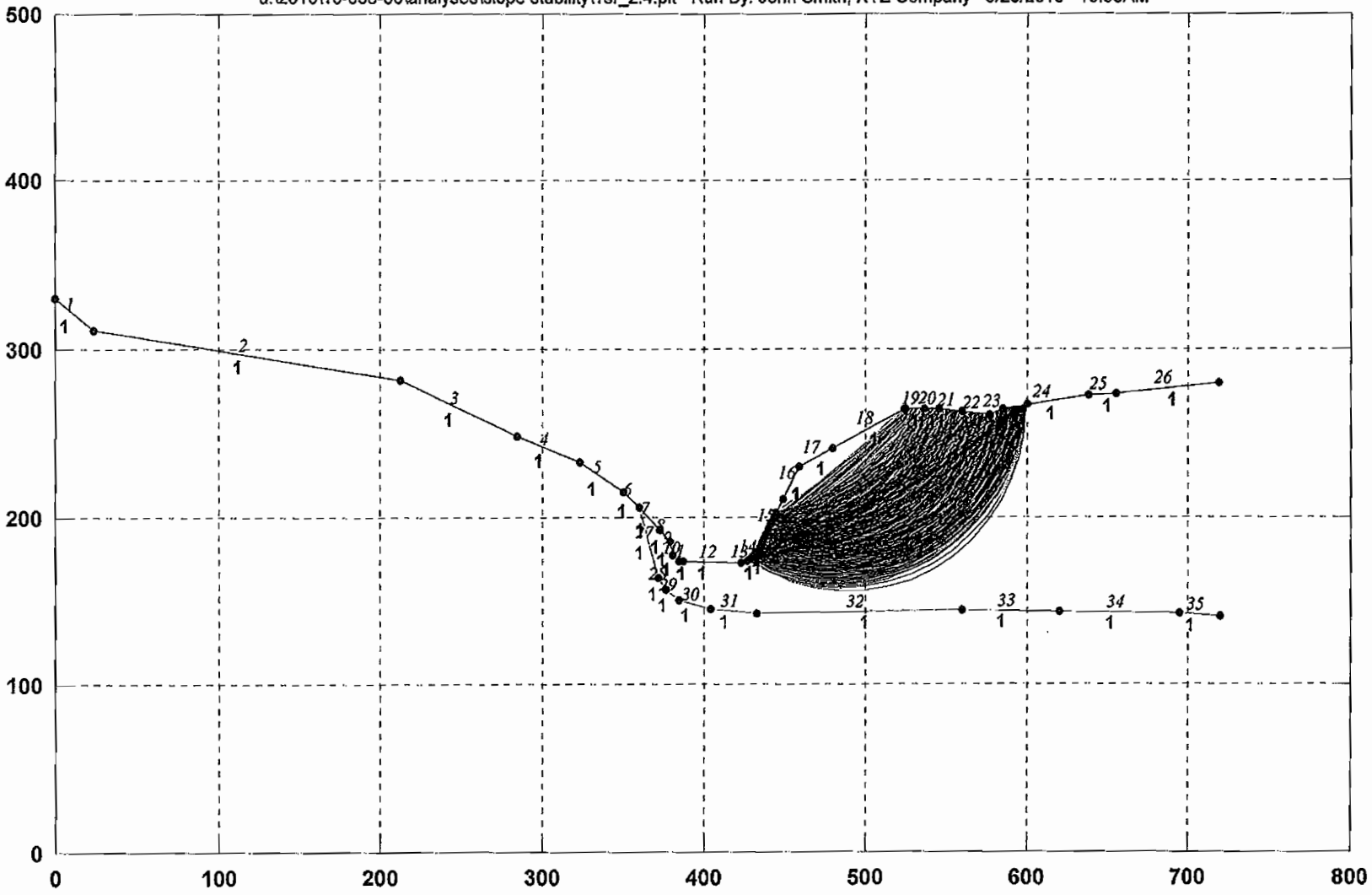
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	570.0	23.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Sect 1, Upper switch back, Amount of bluff face erosion for failure

u:\2010\10-036-00\analyses\slope stability\1sr_2.4.plt Run By: John Smith, XYZ Company 9/28/2010 10:56AM



*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:56AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\1sr_2.4.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\1sr_2.4.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\1sr_2.4.PLT
PROBLEM DESCRIPTION: Sect 1, Upper switch back, Amount of bluff face erosion for failure

BOUNDARY COORDINATES
26 Top Boundaries
35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	330.00	23.00	311.00	1
2	23.00	311.00	212.00	282.00	1
3	212.00	282.00	284.00	248.00	1
4	284.00	248.00	323.00	233.00	1
5	323.00	233.00	350.00	215.00	1
6	350.00	215.00	360.00	206.00	1
7	360.00	206.00	373.00	193.00	1
8	373.00	193.00	379.00	185.00	1
9	379.00	185.00	381.00	177.00	1
10	381.00	177.00	384.00	174.00	1
11	384.00	174.00	387.00	174.00	1
12	387.00	174.00	423.00	173.00	1
13	423.00	173.00	427.00	174.00	1
14	427.00	174.00	433.00	179.00	1
15	433.00	179.00	449.00	211.00	1
16	449.00	211.00	459.00	230.00	1
17	459.00	230.00	480.00	241.00	1
18	480.00	241.00	525.00	265.00	1
19	525.00	265.00	536.00	265.00	1
20	536.00	265.00	545.00	265.00	1
21	545.00	265.00	560.00	263.00	1
22	560.00	263.00	577.00	261.00	1
23	577.00	261.00	585.00	265.00	1
24	585.00	265.00	638.00	273.00	1
25	638.00	273.00	655.00	274.00	1
26	655.00	274.00	719.00	280.00	1
27	360.00	206.00	372.00	164.00	1
28	372.00	164.00	376.00	157.00	1
29	376.00	157.00	384.00	150.00	1
30	384.00	150.00	404.00	145.00	1
31	404.00	145.00	433.00	142.00	1
32	433.00	142.00	560.00	144.00	1
33	560.00	144.00	620.00	143.00	1
34	620.00	143.00	695.00	142.00	1
35	695.00	142.00	720.00	140.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil	Total	Saturated	Cohesion	Friction	Pore	Pressure	Piez.

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	104.5	110.0	570.0	23.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 427.00(ft)
and X = 445.00(ft)
Each Surface Terminates Between X = 524.00(ft)
and X = 600.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 3.265 FS Min = 1.023 FS Ave = 1.684
Standard Deviation = 0.465 Coefficient of Variation = 27.64 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	427.000	174.000
2	440.633	180.255
3	453.813	187.417
4	466.480	195.452
5	478.575	204.324
6	490.043	213.993
7	500.832	224.414
8	510.893	235.539
9	520.179	247.319
10	528.649	259.699
11	531.773	265.000

Circle Center At X = 341.283 ; Y = 378.804 ; and Radius = 222.019
Factor of Safety
*** 1.023 ***
Individual data on the 15 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.0	704.5	0.0	0.0	0.	0.	0.0	0.0	0.0
2	7.6	6484.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	8.4	17577.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	4.8	14820.2	0.0	0.0	0.	0.	0.0	0.0	0.0
5	5.2	19517.7	0.0	0.0	0.	0.	0.0	0.0	0.0
6	7.5	30389.2	0.0	0.0	0.	0.	0.0	0.0	0.0
7	12.1	47014.1	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.4	5318.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	10.0	35596.1	0.0	0.0	0.	0.	0.0	0.0	0.0
10	10.8	33857.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	10.1	26091.0	0.0	0.0	0.	0.	0.0	0.0	0.0
12	9.3	17976.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	4.8	6484.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	3.6	3038.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	3.1	865.2	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	427.947	174.789
2	441.583	181.041
3	454.784	188.162
4	467.497	196.123
5	479.668	204.891

6	491.246	214.428
7	502.182	224.694
8	512.430	235.648
9	521.948	247.241
10	530.695	259.427
11	534.172	265.000

Circle Center At X = 338.308 ; Y = 388.295 ; and Radius = 231.559

Factor of Safety

*** 1.025 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	428.895	175.579
2	443.290	179.794
3	457.174	185.473
4	470.398	192.553
5	482.821	200.960
6	494.310	210.603
7	504.743	221.381
8	514.008	233.177
9	522.007	245.866
10	528.654	259.313
11	530.767	265.000

Circle Center At X = 395.343 ; Y = 316.844 ; and Radius = 145.195

Factor of Safety

*** 1.026 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	429.842	176.368
2	443.447	182.687
3	456.527	190.028
4	469.007	198.350
5	480.813	207.603
6	491.876	217.733
7	502.130	228.680
8	511.516	240.380
9	519.979	252.765
10	527.029	265.000

Circle Center At X = 354.396 ; Y = 356.696 ; and Radius = 195.475

Factor of Safety

*** 1.029 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	429.842	176.368
2	444.021	181.263
3	457.748	187.310
4	470.929	194.470
5	483.474	202.693
6	495.298	211.923
7	506.321	222.097
8	516.466	233.146
9	525.665	244.994
10	533.854	257.561
11	537.870	265.000

Circle Center At X = 377.716 ; Y = 350.364 ; and Radius = 181.636

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	432.684	178.737
2	446.162	185.320
3	459.188	192.759
4	471.706	201.023
5	483.665	210.078
6	495.014	219.885

7	505.708	230.404
8	515.700	241.591
9	524.950	253.400
10	532.884	265.000

Circle Center At X = 337.667 ; Y = 390.430 ; and Radius = 232.039

Factor of Safety

*** 1.036 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	427.947	174.789
2	442.130	179.673
3	455.936	185.538
4	469.297	192.356
5	482.148	200.092
6	494.425	208.711
7	506.068	218.168
8	517.020	228.417
9	527.227	239.409
10	536.640	251.088
11	545.211	263.398
12	546.081	264.856

Circle Center At X = 365.607 ; Y = 379.063 ; and Radius = 213.574

Factor of Safety

*** 1.040 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	431.737	177.947
2	445.721	183.373
3	459.292	189.764
4	472.382	197.087
5	484.929	205.309
6	496.869	214.387
7	508.146	224.278
8	518.703	234.934
9	528.490	246.302
10	537.457	258.326
11	541.742	265.000

Circle Center At X = 361.235 ; Y = 380.391 ; and Radius = 214.369

Factor of Safety

*** 1.042 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	432.684	178.737
2	445.936	185.764
3	458.771	193.528
4	471.146	202.004
5	483.023	211.165
6	494.364	220.983
7	505.133	231.425
8	515.295	242.458
9	524.817	254.048
10	532.825	265.000

Circle Center At X = 315.244 ; Y = 416.326 ; and Radius = 265.030

Factor of Safety

*** 1.043 ***

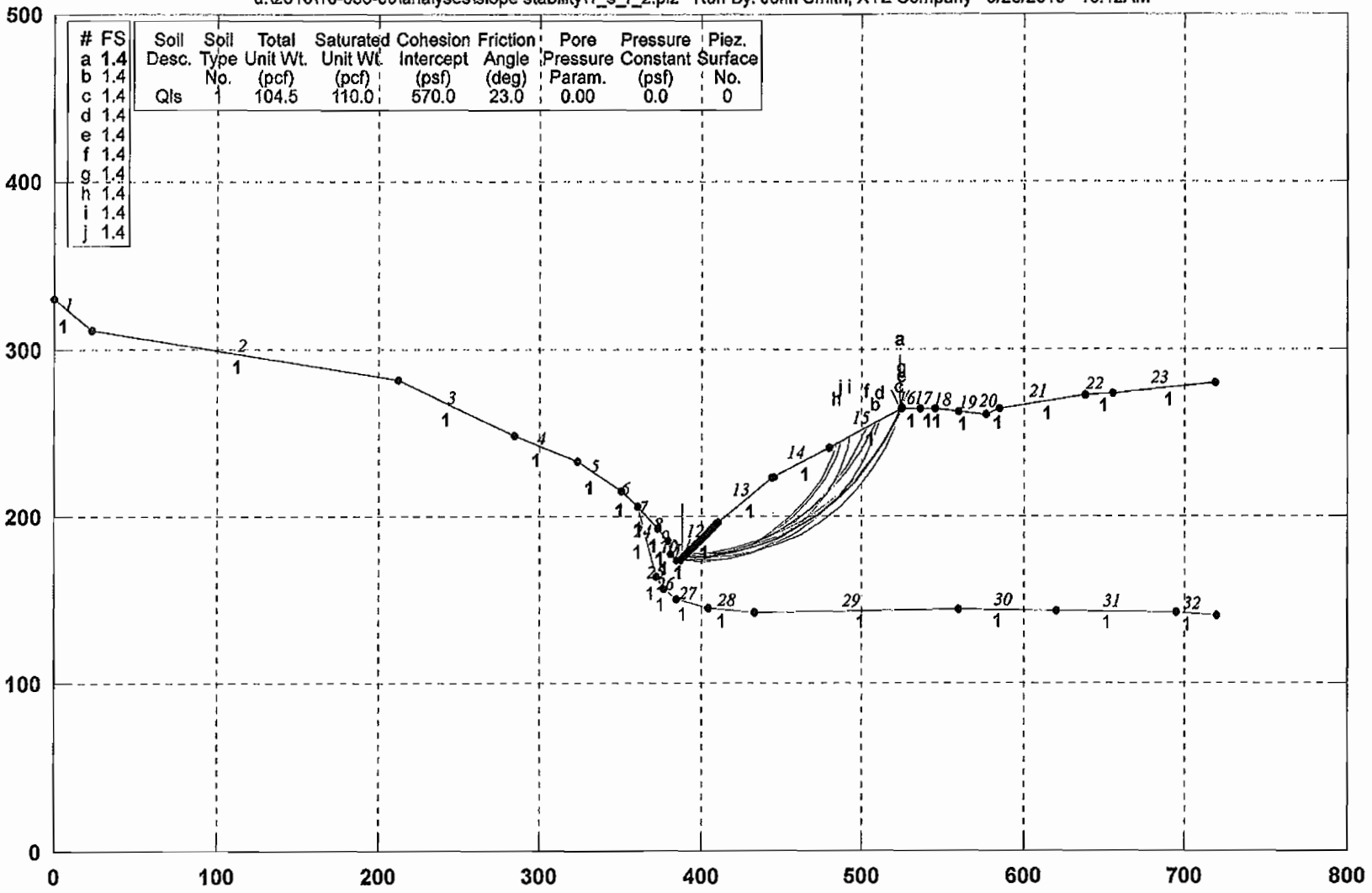
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	428.895	175.579
2	443.097	180.405
3	456.925	186.218
4	470.309	192.990
5	483.184	200.687
6	495.485	209.271
7	507.152	218.699

```
    8        518.126      228.925
    9        528.353      239.898
   10        537.784      251.563
   11        546.370      263.862
   12        546.899      264.747
Circle Center At X =   367.619 ; Y =   379.338 ; and Radius =   212.773
      Factor of Safety
     ***    1.046   ***
         **** END OF GSTABL7 OUTPUT ****
```

Sect 1, Static, Upper swich back, Existing Cond, circ. search @ bluff face

u:\2010\10-036-00\analyses\slope stability\1_s_r_2.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:12AM

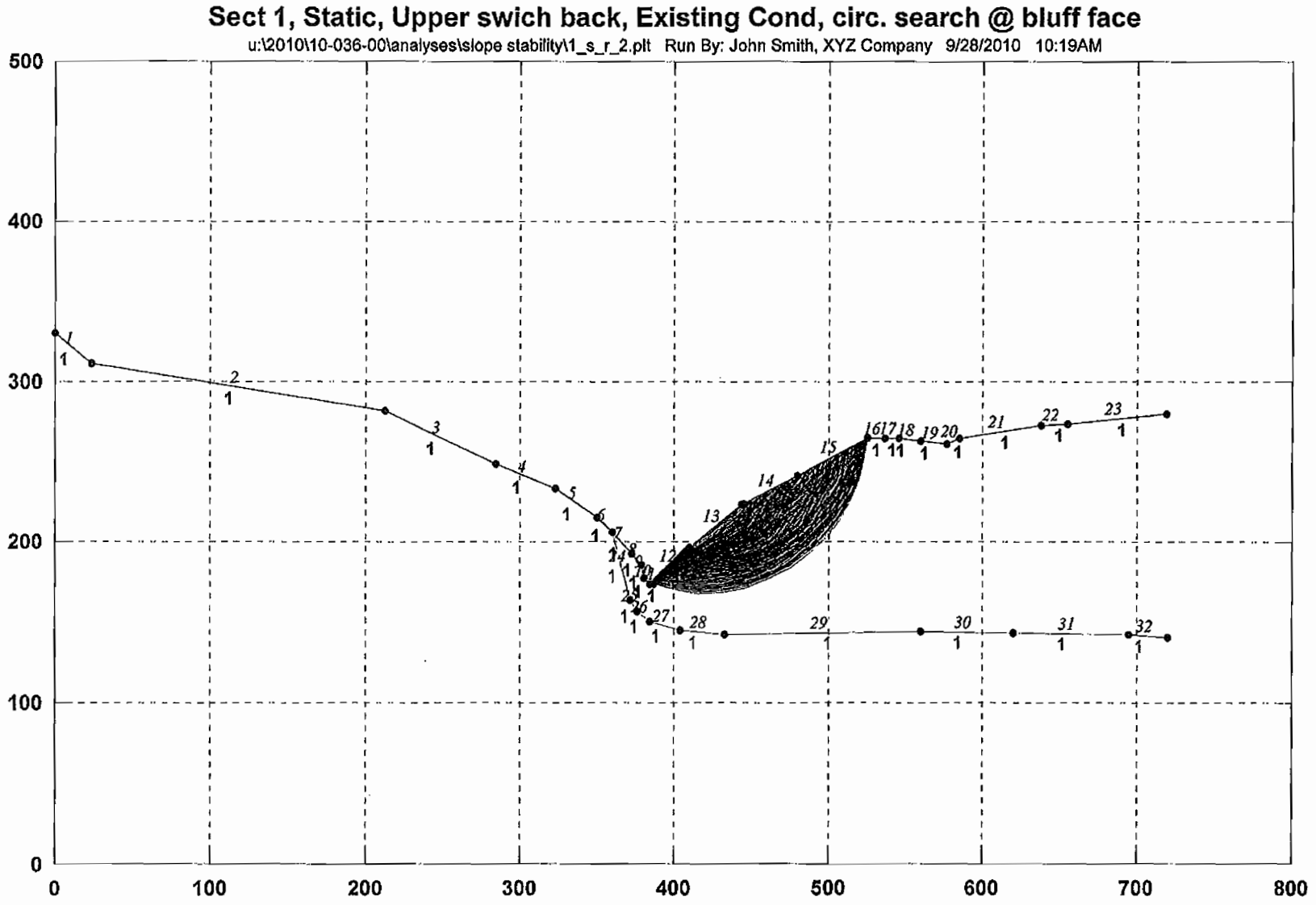


#	FS
a	1.4
b	1.4
c	1.4
d	1.4
e	1.4
f	1.4
g	1.4
h	1.4
i	1.4
j	1.4

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	570.0	23.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.4

Safety Factors Are Calculated By The Modified Bishop Method


Sect 1, Static, Upper swich back, Existing Cond, circ. search @ bluff face
u:\2010\10-036-00\analyses\slope stability\1_s_r_2.plt Run By: John Smith, XYZ Company 9/28/2010 10:19AM
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 9/28/2010
Time of Run: 10:12AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\1_s_r_2.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\1_s_r_2.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\1_s_r_2.PLT
PROBLEM DESCRIPTION: Sect 1, Static, Upper swich back,
Existing Cond, circ. search @ bluff face

BOUNDARY COORDINATES
23 Top Boundaries
32 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	330.00	23.00	311.00	1
2	23.00	311.00	212.00	282.00	1
3	212.00	282.00	284.00	248.00	1
4	284.00	248.00	323.00	233.00	1
5	323.00	233.00	350.00	215.00	1
6	350.00	215.00	360.00	206.00	1
7	360.00	206.00	373.00	193.00	1
8	373.00	193.00	379.00	185.00	1
9	379.00	185.00	381.00	177.00	1
10	381.00	177.00	384.00	174.00	1
11	384.00	174.00	387.00	174.00	1
12	387.00	174.00	410.00	196.00	1
13	410.00	196.00	444.00	223.00	1
14	444.00	223.00	480.00	241.00	1
15	480.00	241.00	525.00	265.00	1
16	525.00	265.00	536.00	265.00	1
17	536.00	265.00	545.00	265.00	1
18	545.00	265.00	560.00	263.00	1
19	560.00	263.00	577.00	261.00	1
20	577.00	261.00	585.00	265.00	1
21	585.00	265.00	638.00	273.00	1
22	638.00	273.00	655.00	274.00	1
23	655.00	274.00	719.00	280.00	1
24	360.00	206.00	372.00	164.00	1
25	372.00	164.00	376.00	157.00	1
26	376.00	157.00	384.00	150.00	1
27	384.00	150.00	404.00	145.00	1
28	404.00	145.00	433.00	142.00	1
29	433.00	142.00	560.00	144.00	1
30	560.00	144.00	620.00	143.00	1
31	620.00	143.00	695.00	142.00	1
32	695.00	142.00	720.00	140.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	570.0	23.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 387.00(ft)
and X = 410.00(ft)
Each Surface Terminates Between X = 445.00(ft)
and X = 525.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 17.699 FS Min = 1.377 FS Ave = 2.042
Standard Deviation = 1.452 Coefficient of Variation = 71.13 %
Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	388.211	175.158
2	403.200	175.723
3	418.050	177.837
4	432.602	181.478
5	446.698	186.606
6	460.187	193.167
7	472.924	201.089
8	484.773	210.287
9	495.605	220.663
10	505.305	232.105
11	513.767	244.490
12	520.902	257.685
13	523.622	264.265

Circle Center At X = 390.262 ; Y = 319.796 ; and Radius = 144.653
Factor of Safety
*** 1.377 ***
Individual data on the 15 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	15.0	10786.5	0.0	0.0	0.	0.	0.0	0.0	0.0
2	6.8	11753.9	0.0	0.0	0.	0.	0.0	0.0	0.0
3	8.1	18450.0	0.0	0.0	0.	0.	0.0	0.0	0.0
4	14.6	43357.0	0.0	0.0	0.	0.	0.0	0.0	0.0
5	11.4	41597.6	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.7	10588.1	0.0	0.0	0.	0.	0.0	0.0	0.0
7	13.5	53332.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	12.7	49449.0	0.0	0.0	0.	0.	0.0	0.0	0.0
9	7.1	26171.6	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.8	16877.9	0.0	0.0	0.	0.	0.0	0.0	0.0
11	10.8	35044.9	0.0	0.0	0.	0.	0.0	0.0	0.0
12	9.7	25872.5	0.0	0.0	0.	0.	0.0	0.0	0.0
13	8.5	16320.4	0.0	0.0	0.	0.	0.0	0.0	0.0
14	7.1	7324.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	2.7	728.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	387.000	174.000
2	401.930	175.451
3	416.618	178.495
4	430.894	183.096
5	444.595	189.202
6	457.563	196.742

7	469.647	205.629
8	480.708	215.760
9	490.619	227.020
10	499.266	239.277
11	506.548	252.390
12	508.057	255.964

Circle Center At X = 381.132 ; Y = 313.047 ; and Radius = 139.171

Factor of Safety

*** 1.389 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.402	177.072
3	419.226	179.362
4	433.738	183.159
5	447.783	188.425
6	461.214	195.104
7	473.889	203.125
8	485.675	212.404
9	496.447	222.843
10	506.091	234.331
11	514.506	246.748
12	521.603	259.963
13	523.302	264.094

Circle Center At X = 389.554 ; Y = 322.368 ; and Radius = 146.052

Factor of Safety

*** 1.390 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	387.000	174.000
2	401.990	173.455
3	416.927	174.829
4	431.566	178.100
5	445.668	183.213
6	459.001	190.084
7	471.348	198.603
8	482.506	208.628
9	492.292	219.996
10	500.546	232.521
11	507.133	245.997
12	511.050	257.560

Circle Center At X = 398.811 ; Y = 290.326 ; and Radius = 116.924

Factor of Safety

*** 1.400 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	390.632	177.474
2	405.592	178.566
3	420.372	181.123
4	434.830	185.120
5	448.825	190.518
6	462.222	197.266
7	474.891	205.297
8	486.709	214.534
9	497.563	224.888
10	507.346	236.258
11	515.966	248.534
12	523.337	261.598
13	524.787	264.886

Circle Center At X = 387.022 ; Y = 329.900 ; and Radius = 152.469

Factor of Safety

*** 1.401 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	388.211	175.158
2	403.177	176.156
3	417.916	178.942
4	432.214	183.478
5	445.864	189.698
6	458.669	197.510
7	470.443	206.803
8	481.017	217.443
9	490.237	229.274
10	497.971	242.127
11	502.951	253.241

Circle Center At X = 387.413 ; Y = 299.896 ; and Radius = 124.741

Factor of Safety

*** 1.410 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.391	175.362
3	419.367	176.209
4	434.133	178.845
5	448.478	183.231
6	462.193	189.304
7	475.082	196.977
8	486.959	206.140
9	497.652	216.659
10	507.007	228.385
11	514.890	241.146
12	521.186	254.761
13	524.397	264.678

Circle Center At X = 404.836 ; Y = 300.310 ; and Radius = 124.949

Factor of Safety

*** 1.412 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	387.000	174.000
2	401.975	174.869
3	416.657	177.938
4	430.726	183.141
5	443.873	190.363
6	455.810	199.447
7	466.276	210.192
8	475.041	222.365
9	481.914	235.697
10	484.541	243.422

Circle Center At X = 388.826 ; Y = 274.670 ; and Radius = 100.687

Factor of Safety

*** 1.430 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	387.000	174.000
2	401.974	173.121
3	416.901	174.604
4	431.409	178.414
5	445.139	184.455
6	457.749	192.578
7	468.927	202.580
8	478.396	214.214
9	485.919	227.191
10	491.312	241.188
11	492.717	247.782

Circle Center At X = 400.050 ; Y = 268.307 ; and Radius = 95.206

Factor of Safety

*** 1.440 ***

Failure Surface Specified By 10 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	388.211	175.158
2	403.193	175.885
3	417.905	178.808
4	432.028	183.862
5	445.254	190.939
6	457.295	199.883
7	467.890	210.502
8	476.809	222.562
9	483.856	235.804
10	487.037	244.753

Circle Center At X = 390.955 ; Y = 276.227 ; and Radius = 101.106

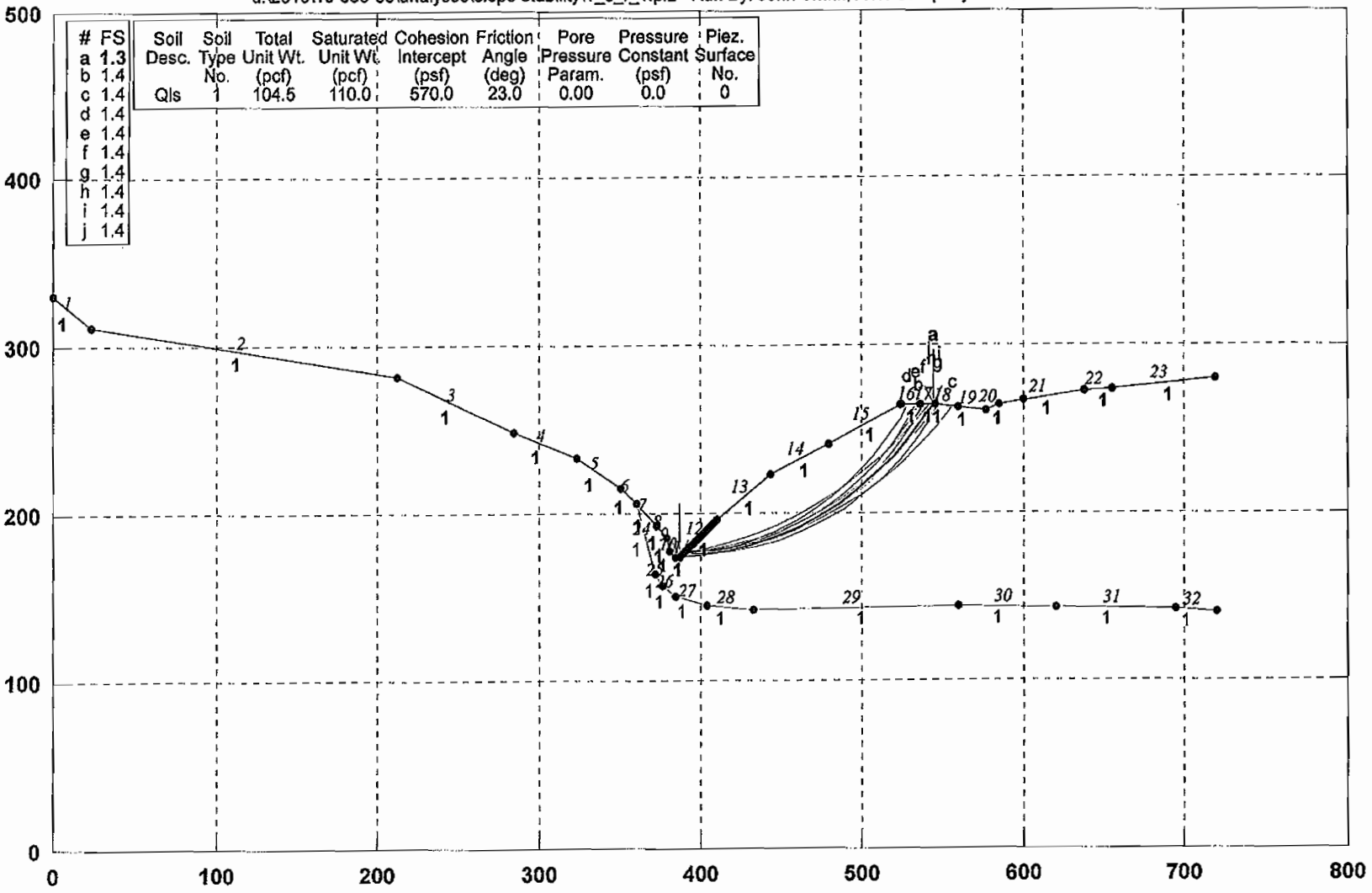
Factor of Safety

*** 1.441 ***

**** END OF GSTABL7 OUTPUT ****

Sect 1, Static, Upper swich back, Existing Cond, circular search at road

u:\2010\10-036-00\analyses\slope stability\1_s_r_1.pl2 Run By: John Smith, XYZ Company 9/28/2010 10:08AM



#	FS
a	1.3
b	1.4
c	1.4
d	1.4
e	1.4
f	1.4
g	1.4
h	1.4
i	1.4
j	1.4

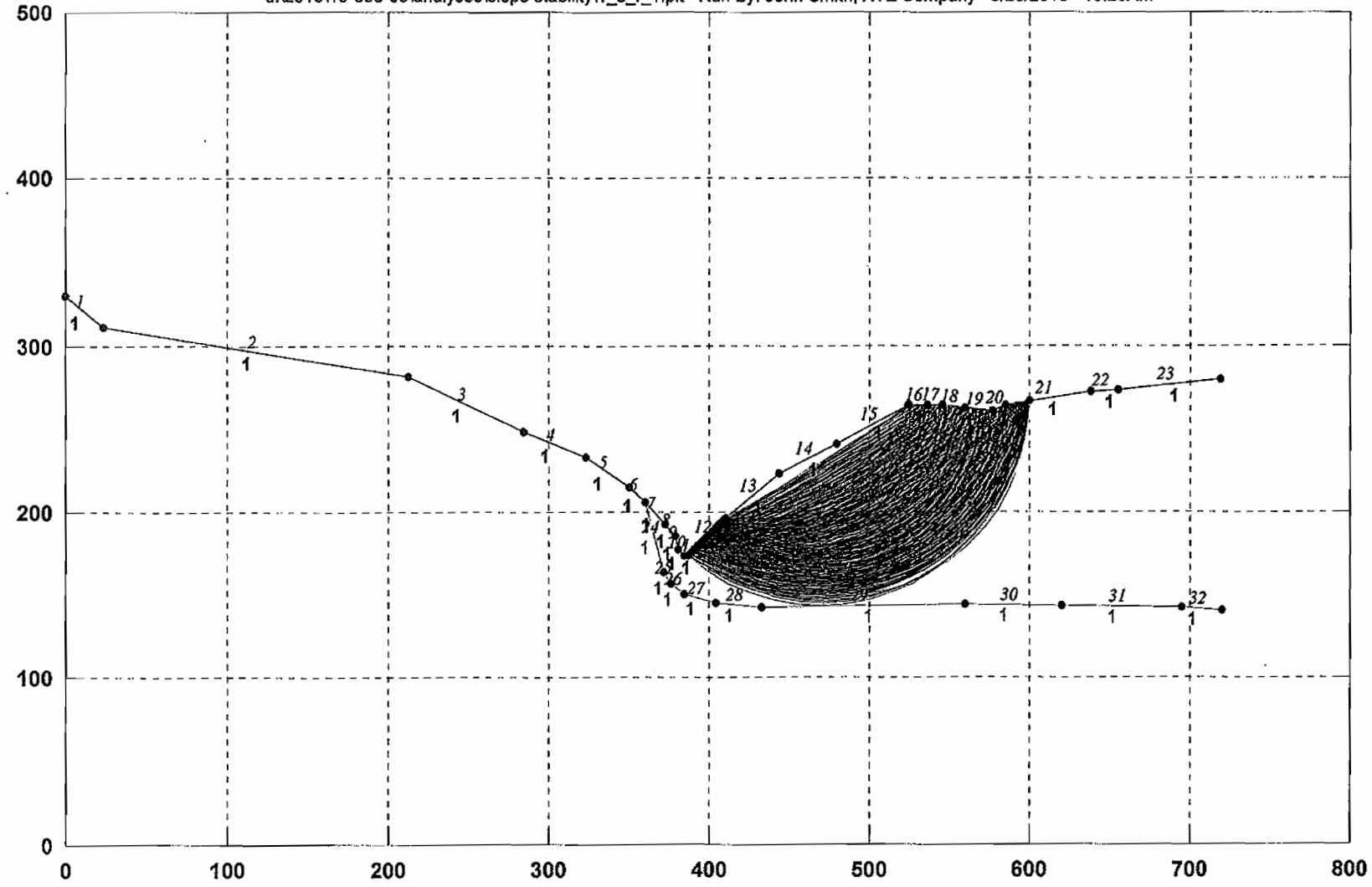
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	570.0	23.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

Sect 1, Static, Upper swich back, Existing Cond, circular search at road

u:\2010\10-036-00\analyses\slope stability\1_s_r_1.plt Run By: John Smith, XYZ Company 9/28/2010 10:20AM



*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

(All Rights Reserved-Unauthorized Use Prohibited)

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 10:08AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\1_s_r_1.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\1_s_r_1.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\1_s_r_1.PLT
PROBLEM DESCRIPTION: Sect 1, Static, Upper swich back,
Existing Cond, circular search at road

BOUNDARY COORDINATES
23 Top Boundaries
32 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd

1	0.00	330.00	23.00	311.00	1
2	23.00	311.00	212.00	282.00	1
3	212.00	282.00	284.00	248.00	1
4	284.00	248.00	323.00	233.00	1
5	323.00	233.00	350.00	215.00	1
6	350.00	215.00	360.00	206.00	1
7	360.00	206.00	373.00	193.00	1
8	373.00	193.00	379.00	185.00	1
9	379.00	185.00	381.00	177.00	1
10	381.00	177.00	384.00	174.00	1
11	384.00	174.00	387.00	174.00	1
12	387.00	174.00	410.00	196.00	1
13	410.00	196.00	444.00	223.00	1
14	444.00	223.00	480.00	241.00	1
15	480.00	241.00	525.00	265.00	1
16	525.00	265.00	536.00	265.00	1
17	536.00	265.00	545.00	265.00	1
18	545.00	265.00	560.00	263.00	1
19	560.00	263.00	577.00	261.00	1
20	577.00	261.00	585.00	265.00	1
21	585.00	265.00	638.00	273.00	1
22	638.00	273.00	655.00	274.00	1
23	655.00	274.00	719.00	280.00	1
24	360.00	206.00	372.00	164.00	1
25	372.00	164.00	376.00	157.00	1
26	376.00	157.00	384.00	150.00	1
27	384.00	150.00	404.00	145.00	1
28	404.00	145.00	433.00	142.00	1
29	433.00	142.00	560.00	144.00	1
30	560.00	144.00	620.00	143.00	1
31	620.00	143.00	695.00	142.00	1
32	695.00	142.00	720.00	140.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	570.0	23.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

500 Trial Surfaces Have Been Generated.

25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 387.00(ft)
and X = 410.00(ft)

Each Surface Terminates Between X = 524.00(ft)
and X = 600.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00(ft)

15.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Attempted = 500

Number of Trial Surfaces With Valid FS = 500

Statistical Data On All Valid FS Values:

FS Max = 3.482 FS Min = 1.342 FS Ave = 1.952

Standard Deviation = 0.392 Coefficient of Variation = 20.07 %

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	387.000	174.000
2	401.954	175.170
3	416.775	177.483
4	431.375	180.925

5	445.668	185.475
6	459.570	191.107
7	473.001	197.787
8	485.879	205.477
9	498.131	214.132
10	509.684	223.699
11	520.469	234.124
12	530.424	245.344
13	539.490	257.294
14	544.455	265.000

Circle Center At X = 379.380 ; Y = 368.904 ; and Radius = 195.053

Factor of Safety

*** 1.342 ***

Individual data on the 18 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	15.0	10262.1	0.0	0.0	0.	0.	0.0	0.0	0.0
2	8.0	13750.0	0.0	0.0	0.	0.	0.0	0.0	0.0
3	6.8	15388.1	0.0	0.0	0.	0.	0.0	0.0	0.0
4	14.6	42678.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	12.6	46246.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.7	6659.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	13.9	56687.1	0.0	0.0	0.	0.	0.0	0.0	0.0
8	13.4	55711.0	0.0	0.0	0.	0.	0.0	0.0	0.0
9	7.0	28798.6	0.0	0.0	0.	0.	0.0	0.0	0.0
10	5.9	23867.1	0.0	0.0	0.	0.	0.0	0.0	0.0
11	12.3	48137.2	0.0	0.0	0.	0.	0.0	0.0	0.0
12	11.6	42054.7	0.0	0.0	0.	0.	0.0	0.0	0.0
13	10.8	34709.8	0.0	0.0	0.	0.	0.0	0.0	0.0
14	4.5	12837.7	0.0	0.0	0.	0.	0.0	0.0	0.0
15	5.4	12874.7	0.0	0.0	0.	0.	0.0	0.0	0.0
16	5.6	9311.5	0.0	0.0	0.	0.	0.0	0.0	0.0
17	3.5	3649.8	0.0	0.0	0.	0.	0.0	0.0	0.0
18	5.0	1998.8	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.382	177.393
3	419.195	179.757
4	433.748	183.392
5	447.933	188.269
6	461.643	194.353
7	474.778	201.598
8	487.237	209.950
9	498.930	219.347
10	509.767	229.718
11	519.668	240.986
12	528.559	253.066
13	535.844	265.000

Circle Center At X = 384.452 ; Y = 349.818 ; and Radius = 173.573

Factor of Safety

*** 1.363 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	387.000	174.000
2	401.942	175.318
3	416.766	177.609
4	431.408	180.865
5	445.807	185.070
6	459.899	190.208
7	473.626	196.257
8	486.928	203.189
9	499.748	210.977
10	512.032	219.585

11	523.726	228.979
12	534.782	239.116
13	545.151	249.955
14	554.790	261.449
15	556.289	263.495

Circle Center At X = 374.338 ; Y = 402.991 ; and Radius = 229.341

Factor of Safety

*** 1.364 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	388.211	175.158
2	403.135	176.661
3	417.869	179.471
4	432.300	183.566
5	446.314	188.914
6	459.804	195.473
7	472.665	203.193
8	484.797	212.014
9	496.106	221.868
10	506.506	232.678
11	515.914	244.360
12	524.259	256.825
13	528.745	265.000

Circle Center At X = 378.608 ; Y = 345.309 ; and Radius = 170.422

Factor of Safety

*** 1.364 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.394	177.213
3	419.226	179.454
4	433.795	183.022
5	447.984	187.887
6	461.678	194.010
7	474.764	201.341
8	487.137	209.821
9	498.697	219.380
10	509.348	229.941
11	519.006	241.419
12	527.591	253.720
13	534.037	265.000

Circle Center At X = 386.968 ; Y = 342.716 ; and Radius = 166.418

Factor of Safety

*** 1.365 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.418	176.639
3	419.320	178.343
4	434.003	181.413
5	448.340	185.824
6	462.209	191.537
7	475.493	198.504
8	488.078	206.666
9	499.857	215.954
10	510.730	226.287
11	520.604	237.578
12	529.396	249.732
13	537.030	262.644
14	538.144	265.000

Circle Center At X = 393.503 ; Y = 338.515 ; and Radius = 162.250

Factor of Safety

*** 1.367 ***

Failure Surface Specified By 14 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	389.421	176.316
2	404.332	177.950
3	419.091	180.626
4	433.626	184.331
5	447.866	189.046
6	461.740	194.749
7	475.179	201.411
8	488.118	208.999
9	500.493	217.476
10	512.243	226.800
11	523.310	236.925
12	533.639	247.802
13	543.180	259.377
14	546.998	264.734

Circle Center At X = 373.799 ; Y = 388.781 ; and Radius = 213.039

Factor of Safety

*** 1.368 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	390.632	177.474
2	405.621	178.047
3	420.507	179.888
4	435.184	182.984
5	449.546	187.313
6	463.489	192.844
7	476.913	199.536
8	489.722	207.342
9	501.823	216.206
10	513.130	226.063
11	523.560	236.843
12	533.039	248.468
13	541.499	260.855
14	543.842	265.000

Circle Center At X = 391.506 ; Y = 353.799 ; and Radius = 176.328

Factor of Safety

*** 1.378 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.421	176.253
3	419.369	177.499
4	434.152	180.045
5	448.656	183.870
6	462.770	188.946
7	476.389	195.235
8	489.406	202.688
9	501.724	211.248
10	513.248	220.850
11	523.890	231.421
12	533.569	242.880
13	542.212	255.140
14	547.734	264.636

Circle Center At X = 397.729 ; Y = 347.470 ; and Radius = 171.356

Factor of Safety

*** 1.379 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.421	176.316
2	404.154	179.133
3	418.687	182.846
4	432.966	187.441
5	446.938	192.900
6	460.549	199.204
7	473.749	206.328

8	486.488	214.246
9	498.720	222.929
10	510.398	232.344
11	521.478	242.455
12	531.919	253.225
13	541.681	264.613
14	541.974	265.000

Circle Center At X = 350.806 ; Y = 418.292 ; and Radius = 245.038

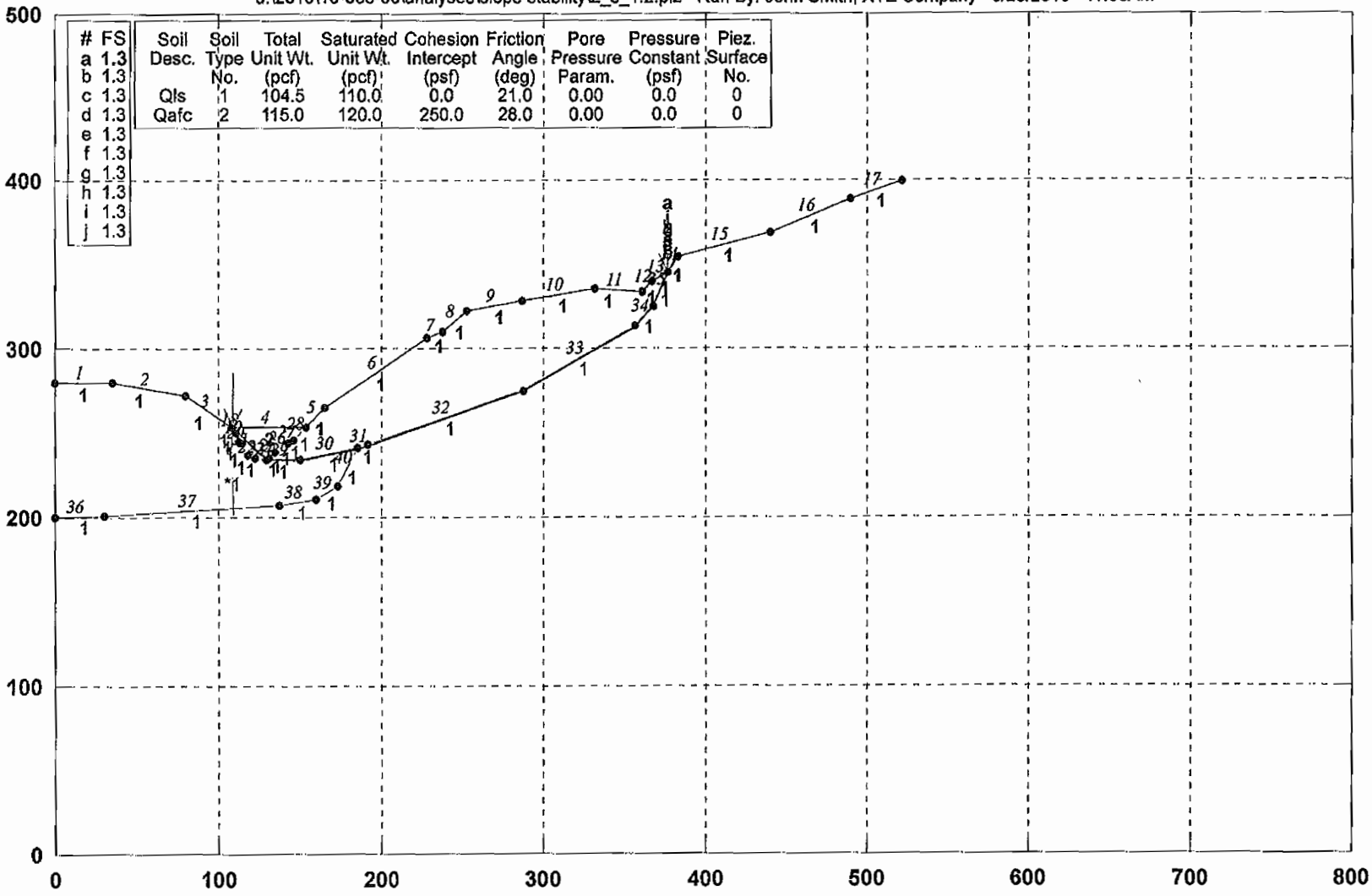
Factor of Safety

*** 1.384 ***

**** END OF GSTABL7 OUTPUT ****

Sect 2, Terrapaca Landslide, Fill height at toe for approx. 1.25 FS

u:\2010\10-036-00\analyses\slope stability\2_s_1.2.pl2 Run By: John Smith, XYZ Company 9/28/2010 11:00AM



#	FS
a	1.3
b	1.3
c	1.3
d	1.3
e	1.3
f	1.3
g	1.3
h	1.3
i	1.3
j	1.3

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	0.0	21.0	0.00	0.0	0
Qafc	2	115.0	120.0	250.0	28.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 9/28/2010
Time of Run: 11:00AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_1.2.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_1.2.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_1.2.PLT
PROBLEM DESCRIPTION: Sect 2, Terrapaca Landslide, Fill height at toe for approx. 1.25 FS

BOUNDARY COORDINATES
17 Top Boundaries
40 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	280.00	35.00	280.00	1
2	35.00	280.00	80.00	272.00	1
3	80.00	272.00	108.00	254.00	1
4	108.00	254.00	154.00	254.00	2
5	154.00	254.00	165.00	265.00	1
6	165.00	265.00	228.00	306.00	1
7	228.00	306.00	238.00	310.00	1
8	238.00	310.00	253.00	322.00	1
9	253.00	322.00	287.00	328.00	1
10	287.00	328.00	332.00	335.00	1
11	332.00	335.00	361.00	334.00	1
12	361.00	334.00	367.00	340.00	1
13	367.00	340.00	377.00	345.00	1
14	377.00	345.00	383.00	355.00	1
15	383.00	355.00	440.00	369.00	1
16	440.00	369.00	490.00	389.00	1
17	490.00	389.00	521.00	399.00	1
18	108.00	254.00	111.00	250.00	1
19	111.00	250.00	112.00	245.00	1
20	112.00	245.00	113.00	244.00	1
21	113.00	244.00	118.00	237.00	1
22	118.00	237.00	122.00	235.00	1
23	122.00	235.00	129.00	234.00	1
24	129.00	234.00	131.00	235.00	1
25	131.00	235.00	134.00	239.00	1
26	134.00	239.00	142.00	244.00	1
27	142.00	244.00	146.00	246.00	1
28	146.00	246.00	154.00	254.00	1
29	129.00	234.00	150.00	234.00	1
30	150.00	234.00	185.00	241.00	1
31	185.00	241.00	191.00	243.00	1
32	191.00	243.00	288.00	275.00	1
33	288.00	275.00	356.00	313.00	1
34	356.00	313.00	368.00	325.00	1
35	368.00	325.00	377.00	345.00	1
36	0.00	200.00	30.00	201.00	1
37	30.00	201.00	137.00	207.00	1
38	137.00	207.00	160.00	211.00	1
39	160.00	211.00	173.00	219.00	1
40	173.00	219.00	185.00	241.00	1

Default Y-Origin = 0.00(ft)

Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	0.0	21.0	0.00	0.0	0
2	115.0	120.0	250.0	28.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	108.00	254.00	109.00	200.00

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
10 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	130.00	234.00	130.00	234.00	0.10
2	150.00	234.00	150.00	234.00	1.00
3	185.00	241.00	185.00	241.00	1.00
4	191.00	243.00	191.00	243.00	1.00
5	288.00	275.00	288.00	275.00	1.00
6	356.00	313.00	356.00	313.00	1.00
7	368.00	325.00	368.00	325.00	1.00
8	377.00	345.00	377.00	345.00	0.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 10
Number of Trial Surfaces With Valid FS = 10
Statistical Data On All Valid FS Values:
FS Max = 1.307 FS Min = 1.298 FS Ave = 1.302
Standard Deviation = 0.003 Coefficient of Variation = 0.20 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.467	254.000
2	115.170	247.420
3	122.311	240.420
4	130.000	234.026
5	150.000	234.189
6	185.000	240.613
7	191.000	242.626
8	288.000	275.073
9	356.000	312.547
10	368.000	325.392
11	377.000	345.000

Factor of Safety
*** 1.298 ***
Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.7	2536.0	0.0	0.0	0.	0.	0.0	0.0	0.0
2	7.1	8277.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	7.3	14023.5	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.4	810.4	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.0	2289.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	3.0	6790.9	0.0	0.0	0.	0.	0.0	0.0	0.0

7	8.0	17693.5	0.0	0.0	0.	0.	0.0	0.0	0.0
8	4.0	8679.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	4.0	8539.7	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.0	8211.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	7.5	17337.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	3.5	9752.6	0.0	0.0	0.	0.	0.0	0.0	0.0
13	19.8	67490.5	0.0	0.0	0.	0.	0.0	0.0	0.0
14	0.2	916.2	0.0	0.0	0.	0.	0.0	0.0	0.0
15	6.0	24044.8	0.0	0.0	0.	0.	0.0	0.0	0.0
16	37.0	174557.4	0.0	0.0	0.	0.	0.0	0.0	0.0
17	10.0	53634.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	15.0	86437.7	0.0	0.0	0.	0.	0.0	0.0	0.0
19	19.2	114703.5	0.0	0.0	0.	0.	0.0	0.0	0.0
20	14.8	84081.0	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.0	5556.5	0.0	0.0	0.	0.	0.0	0.0	0.0
22	9.4	50315.7	0.0	0.0	0.	0.	0.0	0.0	0.0
23	34.6	153748.6	0.0	0.0	0.	0.	0.0	0.0	0.0
24	24.0	71860.4	0.0	0.0	0.	0.	0.0	0.0	0.0
25	5.0	9856.1	0.0	0.0	0.	0.	0.0	0.0	0.0
26	1.4	2405.5	0.0	0.0	0.	0.	0.0	0.0	0.0
27	4.6	7557.4	0.0	0.0	0.	0.	0.0	0.0	0.0
28	1.0	1608.6	0.0	0.0	0.	0.	0.0	0.0	0.0
29	9.0	7104.5	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.852	254.000
2	115.360	247.560
3	122.432	240.491
4	130.000	233.954
5	150.000	234.124
6	185.000	241.498
7	191.000	242.634
8	288.000	275.251
9	356.000	312.817
10	368.000	324.551
11	377.000	345.000

Factor of Safety
*** 1.301 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.893	254.000
2	115.334	247.571
3	122.831	240.954
4	130.000	233.982
5	150.000	234.461
6	185.000	241.488
7	191.000	242.620
8	288.000	275.327
9	356.000	312.826
10	368.000	325.088
11	377.000	345.000

Factor of Safety
*** 1.301 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	109.028	254.000
2	115.392	247.686
3	122.602	240.757
4	130.000	234.028
5	150.000	234.218
6	185.000	241.461
7	191.000	242.607
8	288.000	274.999
9	356.000	312.731
10	368.000	324.647

11	377.000	345.000

Factor of Safety
*** 1.301 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.423	254.000
2	115.240	247.472
3	122.759	240.878
4	130.000	233.982
5	150.000	234.387
6	185.000	241.076
7	191.000	242.979
8	288.000	274.942
9	356.000	312.557
10	368.000	325.167
11	377.000	345.000

Factor of Safety
*** 1.302 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	109.758	254.000
2	115.778	248.095
3	122.851	241.026
4	130.000	234.033
5	150.000	234.169
6	185.000	240.704
7	191.000	243.156
8	288.000	275.496
9	356.000	313.441
10	368.000	325.460
11	377.000	345.000

Factor of Safety
*** 1.303 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	109.697	254.000
2	115.749	248.066
3	122.871	241.046
4	130.000	234.034
5	150.000	233.602
6	185.000	241.254
7	191.000	243.011
8	288.000	275.342
9	356.000	313.467
10	368.000	325.353
11	377.000	345.000

Factor of Safety
*** 1.303 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	109.279	254.000
2	115.755	248.035
3	122.828	240.965
4	130.000	233.997
5	150.000	233.928
6	185.000	240.632
7	191.000	243.177
8	288.000	275.405
9	356.000	312.910
10	368.000	325.037
11	377.000	345.000

Factor of Safety
*** 1.304 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	109.731	254.000
2	115.785	248.038
3	122.897	241.008
4	130.000	233.969
5	150.000	233.680
6	185.000	240.576
7	191.000	242.718
8	288.000	275.200
9	356.000	312.866
10	368.000	325.309
11	377.000	345.000

Factor of Safety

*** 1.304 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.705	254.000
2	115.771	248.075
3	122.842	241.004
4	130.000	234.021
5	150.000	234.208
6	185.000	240.925
7	191.000	243.200
8	288.000	274.627
9	356.000	312.550
10	368.000	325.063
11	377.000	345.000

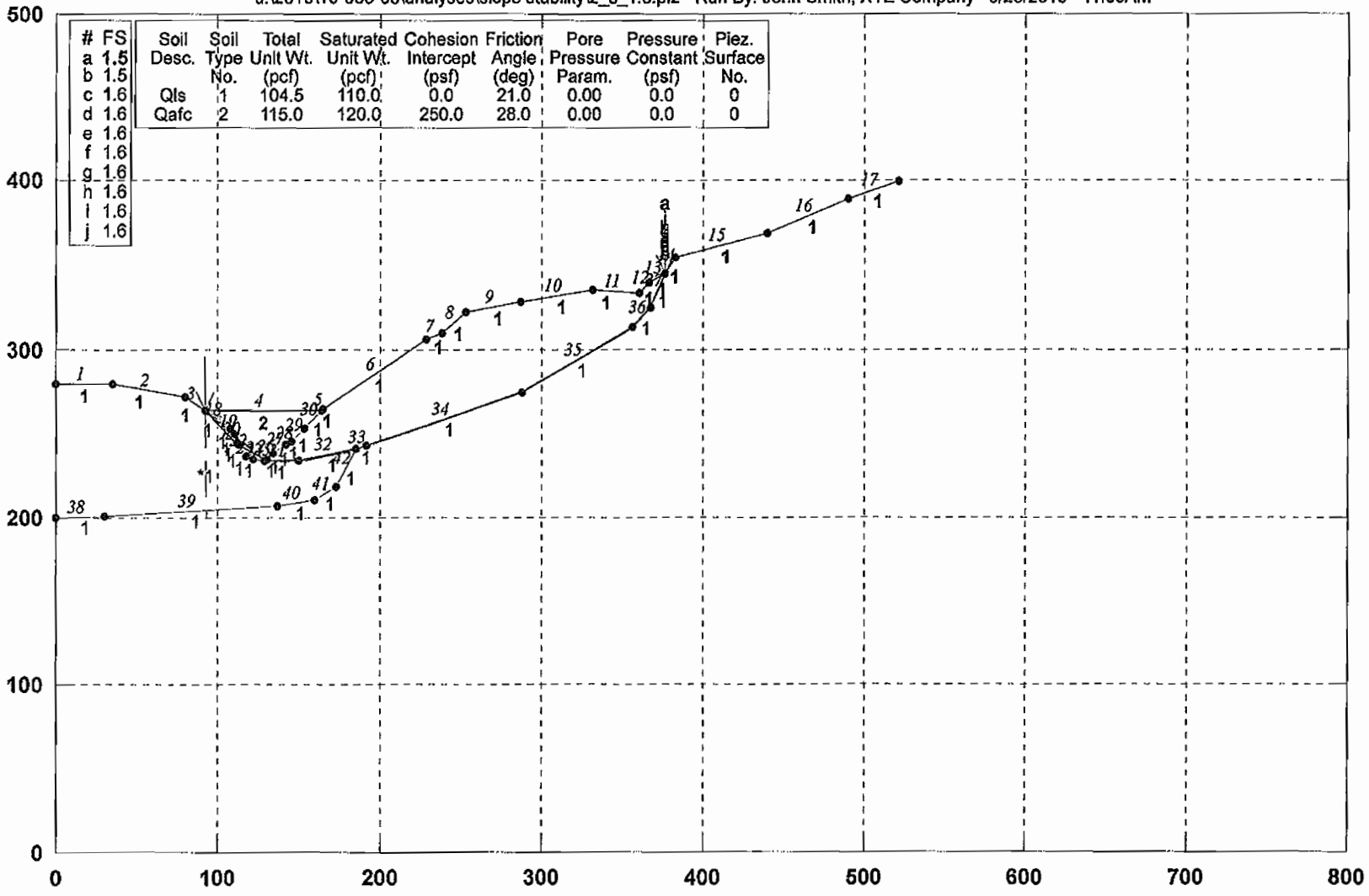
Factor of Safety

*** 1.307 ***

**** END OF GSTABL7 OUTPUT ****

Sect 2, Terrapaca Landslide, Fill height at toe for approx. 1.5 FS

u:\2010\10-036-00\analyses\slope stability\2_s_1.3.pl2 Run By: John Smith, XYZ Company 9/28/2010 11:05AM



#	FS
a	1.5
b	1.5
c	1.6
d	1.6
e	1.6
f	1.6
g	1.6
h	1.6
i	1.6
j	1.6

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	0.0	21.0	0.00	0.0	0
Qafc	2	115.0	120.0	250.0	28.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.5

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 11:05AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_1.3.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_1.3.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\2_s_1.3.PLT
PROBLEM DESCRIPTION: Sect 2, Terrapaca Landslide, Fill
height at toe for approx. 1.5 FS

BOUNDARY COORDINATES
17 Top Boundaries
42 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	280.00	35.00	280.00	1
2	35.00	280.00	80.00	272.00	1
3	80.00	272.00	92.00	264.00	1
4	92.00	264.00	164.00	264.00	2
5	164.00	264.00	165.00	265.00	1
6	165.00	265.00	228.00	306.00	1
7	228.00	306.00	238.00	310.00	1
8	238.00	310.00	253.00	322.00	1
9	253.00	322.00	287.00	328.00	1
10	287.00	328.00	332.00	335.00	1
11	332.00	335.00	361.00	334.00	1
12	361.00	334.00	367.00	340.00	1
13	367.00	340.00	377.00	345.00	1
14	377.00	345.00	383.00	355.00	1
15	383.00	355.00	440.00	369.00	1
16	440.00	369.00	490.00	389.00	1
17	490.00	389.00	521.00	399.00	1
18	92.00	264.00	108.00	254.00	1
19	108.00	254.00	111.00	250.00	1
20	111.00	250.00	112.00	245.00	1
21	112.00	245.00	113.00	244.00	1
22	113.00	244.00	118.00	237.00	1
23	118.00	237.00	122.00	235.00	1
24	122.00	235.00	129.00	234.00	1
25	129.00	234.00	131.00	235.00	1
26	131.00	235.00	134.00	239.00	1
27	134.00	239.00	142.00	244.00	1
28	142.00	244.00	146.00	246.00	1
29	146.00	246.00	154.00	254.00	1
30	154.00	254.00	164.00	264.00	1
31	129.00	234.00	150.00	234.00	1
32	150.00	234.00	185.00	241.00	1
33	185.00	241.00	191.00	243.00	1
34	191.00	243.00	288.00	275.00	1
35	288.00	275.00	356.00	313.00	1
36	356.00	313.00	368.00	325.00	1
37	368.00	325.00	377.00	345.00	1
38	0.00	200.00	30.00	201.00	1
39	30.00	201.00	137.00	207.00	1
40	137.00	207.00	160.00	211.00	1
41	160.00	211.00	173.00	219.00	1

42	173.00	219.00	185.00	241.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	0.0	21.0	0.00	0.0	0
2	115.0	120.0	250.0	28.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	92.00	264.00	93.00	200.00

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
10 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	130.00	234.00	130.00	234.00	0.10
2	150.00	234.00	150.00	234.00	1.00
3	185.00	241.00	185.00	241.00	1.00
4	191.00	243.00	191.00	243.00	1.00
5	288.00	275.00	288.00	275.00	1.00
6	356.00	313.00	356.00	313.00	1.00
7	368.00	325.00	368.00	325.00	1.00
8	377.00	345.00	377.00	345.00	0.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 10
Number of Trial Surfaces With Valid FS = 10
Statistical Data On All Valid FS Values:
FS Max = 1.621 FS Min = 1.521 FS Ave = 1.567
Standard Deviation = 0.027 Coefficient of Variation = 1.73 %
Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.373	264.000
2	98.401	257.975
3	105.551	250.983
4	112.728	244.020
5	121.526	239.266
6	130.000	233.956
7	150.000	234.107
8	185.000	241.380
9	191.000	242.852
10	288.000	274.742
11	356.000	313.019
12	368.000	325.402
13	377.000	345.000

Factor of Safety
*** 1.521 ***
Individual data on the 37 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.6	22.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	5.4	2008.8	0.0	0.0	0.	0.	0.0	0.0	0.0

3	7.1	7581.0	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.4	3873.6	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.0	5660.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.0	2136.7	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.7	1641.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.3	626.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.1	342.3	0.0	0.0	0.	0.	0.0	0.0	0.0
10	8.4	21650.2	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.0	25032.7	0.0	0.0	0.	0.	0.0	0.0	0.0
12	0.4	1417.7	0.0	0.0	0.	0.	0.0	0.0	0.0
13	0.1	239.5	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.0	3446.3	0.0	0.0	0.	0.	0.0	0.0	0.0
15	3.0	10263.2	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.8	6036.4	0.0	0.0	0.	0.	0.0	0.0	0.0
17	6.2	20919.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	4.0	13312.1	0.0	0.0	0.	0.	0.0	0.0	0.0
19	4.0	13173.5	0.0	0.0	0.	0.	0.0	0.0	0.0
20	4.0	12825.5	0.0	0.0	0.	0.	0.0	0.0	0.0
21	10.0	29808.7	0.0	0.0	0.	0.	0.0	0.0	0.0
22	1.0	2861.2	0.0	0.0	0.	0.	0.0	0.0	0.0
23	20.0	67310.2	0.0	0.0	0.	0.	0.0	0.0	0.0
24	4.3	16935.5	0.0	0.0	0.	0.	0.0	0.0	0.0
25	1.7	6797.8	0.0	0.0	0.	0.	0.0	0.0	0.0
26	37.0	174092.9	0.0	0.0	0.	0.	0.0	0.0	0.0
27	10.0	53649.9	0.0	0.0	0.	0.	0.0	0.0	0.0
28	15.0	86573.2	0.0	0.0	0.	0.	0.0	0.0	0.0
29	34.0	199591.1	0.0	0.0	0.	0.	0.0	0.0	0.0
30	1.0	5590.7	0.0	0.0	0.	0.	0.0	0.0	0.0
31	44.0	204389.0	0.0	0.0	0.	0.	0.0	0.0	0.0
32	19.3	59896.3	0.0	0.0	0.	0.	0.0	0.0	0.0
33	4.7	11134.6	0.0	0.0	0.	0.	0.0	0.0	0.0
34	5.0	9659.6	0.0	0.0	0.	0.	0.0	0.0	0.0
35	6.0	9860.1	0.0	0.0	0.	0.	0.0	0.0	0.0
36	1.0	1605.6	0.0	0.0	0.	0.	0.0	0.0	0.0
37	9.0	7100.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	93.283	264.000
2	98.663	258.622
3	105.835	251.654
4	113.655	245.421
5	122.351	240.482
6	130.000	234.041
7	150.000	233.969
8	185.000	240.928
9	191.000	242.632
10	288.000	275.177
11	356.000	313.405
12	368.000	324.910
13	377.000	345.000

Factor of Safety
*** 1.539 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	93.423	264.000
2	98.752	258.733
3	106.374	252.259
4	113.756	245.514
5	121.276	238.922
6	130.000	234.034
7	150.000	233.945
8	185.000	240.870
9	191.000	243.338
10	288.000	275.318
11	356.000	312.529
12	368.000	325.438

13	377.000	345.000

Factor of Safety
*** 1.555 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	93.030	264.000
2	98.593	258.554
3	107.225	253.504
4	114.617	246.770
5	122.331	240.406
6	130.000	233.988
7	150.000	234.069
8	185.000	240.517
9	191.000	242.946
10	288.000	274.825
11	356.000	313.371
12	368.000	324.554
13	377.000	345.000

Factor of Safety
*** 1.560 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	93.313	264.000
2	98.747	258.795
3	106.882	252.981
4	114.718	246.768
5	121.810	239.717
6	130.000	233.980
7	150.000	234.478
8	185.000	240.606
9	191.000	243.403
10	288.000	274.836
11	356.000	312.624
12	368.000	325.237
13	377.000	345.000

Factor of Safety
*** 1.567 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	93.133	264.000
2	99.181	259.053
3	106.492	252.230
4	115.366	247.620
5	122.636	240.753
6	130.000	233.988
7	150.000	234.427
8	185.000	240.655
9	191.000	243.160
10	288.000	275.287
11	356.000	313.128
12	368.000	324.528
13	377.000	345.000

Factor of Safety
*** 1.569 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	94.343	264.000
2	99.507	259.790
3	106.782	252.929
4	114.627	246.728
5	121.946	239.913
6	130.000	233.986
7	150.000	233.846
8	185.000	240.877

9	191.000	242.920
10	288.000	274.693
11	356.000	312.665
12	368.000	325.055
13	377.000	345.000

Factor of Safety
*** 1.571 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	94.404	264.000
2	100.087	260.425
3	107.239	253.435
4	114.321	246.376
5	122.165	240.173
6	130.000	233.959
7	150.000	233.687
8	185.000	241.158
9	191.000	243.093
10	288.000	275.336
11	356.000	313.482
12	368.000	324.874
13	377.000	345.000

Factor of Safety
*** 1.579 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.099	264.000
2	99.961	260.342
3	107.455	253.721
4	114.544	246.667
5	121.932	239.929
6	130.000	234.020
7	150.000	234.015
8	185.000	241.133
9	191.000	243.154
10	288.000	275.421
11	356.000	313.028
12	368.000	324.819
13	377.000	345.000

Factor of Safety
*** 1.589 ***

Failure Surface Specified By 13 Coordinate Points

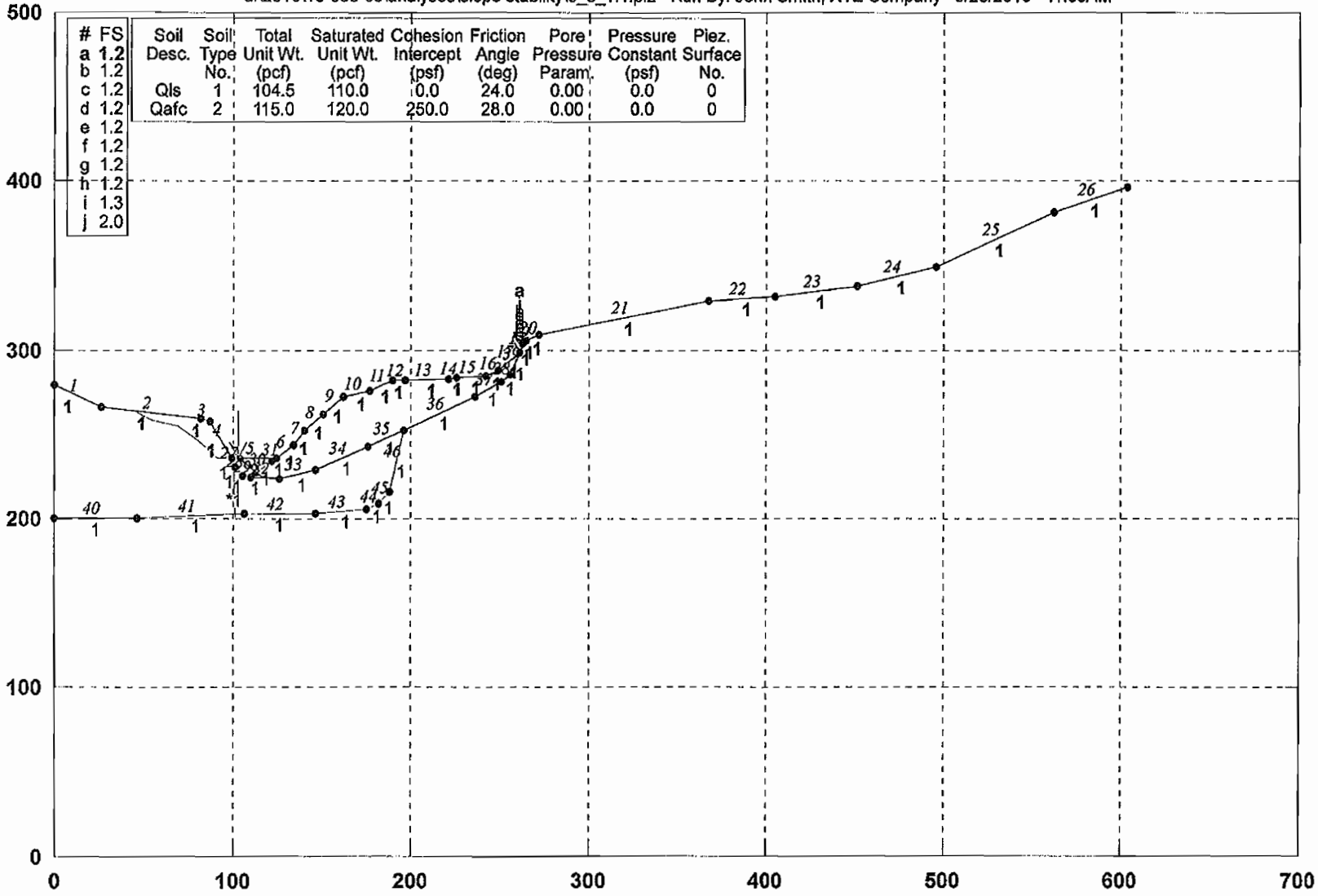
Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.743	264.000
2	101.191	261.721
3	108.467	254.861
4	115.792	248.053
5	122.863	240.982
6	130.000	233.977
7	150.000	234.465
8	185.000	241.279
9	191.000	243.308
10	288.000	275.395
11	356.000	313.135
12	368.000	324.871
13	377.000	345.000

Factor of Safety
*** 1.621 ***

**** END OF GSTABL7 OUTPUT ****

Sect 3, Terrapaca Landslide, Fill height at toe for approx. 1.25 FS

u:\2010\10-036-00\analyses\slope stability\3_s_1.1.pl2 Run By: John Smith, XYZ Company 9/28/2010 11:06AM



#	FS
a	1.2
b	1.2
c	1.2
d	1.2
e	1.2
f	1.2
g	1.2
h	1.2
i	1.3
j	2.0

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	0.0	24.0	0.00	0.0	0
Qafc	2	115.0	120.0	250.0	28.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.2

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2010
Time of Run: 11:06AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_1.1.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_1.1.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_1.1.PLT
PROBLEM DESCRIPTION: Sect 3, Terrapaca Landslide, Fill
height at toe for approx. 1.25 FS

BOUNDARY COORDINATES
26 Top Boundaries
46 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	280.00	26.00	267.00	1
2	26.00	267.00	82.00	260.00	1
3	82.00	260.00	87.00	258.00	1
4	87.00	258.00	99.50	236.00	1
5	99.50	236.00	125.00	236.00	2
6	125.00	236.00	134.00	244.00	1
7	134.00	244.00	140.00	253.00	1
8	140.00	253.00	151.00	262.00	1
9	151.00	262.00	162.00	273.00	1
10	162.00	273.00	177.00	276.00	1
11	177.00	276.00	190.00	282.00	1
12	190.00	282.00	197.00	282.00	1
13	197.00	282.00	221.00	283.00	1
14	221.00	283.00	226.00	284.00	1
15	226.00	284.00	242.00	285.00	1
16	242.00	285.00	249.00	288.00	1
17	249.00	288.00	261.00	299.00	1
18	261.00	299.00	263.00	304.00	1
19	263.00	304.00	265.00	306.00	1
20	265.00	306.00	272.00	309.00	1
21	272.00	309.00	368.00	329.00	1
22	368.00	329.00	405.00	332.00	1
23	405.00	332.00	451.00	338.00	1
24	451.00	338.00	496.00	349.00	1
25	496.00	349.00	562.00	382.00	1
26	562.00	382.00	604.00	396.00	1
27	99.50	236.00	101.00	231.00	1
28	101.00	231.00	105.00	226.00	1
29	105.00	226.00	110.00	225.00	1
30	110.00	225.00	122.00	234.00	1
31	122.00	234.00	125.00	236.00	1
32	110.00	225.00	126.00	224.00	1
33	126.00	224.00	146.00	229.00	1
34	146.00	229.00	176.00	243.00	1
35	176.00	243.00	196.00	253.00	1
36	196.00	253.00	236.00	273.00	1
37	236.00	273.00	251.00	281.00	1
38	251.00	281.00	256.00	286.00	1
39	256.00	286.00	261.00	299.00	1
40	0.00	200.00	46.00	200.00	1
41	46.00	200.00	106.00	203.00	1

42	106.00	203.00	146.00	203.00	1
43	146.00	203.00	175.00	206.00	1
44	175.00	206.00	182.00	209.00	1
45	182.00	209.00	188.00	216.00	1
46	188.00	216.00	196.00	253.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	0.0	24.0	0.00	0.0	0
2	115.0	120.0	250.0	28.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	100.00	235.00	101.00	200.00

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
10 Trial Surfaces Have Been Generated.
9 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 15.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	117.00	225.00	117.00	225.00	0.00
2	126.00	224.00	126.00	224.00	0.00
3	146.00	229.00	146.00	229.00	0.00
4	176.00	243.00	176.00	243.00	0.00
5	196.00	253.00	196.00	253.00	0.00
6	236.00	273.00	236.00	273.00	0.00
7	251.00	281.00	251.00	281.00	0.00
8	256.00	286.00	256.00	286.00	0.00
9	261.00	299.00	261.00	299.00	0.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 10
Number of Trial Surfaces With Valid FS = 10
Statistical Data On All Valid FS Values:
FS Max = 2.044 FS Min = 1.241 FS Ave = 1.325
Standard Deviation = 0.253 Coefficient of Variation = 19.10 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.069	236.000
2	105.210	234.273
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.241 ***
Individual data on the 24 slices

Slice	Width	Weight	Water Force Top	Water Force Bot	Tie Force Norm	Tie Force Tan	Earthquake Force Hor	Earthquake Force Ver	Surcharge Load

No.	(ft)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)
1	2.1	212.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	8.4	4833.4	0.0	0.0	0.	0.	0.0	0.0	0.0
3	3.4	3700.0	0.0	0.0	0.	0.	0.0	0.0	0.0
4	5.0	6096.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.0	3706.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.0	1294.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	8.0	12911.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	6.0	13637.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	6.0	17057.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	5.0	15564.2	0.0	0.0	0.	0.	0.0	0.0	0.0
11	11.0	38623.2	0.0	0.0	0.	0.	0.0	0.0	0.0
12	14.0	50717.3	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.0	3411.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	13.0	43811.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	6.0	19123.5	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.0	3004.4	0.0	0.0	0.	0.	0.0	0.0	0.0
17	24.0	57684.0	0.0	0.0	0.	0.	0.0	0.0	0.0
18	5.0	8751.9	0.0	0.0	0.	0.	0.0	0.0	0.0
19	10.0	14434.1	0.0	0.0	0.	0.	0.0	0.0	0.0
20	6.0	6403.2	0.0	0.0	0.	0.	0.0	0.0	0.0
21	7.0	6169.0	0.0	0.0	0.	0.	0.0	0.0	0.0
22	2.0	1766.0	0.0	0.0	0.	0.	0.0	0.0	0.0
23	5.0	4506.6	0.0	0.0	0.	0.	0.0	0.0	0.0
24	5.0	2198.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.329	236.000
2	105.231	234.300
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.241 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.921	236.000
2	105.441	234.560
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.242 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.642	236.000
2	105.324	234.417
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000

9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.242 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.620	236.000
2	104.841	233.783
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.242 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.203	236.000
2	105.313	234.403
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.245 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.595	236.000
2	105.959	235.153
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.248 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.313	236.000
2	106.059	235.261
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety

*** 1.248 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.536	236.000
2	106.343	235.556
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

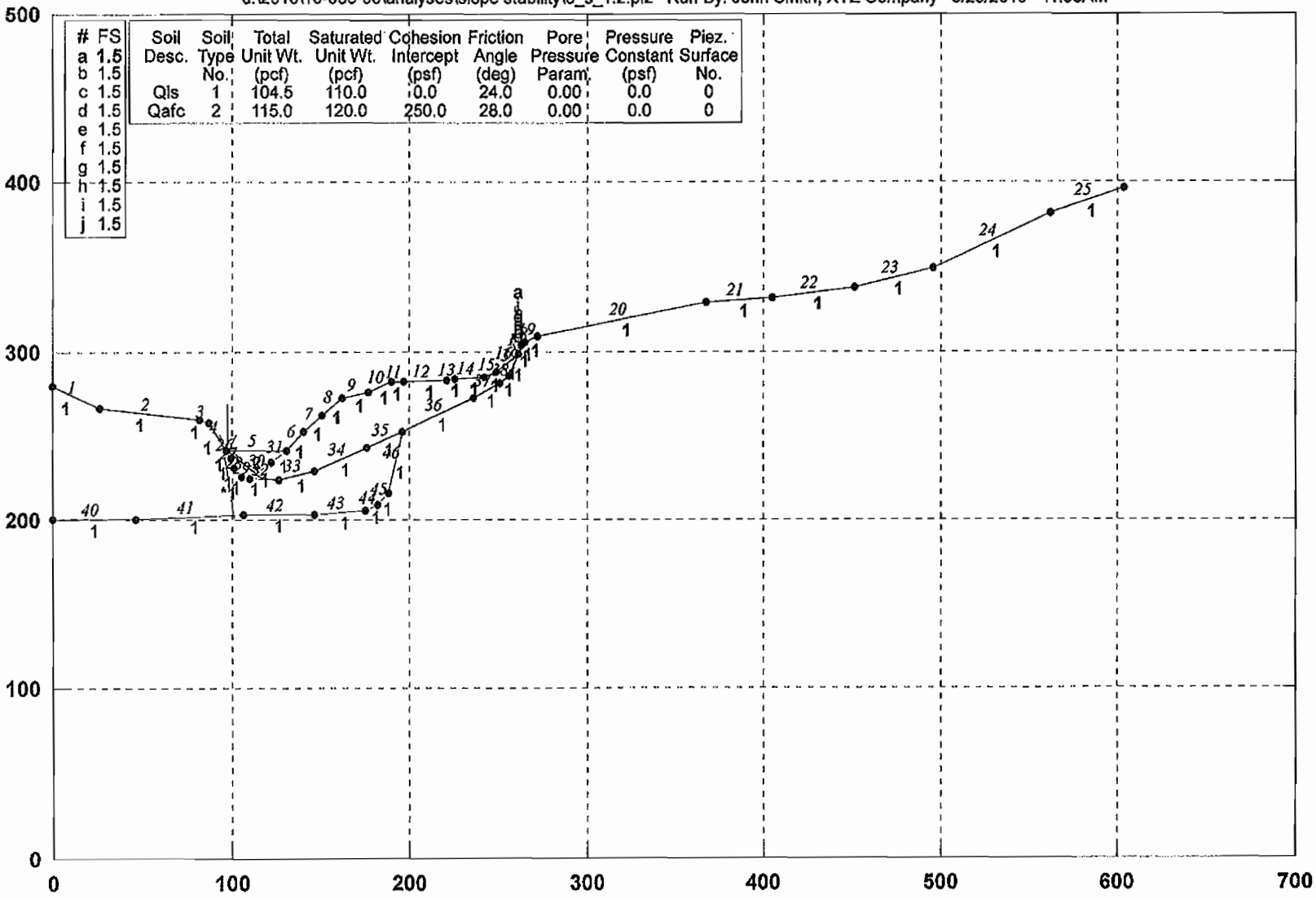
Factor of Safety
*** 1.252 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.728	264.784
2	53.941	258.576
3	68.593	255.362
4	80.468	246.199
5	91.371	235.896
6	106.368	235.581
7	117.000	225.000
8	126.000	224.000
9	146.000	229.000
10	176.000	243.000
11	196.000	253.000
12	236.000	273.000
13	251.000	281.000
14	256.000	286.000
15	261.000	299.000

Factor of Safety
*** 2.044 ***
**** END OF GSTABL7 OUTPUT ****

Sect 3, Terrapaca Landslide, Fill height at toe for approx. 1.5 FS

u:\2010\10-036-00\analyses\slope stability\3_s_1.2.pl2 Run By: John Smith, XYZ Company 9/28/2010 11:08AM



#	FS
a	1.5
b	1.5
c	1.5
d	1.5
e	1.5
f	1.5
g	1.5
h	1.5
i	1.5
j	1.5

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Qls	1	104.5	110.0	0.0	24.0	0.00	0.0	0
Qafc	2	115.0	120.0	250.0	28.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.5

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c=0

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.005, Sept. 2006 **

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 9/28/2010
Time of Run: 11:08AM
Run By: John Smith, XYZ Company
Input Data Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_1.2.in
Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_1.2.OUT
Unit System: English
Plotted Output Filename: U:\2010\10-036-00\Analyses\Slope Stability\3_s_1.2.PLT
PROBLEM DESCRIPTION: Sect 3, Terrapaca Landslide, Fill height at toe for approx. 1.5 FS

BOUNDARY COORDINATES
25 Top Boundaries
46 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	280.00	26.00	267.00	1
2	26.00	267.00	82.00	260.00	1
3	82.00	260.00	87.00	258.00	1
4	87.00	258.00	96.50	241.50	1
5	96.50	241.50	131.00	241.50	2
6	131.00	241.50	140.00	253.00	1
7	140.00	253.00	151.00	262.00	1
8	151.00	262.00	162.00	273.00	1
9	162.00	273.00	177.00	276.00	1
10	177.00	276.00	190.00	282.00	1
11	190.00	282.00	197.00	282.00	1
12	197.00	282.00	221.00	283.00	1
13	221.00	283.00	226.00	284.00	1
14	226.00	284.00	242.00	285.00	1
15	242.00	285.00	249.00	288.00	1
16	249.00	288.00	261.00	299.00	1
17	261.00	299.00	263.00	304.00	1
18	263.00	304.00	265.00	306.00	1
19	265.00	306.00	272.00	309.00	1
20	272.00	309.00	368.00	329.00	1
21	368.00	329.00	405.00	332.00	1
22	405.00	332.00	451.00	338.00	1
23	451.00	338.00	496.00	349.00	1
24	496.00	349.00	562.00	382.00	1
25	562.00	382.00	604.00	396.00	1
26	96.50	241.50	99.00	237.00	1
27	99.00	237.00	101.00	231.00	1
28	101.00	231.00	105.00	226.00	1
29	105.00	226.00	110.00	225.00	1
30	110.00	225.00	122.00	234.00	1
31	122.00	234.00	131.00	241.50	1
32	110.00	225.00	126.00	224.00	1
33	126.00	224.00	146.00	229.00	1
34	146.00	229.00	176.00	243.00	1
35	176.00	243.00	196.00	253.00	1
36	196.00	253.00	236.00	273.00	1
37	236.00	273.00	251.00	281.00	1
38	251.00	281.00	256.00	286.00	1
39	256.00	286.00	261.00	299.00	1
40	0.00	200.00	46.00	200.00	1
41	46.00	200.00	106.00	203.00	1

42	106.00	203.00	146.00	203.00	1
43	146.00	203.00	175.00	206.00	1
44	175.00	206.00	182.00	209.00	1
45	182.00	209.00	188.00	216.00	1
46	188.00	216.00	196.00	253.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	104.5	110.0	0.0	24.0	0.00	0.0	0
2	115.0	120.0	250.0	28.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	95.00	245.00	101.00	200.00

Janbus Empirical Coef is being used for the case of c=0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
10 Trial Surfaces Have Been Generated.
9 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 15.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	117.00	225.00	117.00	225.00	0.00
2	126.00	224.00	126.00	224.00	0.00
3	146.00	229.00	146.00	229.00	0.00
4	176.00	243.00	176.00	243.00	0.00
5	196.00	253.00	196.00	253.00	0.00
6	236.00	273.00	236.00	273.00	0.00
7	251.00	281.00	251.00	281.00	0.00
8	256.00	286.00	256.00	286.00	0.00
9	261.00	299.00	261.00	299.00	0.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 10
Number of Trial Surfaces With Valid FS = 10
Statistical Data On All Valid FS Values:
FS Max = 1.517 FS Min = 1.507 FS Ave = 1.512
Standard Deviation = 0.004 Coefficient of Variation = 0.27 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.179	241.500
2	105.231	234.300
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.507 ***
Individual data on the 23 slices

Slice	Width	Weight	Water Force Top	Water Force Bot	Tie Force Norm	Tie Force Tan	Earthquake Force Hor	Earthquake Force Ver	Surcharge Load

No.	(ft)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)
1	8.1	3333.8	0.0	0.0	0.	0.	0.0	0.0	0.0
2	8.4	10098.6	0.0	0.0	0.	0.	0.0	0.0	0.0
3	3.4	5846.2	0.0	0.0	0.	0.	0.0	0.0	0.0
4	5.0	9258.6	0.0	0.0	0.	0.	0.0	0.0	0.0
5	4.0	7467.1	0.0	0.0	0.	0.	0.0	0.0	0.0
6	5.0	8926.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	9.0	19632.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	6.0	17057.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	5.0	15564.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	11.0	38623.2	0.0	0.0	0.	0.	0.0	0.0	0.0
11	14.0	50717.3	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.0	3411.9	0.0	0.0	0.	0.	0.0	0.0	0.0
13	13.0	43811.6	0.0	0.0	0.	0.	0.0	0.0	0.0
14	6.0	19123.5	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.0	3004.4	0.0	0.0	0.	0.	0.0	0.0	0.0
16	24.0	57684.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	5.0	8751.9	0.0	0.0	0.	0.	0.0	0.0	0.0
18	10.0	14434.1	0.0	0.0	0.	0.	0.0	0.0	0.0
19	6.0	6403.2	0.0	0.0	0.	0.	0.0	0.0	0.0
20	7.0	6169.0	0.0	0.0	0.	0.	0.0	0.0	0.0
21	2.0	1766.0	0.0	0.0	0.	0.	0.0	0.0	0.0
22	5.0	4506.6	0.0	0.0	0.	0.	0.0	0.0	0.0
23	5.0	2198.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.380	241.500
2	105.323	234.415
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.507 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.426	241.500
2	105.689	234.852
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.508 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.731	241.500
2	105.704	234.870
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000

10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.508 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	98.268	241.500
2	106.127	235.334
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.513 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.265	241.500
2	106.078	235.282
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.514 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.324	241.500
2	106.035	235.236
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.514 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.567	241.500
2	106.100	235.304
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety
*** 1.516 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.133	241.500
2	106.349	235.562
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety

*** 1.517 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.844	241.500
2	106.091	235.295
3	117.000	225.000
4	126.000	224.000
5	146.000	229.000
6	176.000	243.000
7	196.000	253.000
8	236.000	273.000
9	251.000	281.000
10	256.000	286.000
11	261.000	299.000

Factor of Safety

*** 1.517 ***

**** END OF GSTABL7 OUTPUT ****

APPENDIX D

Geophysical Testing Results

GMU
GEOTECHNICAL, INC.

NORCAL GEOPHYSICAL CONSULTANTS, INC.

July 22, 2010

Ms Lisa Bates
Engineering Geologist
GMU Geotechnical, Inc.
23241 Arroyo Vista
Rancho Santa Margarita, CA 92688

RE: BOREHOLE GEOPHYSICAL LOGGING REPORT
PALOS VERDE DRIVE
RANCHO PALOS VERDE, CALIFORNIA

NORCAL JOB No. 10-703.02B

Dear Ms Bates,

This report presents the findings of a borehole geophysical logging survey performed by NORCAL Geophysical Consultants for the subject project. The survey was part of a geotechnical site characterization concerning a proposed drainage tunnel. The survey was conducted by NORCAL Professional Geophysicist William J. Henrich on June 28, 2010. Logistical support was provided by Ms Wendy Drummond of GMU Geotechnical, Inc.

1.0 PURPOSE

The purpose of the geophysical logging was to quantitatively map orientations of the borehole discontinuities such as bedding, fractures, geologic contacts etc. in two core borings. One borehole was located along Palos Verde Drive; the other was located approximately 1/4 mile up slope on a line parallel to the tunnel alignment. Additionally, we were tasked to measure compressional (P-) and shear (S-) wave velocities as an aid in the determination of shear strength of the underlying bedrock.

2.0 SCOPE OF WORK

Our scope of work consisted of geophysical logging in two boreholes labeled as CH-1 and CH-2. The geophysical logging suite consisted of caliper, optical televiewer and Suspension P- and S-wave velocity tools. We were also tasked to analyze and interpret these field data and present the results in a written report.

3.0 BOREHOLE CONDITIONS

Boreholes were drilled with HQ diamond core methods. The boreholes penetrated shales and siltstone units of the Monterey Formation. This area of Palos Verde is prone to landsliding. It was reported by the on site geologist that both boreholes intercepted "multiple" slide planes. Both boreholes were drilled vertically. Borehole CH-1 had been completed to 150 below ground

surface and allowed to equilibrate for three days prior to geophysical logging. The static water level encountered during geophysical logging was 103 feet below ground surface. Borehole CH-2 was dry down to 93 feet below ground surface.

4.0 BOREHOLE LOGGING METHODOLOGY

Geophysical logging consists of lowering various probes down the test bores and conducting various physical property measurements of the geologic formations. Our geophysical logging instruments (console, PC computer, downhole tools and DC powered four conductor winch) consisted of a digital ***Robertson Geologging, Ltd.*** Model ***Micrologger2 System***. The following discusses the three logging methods used in this survey.

a.) Caliper

Borehole diameter was measured by a mechanical spring loaded 3-armed device and calibrated to read diameters in units of inches. Caliper logs are used to indicate formation washouts associated with either fracture zones or voids. The caliper log results are often used to correct the response of other logs (see section OPTV data reduction).

b.) Image Logs

The presence and orientation of borehole discontinuities (fractures, bedding, geologic contacts, etc.) can be measured with image logging tools consisting of either optical (OPTV) or acoustic televiewer (BHTV). Our tool of choice for this survey was the OPTV televiewer. The OPTV tool consists of a charged coupled device (CCD) video camera that can operate in either dry or water-filled portions of the borehole providing that the water-filled portion is optically clear. A light source composed of a circular series of LEDs located at the bottom of the tool illuminates the borehole via a transparent viewing glass. Light reflected from the borehole wall is gathered by a hyperbolic mirror inside the transparent viewing window and reflected vertically up to the CCD camera. This results in a radial image strip that is referenced to magnetic north by an on board magnetic compass. The acquisition system then converts the analog data to oriented, digitized radial images with a maximum resolution of 0.004 feet. Built-in computer software also unwraps and composites the radial images into a real-time, two-dimensional plot of the borehole wall on the computer screen. During acquisition the inclination (tilt from vertical) of the borehole is recorded by an omni-directional three-axis accelerometer. The bearing (azimuth) of the tool was measured by a three-axis magnetometer.

c.) Suspension P- and S-wave Logger

We used an OYO-Robertson Model 3403 digital suspension logging system to measure downhole compressional (P-) and shear (S-) velocities. The probe is equipped with a dipole seismic energy source located near the base of the probe and a pair of geophones (detectors) located towards the upper end of the probe. A schematic showing the probe configuration and equipment attachments is shown in Appendix A. In this survey the distance from the energy source to the first geophone was 7.02 feet (2.13 meters). The in-line distance between the

geophone pair is 3.28 feet (1.0 meter). Each geophone contains one horizontal and one vertical oriented element. The horizontal geophone elements preferentially record the shear wave, the vertical geophone elements record first arriving P-wave energy.

Suspension seismic data is collected at discrete depths in a fluid-filled boring. At each measurement depth, the energy source is activated via commands from the surface control console. This activation causes a metal solenoid to strike a plate (anvil) mounted inside the probe housing. This energy transmits through the fluid to the borehole wall which produces a seismic wave ("flexure") in the adjacent formation. As this wave propagates radially in the formation away from the source, a seismic interaction between the seismic wave and the borehole wall creates tube waves together with a refracted compressional P-wave that travels up the borehole to the two recording geophones. P-wave arrival times are identified as the first break on the vertical geophone seismic records. Tube wave arrivals are later arriving seismic events and are recorded on the horizontal geophones. The identification of the tube wave arrival times are facilitated by recording seismic records from two opposite directions (horizontally left and right) of solenoid impacts. By superimposing these two seismic records, the onset of the tube wave/S-wave arrival time is usually identified as a higher amplitude and phase reversal event. The velocity of the tube wave is very close (90 percent) to that of the S-wave. Hence, we report tube wave velocities as seismic S-wave velocities.

When assembled, the suspension logging tool measures approximately 19 feet in length. The measuring point of the tool is taken at the center of the pair of geophones. This measuring point is approximately 11 feet from the bottom of the probe. Therefore, the maximum depth of our survey will always be reported 11 feet from the total depth of the borehole assuming the borehole is free of obstructions.

5.0 DATA ACQUISITION

a.) Caliper

Prior to the survey, the caliper log response was calibrated to read in units of inches. The caliper logs were acquired in the up going direction at speeds ranging from 10 to12-feet-per-minute. The digital data sampling rate was every 0.05 feet.

b.) OPTV Logs

The OPTV logging was recorded initially in an downhole direction at a logging speed of 4 feet-per-minute. After a review of this initial log, lighting parameters were adjusted and a second up going log was recorded. The purpose of the second log was to improve image quality and to create a repeat log to demonstrate the stability of the magnetic north reference measured by the instrumentation. The north compass direction was checked with a Brunton Compass prior to geophysical logging.

c.) Suspension Logging

We measured seismic suspension velocities ranging from one to two-foot intervals beginning approximately 11 feet from the bottom of each borehole. At each measurement station, we cycled the energy source to fire 3 times in succession into each geophone element. This cycling stacks seismic records to achieve better signal to noise ratios. We also recorded S-wave data using a 2.4 KHz low pass filter. This filtering reduces high frequency interference from the onset of earlier arriving P-wave modes.

Only borehole CH-,1 under ambient conditions, had a standing water column beginning at 103 feet below ground surface (bgs). The survey target interval in this borehole ranged from 90 to 70 feet bgs. Borehole CH-2 was dry down to total depth or approximately 93 feet bgs. The operation of the suspension logging requires a fluid-filled borehole column. Therefore, water was gravity fed into the boreholes from a water truck to raise the water level in each of the boreholes. Despite the constant influx of imported water, the water level in CH-1 did not rise above 103 feet. As a result, Suspension measurements were regulated to depths below 103 feet bgs.

6.0 DATA REDUCTION

a.) OPTV Image Logs

We used the computer program WELLCAD (Version 4.0, ALT, Luxemburg) to produce merged borehole optical televiewer images and caliper log plots and to calculate orientations of interpreted discontinuities (e.g. bedding and fractures) from the televiewer imagery. Corrections for the magnetic declination in the survey area required adding 13.5 degrees to the magnetic compass bearings in order to orient the borehole images to true north (NOAA, 2004, Magnetic Declination for The U.S.). Since borehole diameter is a major input parameter in determining dip magnitude, we input caliper log data into the program calculation of dips. Discontinuities analysis was performed interactively on sections of the unwrapped OPTV image as viewed on a computer monitor. An interpretable discontinuity on a two-dimensional unwrapped borehole televiewer log appears as a recognizable sinusoidal shaped trace that usually extends across the width of the borehole image. The sinusoidal shape is a visual manifestation of a planar discontinuity intercepting a three-dimensional cylindrical borehole. Planar discontinuities can be geologic features that include discrete fractures, bedding planes or other such planar contacts. Identified discontinuity traces on the image logs were fitted with a bendable sinusoid that best overlies the trend of the trace. WELLCAD then calculates a plane that represents the orientation of the discontinuity in terms of dip direction and dip magnitude based on the sinusoid overlay. The process is repeated for every significant discontinuity until the entire open section of the borehole is interpreted. At this stage, apparent dip direction and dip magnitude of the discontinuities are converted to true geographic dip direction and magnitude by factoring a correction for borehole deviation (azimuth and tilt).

Most discontinuities were observed to be continuous (360 degrees) across the "unwrapped" image plot, however, in complex fracture zones or in occurrences of high angle discontinuities

(greater than 60 degree dip) the discontinuity trace is shown either in segments or in one partial irregular segment (much less than 360 degrees across). In either case only portions of the discontinuity are presented. Nonetheless, a best fit sinusoid was superimposed over these incomplete traces. These sinusoids and resulting calculations represent an approximate dip direction and magnitude for these noncontinuous features.

b.) Suspension Logs

Seismic P- and S-wave velocities were calculated with the interpretation computer software Glog SUS, Version 1.12 published by Oyo Corporation (2000). A typical interpreted seismic record is presented in Appendix B. This record shows six geophone traces. Traces H1 and H2 are horizontal geophone elements which are preferentially aligned to record S-waves. H1 is the geophone nearest to the source, H2 is the farthest from the source. V1 and V2 are the vertical geophone elements which are preferentially aligned to record P-waves. The horizontal geophone elements (H1 and H2) show a total of four S-wave arrival times; two arrival times identified at each geophone are referenced as "up" and "down" breaks. The"up" and "down" breaks are the result of two separate and oppositely directed (180 degrees) solenoid impacts by the energy source. As the example record illustrates, these opposing impacts produce amplitude phase reversals which identifies the on set of the S-wave energy. All seismic records were analyzed for P- and S- arrival times in this manner. Seismic velocities are calculated by dividing the geophone spacing interval (1 meter) by the interpreted interval travel times in microseconds to yield seismic velocities in meters per second. Two S-wave velocities are calculated at each depth measurement station. We averaged the results of two S-wave interval velocities and presented a single S-wave value at each measurement station.

The interval velocity calculation method is the preferred reduction technique. However, we have noticed that depending on borehole conditions the waveform record can show more than one S-wave phase reversal. To help eliminate this equivalence we calculate direct velocities from the arrival times. That is, we divide the travel distance from the source to the detectors by the arrival times (see graphic regarding the probe geometry). These direct arrival time velocities are compared to the interval velocities. When we see velocity discrepancies we reinterpret arrival times in the Glog-SUS program so that the interval velocities approximately correspond to the direct velocity calculation. It should be noted that the direct velocity calculation though useful as a velocity constraint can not substitute for an interval velocity because the delay times due to instrumental and probe standoff are not known precisely.

7.0 PRESENTATION AND RESULTS

Summary plots of all log data and interpretative illustrations can be found in Appendix C at a vertical scale of one inch equals two feet. The plots present the caliper log trace (green) superimposed on the initial Down going OPTV image plot in the far left track. Additional plots left to right are as follows: Up going OPTV log with sinusoid overlays, Tadpole, Suspension P- and S-wave Velocities (bar graph) and borehole deviation (see Azimuth and Tilt).

The tadpole symbol depicts discontinuity dip magnitude by its position on the depth versus degrees (0° to 90°) plot where 0° represents horizontal and 90° represents vertical. Dip

direction is indicated by the position of the symbols tail as if it were positioned on a 360°compass face where north is the tail pointing vertically up the page, east is the tail pointing 90° to the right of vertical, south is pointing vertically down the page and west is 90° from vertical to the left of the page. The color of the sinusoid and tadpole have classification meaning. Black refers to fractures; green to bedding and blue to contacts.

Due either to the complexity or incompleteness of discontinuity traces in some fracture intervals, not all possible fractures were subject to tabulation and interpretation. This is to say that the number of interpreted fractures in our analysis will not always correlate to the fracture frequency as determined from rock core analysis for reasons of significance, silica mineralization within fractures and undetected mechanical breakage of core samples at the surface.

a.) Discontinuity analysis

Interpreted discontinuities were classified as bedding, fractures and contacts. We identified discontinuities as bedding because these features appeared closely spaced, had very thin traces with no open aperture and followed a near constant dip direction and angle across limited depth intervals. A contact classification was given to a discontinuity that visually appeared to separate distinctly different rock units. A discontinuity was classified as a fracture because we observed evidence of an open or partially open aperture. This open or partially aperture characteristic can be inferred by caliper log breakouts or the appearance of an open aperture of the discontinuity on an optical televiewer. A complete listing of interpreted discontinuity depth, dip direction (Azimuth), dip angle from horizontal, WELLCAD code and classification ("class") has been summarized in a series of tables. These discontinuity tables are presented in Appendix D.

b.) Suspension P- and S- wave velocities

Suspension S- and P-wave Interval velocities presented in bar graph form on the Log Summary Plots (see Appendix C) are presented as numerical tables in Appendix E. In general, Borehole CH-1 ranged from 1100 to 2600 feet per second (fps). S-wave velocities in Borehole CH-2 ranged from 760 to 1649 fps. The lower S-wave velocities in CH-2 versus CH-1 are probably the result of the rock mass in the former having been subjected to greater amounts of weathering and possibly greater slide movement. Landslide movement mechanically deforms the rock which reduces shear strength and S-wave velocity. P-wave velocities were measured below 5000 fps in Boreholes CH-1 above 120 feet and all of CH-2. It is our experience that in unsaturated bedrock where we are adding water to the borehole to create an artificially high fluid column, the P-wave arrivals on the waveform records are not conclusive because the signal level is relatively weak compared to the S-wave. We therefore state that our P-wave results are at best estimates.

STANDARD CARE AND WARRANTY

The scope of NORCAL's services for this project consisted of using the downhole geophysical techniques to measure the orientation of bedrock discontinuities and measure Suspension

seismic velocities. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the standard of care ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

Thank you for the opportunity to participate in this investigation. Should you have questions please call me at your earliest convenience.

Yours very truly,

NORCAL Geophysical Consultants, Inc.

William J. Henrich, CEG, GP
Professional Geophysicist-893

Enclosures

WJH/KGB/tt

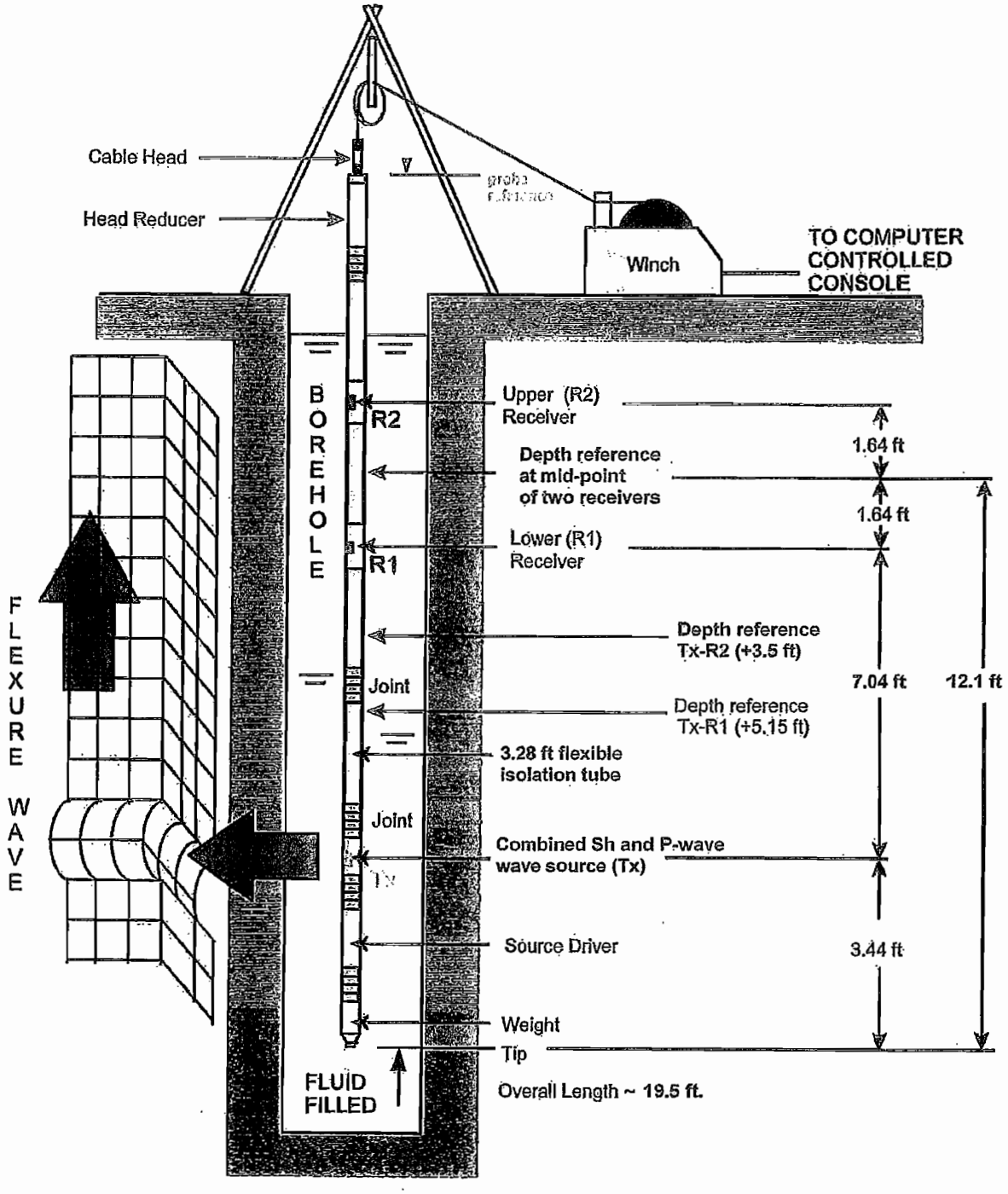
ENCLOSURES

APPENDIX A: Suspension Logging Probe and System Schematic
APPENDIX B: Example Survey Suspension Waveform Records with Interpreted Arrival Times
APPENDIX C: Summary Log Plots, CH-1 and CH-2
APPENDIX D: Discontinuity Tables, CH-1 and CH-2
APPENDIX E: P-and S-wave Suspension Velocity Table, CH-1 and CH-2

APPENDIX A

Suspension Logging Probe and System Schematic

SUSPENSION LOGGING PROBE AND EQUIPMENT CONFIGURATION



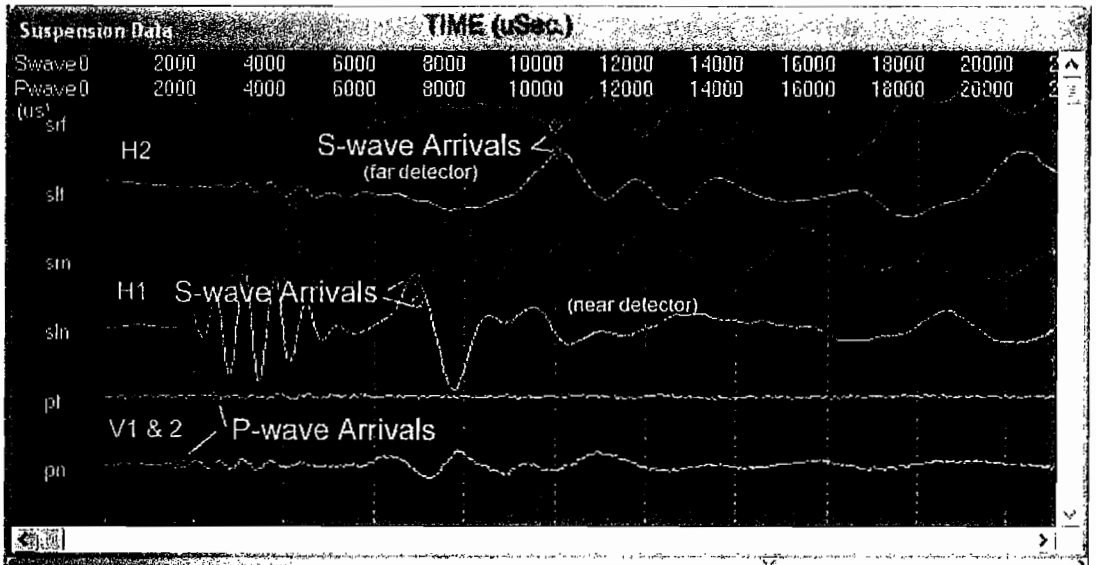
Constructed with 1 meter (3.28 ft) isolation tube

Drawing not to scale

APPENDIX B

Example Suspension Waveform Record with Interpreted Arrival Times

Example Interpreted Waveform Record via GLOG-SUS Program CH-2



Data List

Depth	File Name	Vsr(m/s)	Vsl(m/s)	Vp(m/s)
67.1	C002_039.org	342	331	1190
68.0	C002_038.org	331	325	1138
69.0	C002_037.org	365	360	1190
70.0	C002_036.org	394	382	1250
71.0	C002_035.org	427	455	1250
72.0	C002_034.org	424	431	1220
73.0	C002_033.org	476	463	1316

Append

Delete

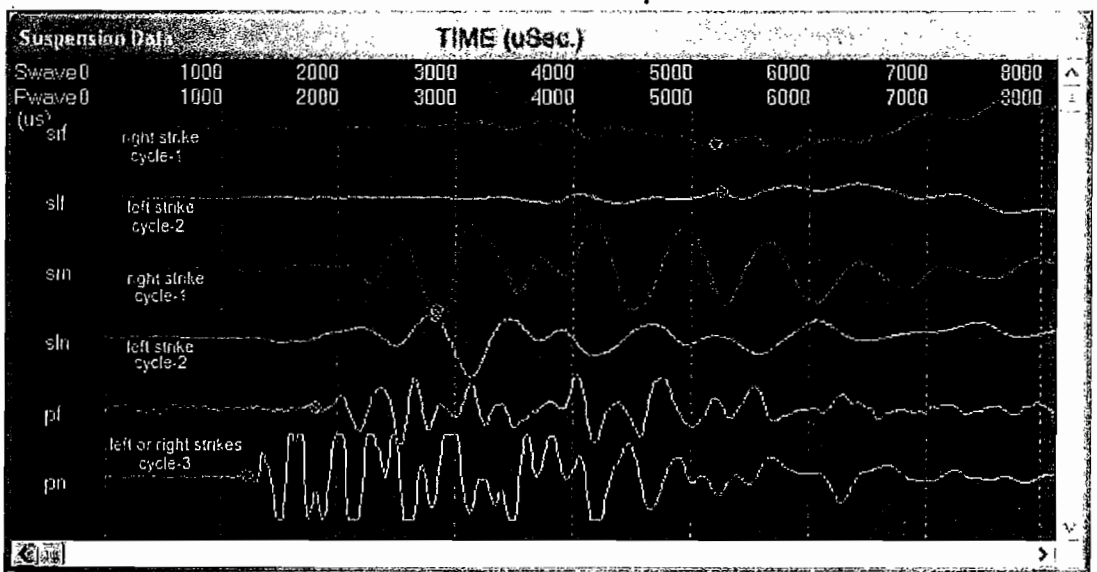
(us)

srf = 10000 slf = 10040

srn = 6980 sln = 6960

pf = 2580 pn = 4620

Example Waveform Record CH-1



Data List

Depth	File Name	Vsr(m/s)	Vsl(m/s)	Vp(m/s)
119.0	C001_017.org	505	485	1600
120.0	C001_016.org	461	461	1575
122.0	C001_014.org	487	501	1653
122.1	C001_015.org	505	472	1709
124.0	C001_011.org	417	427	1754
124.1	C001_012.org	424	412	1724
124.2	C001_013.org	417	409	1770

Append

Delete

(us)

srf = 5220 slf = 5270

srn = 2860 sln = 2840

pf = 1820 pn = 1240

APPENDIX C

Summary Log Plots, CH-1 and CH-2

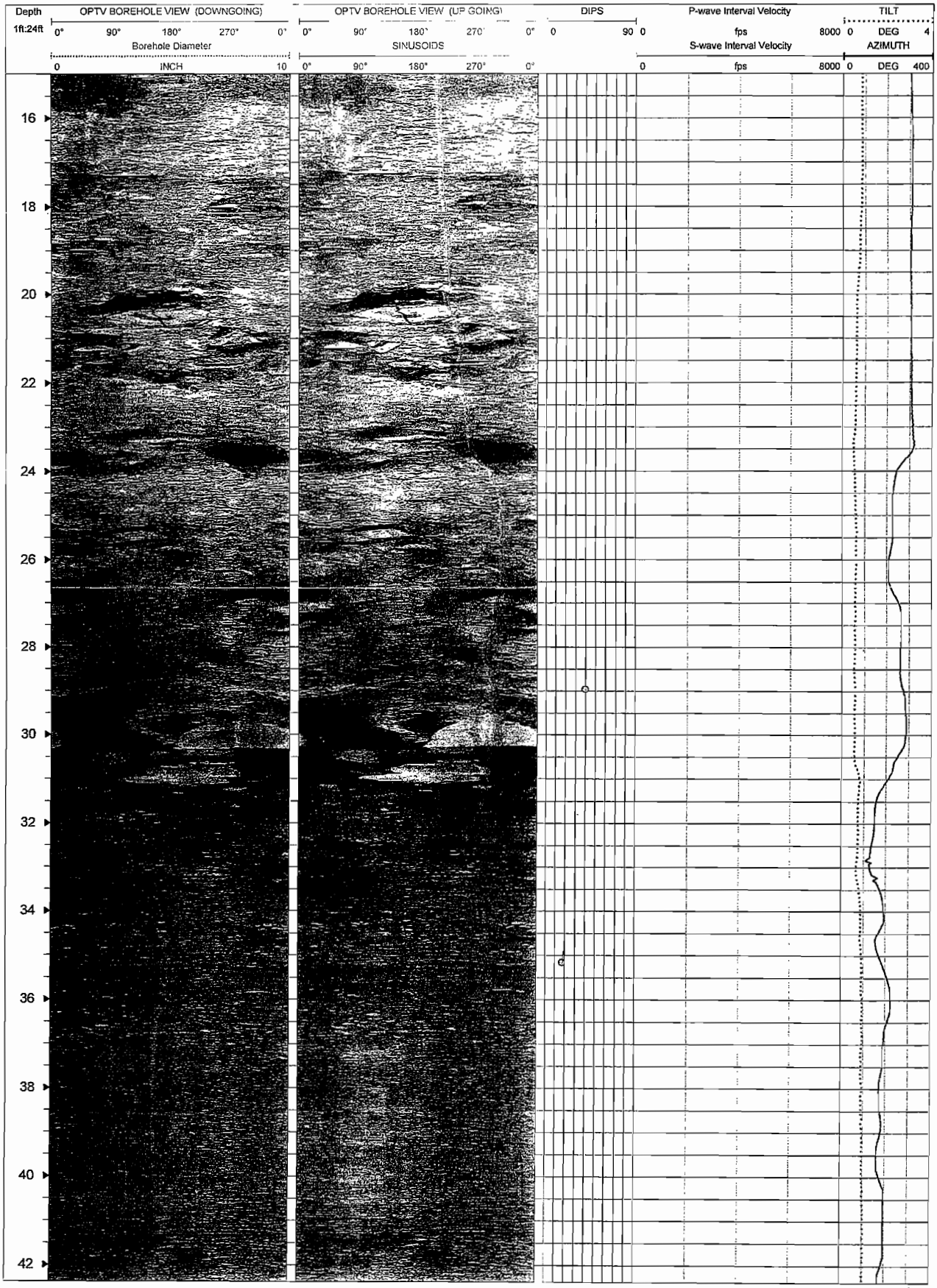
NORCAL

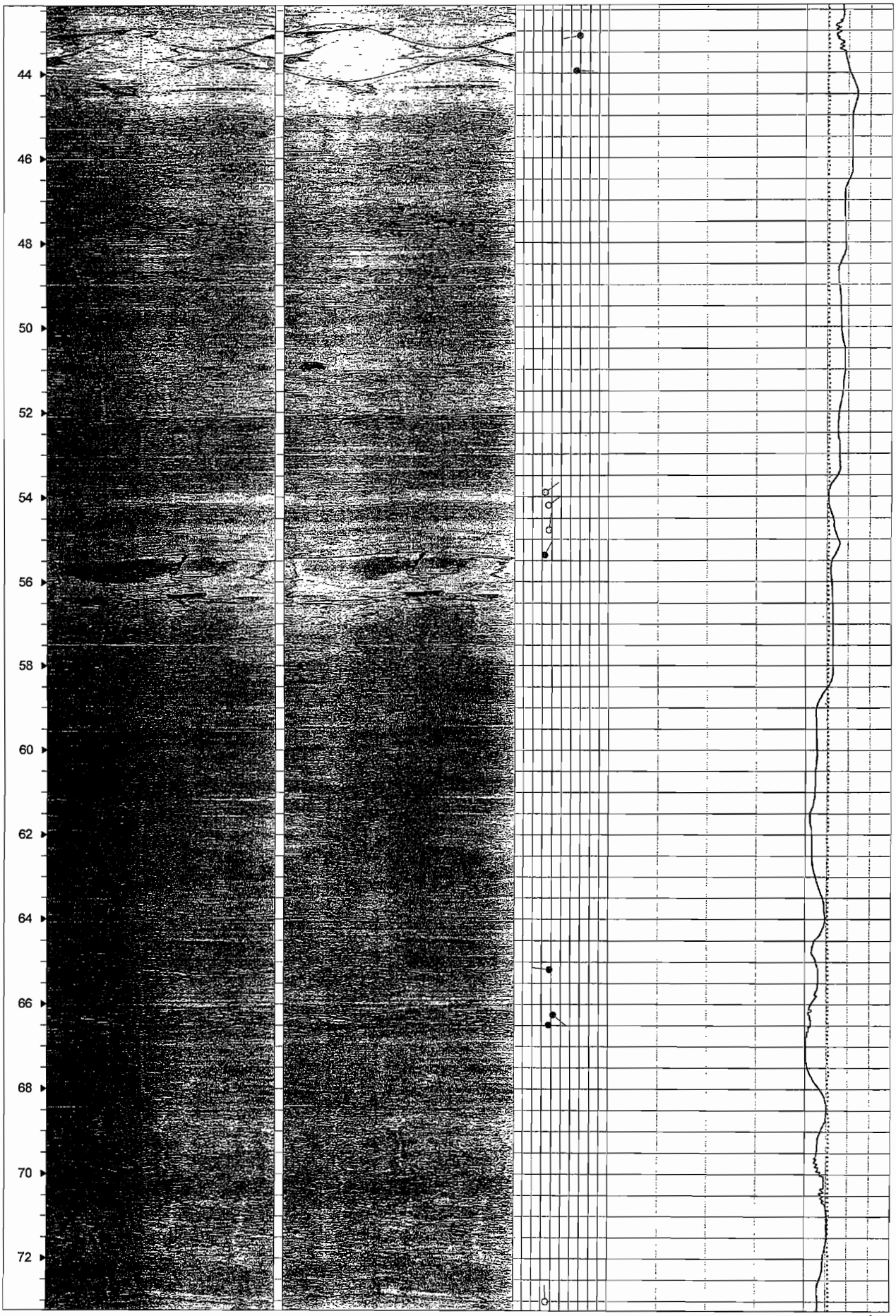
OPTV, CALIPER, SUSPENSION LOG SUMMARY PLOT

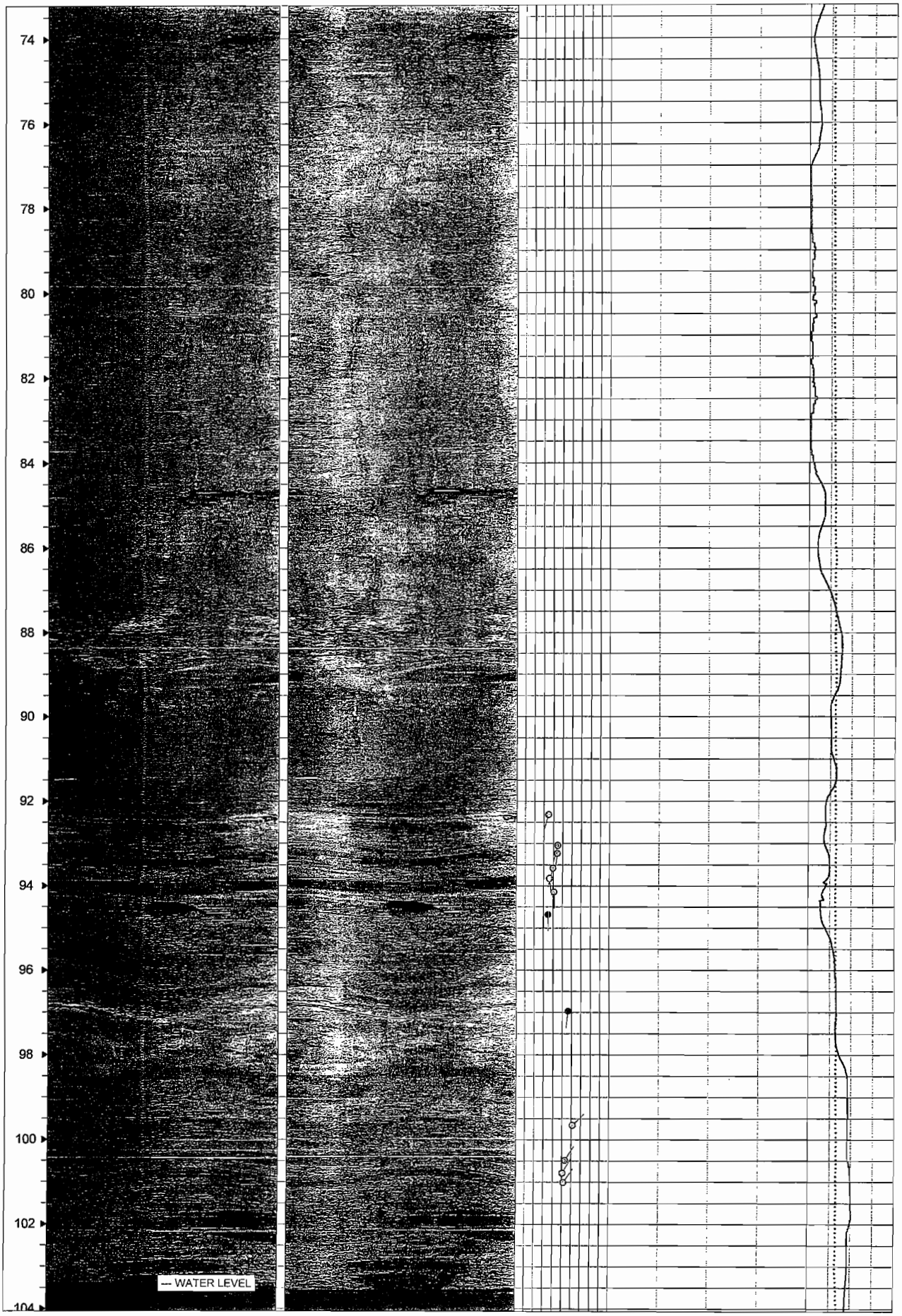
COMPANY: GMU Geotechnical
WELL ID: CH-1
FIELD: PALOS VERDE
COUNTY: LOS ANGELES

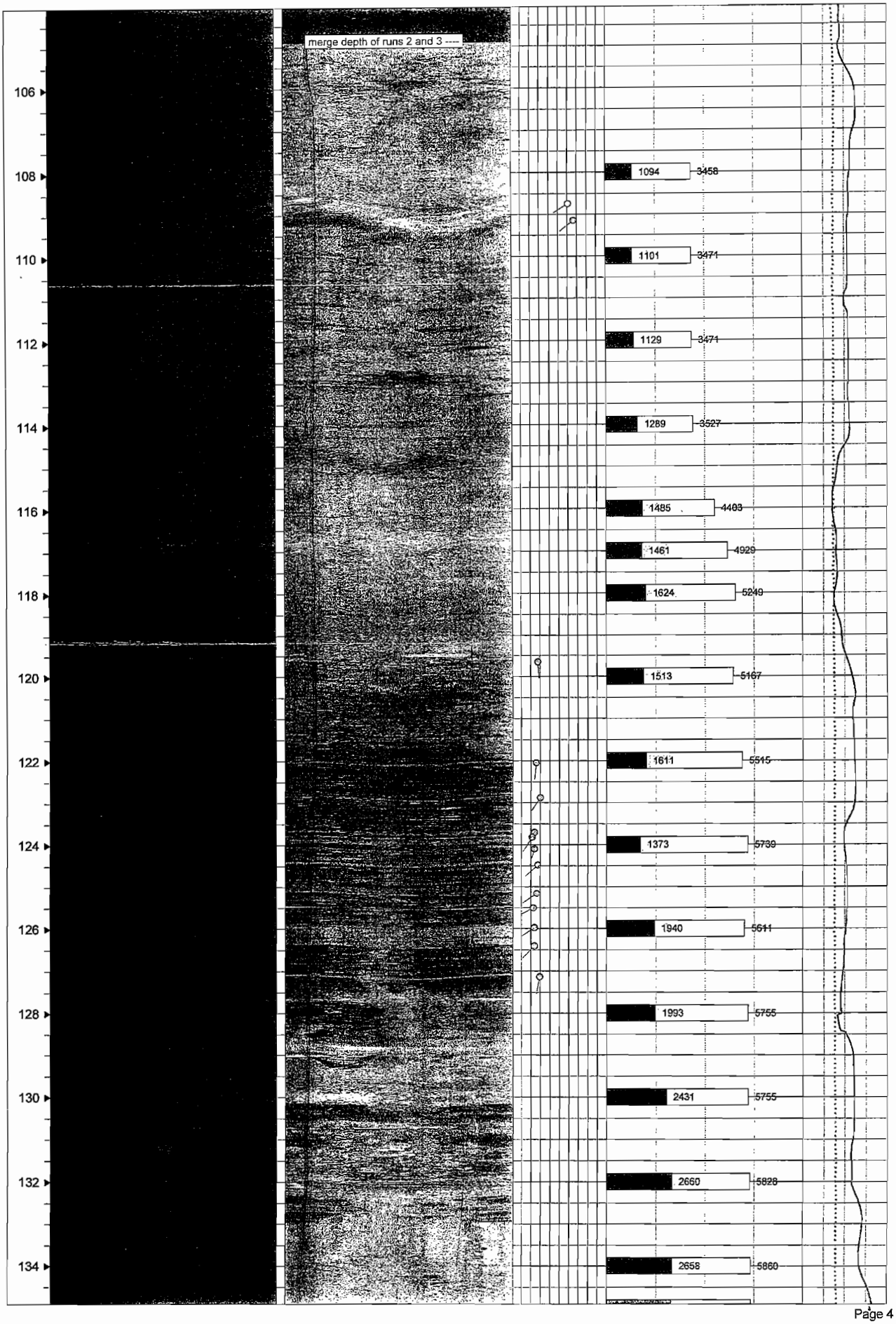
DATE: JUNE 28, 2010
Borehole Dia. 4 in
JOB NO 10-703.02B
STATE: CA

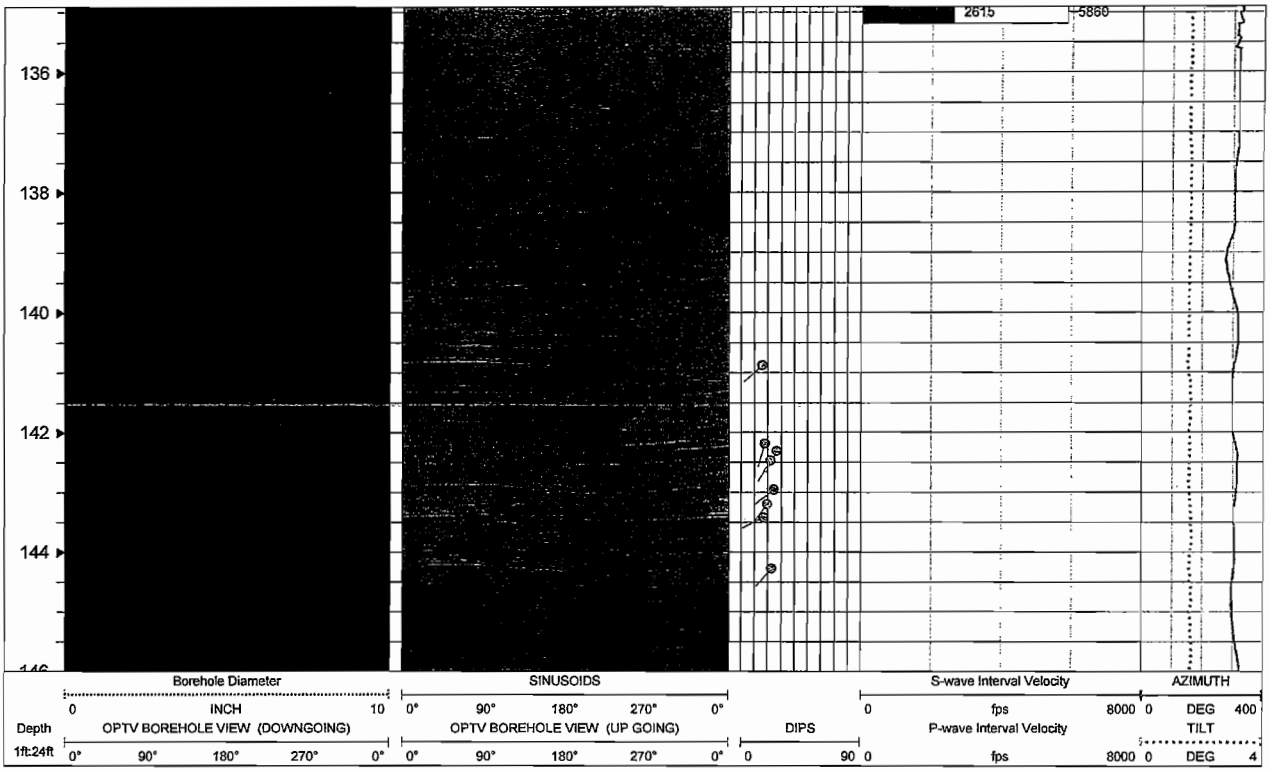
NOTES: Water added to borehole during Suspension logging. Unable to maintain water level above 103 feet. Therefore, velocity data acquisition restricted to lower borehole depths.




44
46
48
50
52
54
56
58
60
62
64
66
68
70
72


74
76
78
80
82
84
86
88
90
92
94
96
98
100
102
104
— WATER LEVEL


merge depth of runs 2 and 3 ----
106
108
110
112
114
116
118
120
122
124
126
128
130
132
134
1094
3458
1101
3471
1129
3471
1289
3527
1485
4403
1461
4929
1624
5249
1513
5167
1611
5515
1373
5739
1940
5611
1993
5755
2431
5755
2660
5828
2658
5860


2615
5860
136
138
140
142
144
Borehole Diameter
SINUSOIDS
S-wave Interval Velocity
AZIMUTH
0
INCH
10
0°
90°
180°
270°
0°
0
fps
8000
0
DEG
400
Depth
OPTV BOREHOLE VIEW (DOWNGOING)
OPTV BOREHOLE VIEW (UP GOING)
DIPS
P-wave Interval Velocity
TILT
1ft:24ft
0°
90°
180°
270°
0°
0
90
0
fps
8000
0
DEG
4

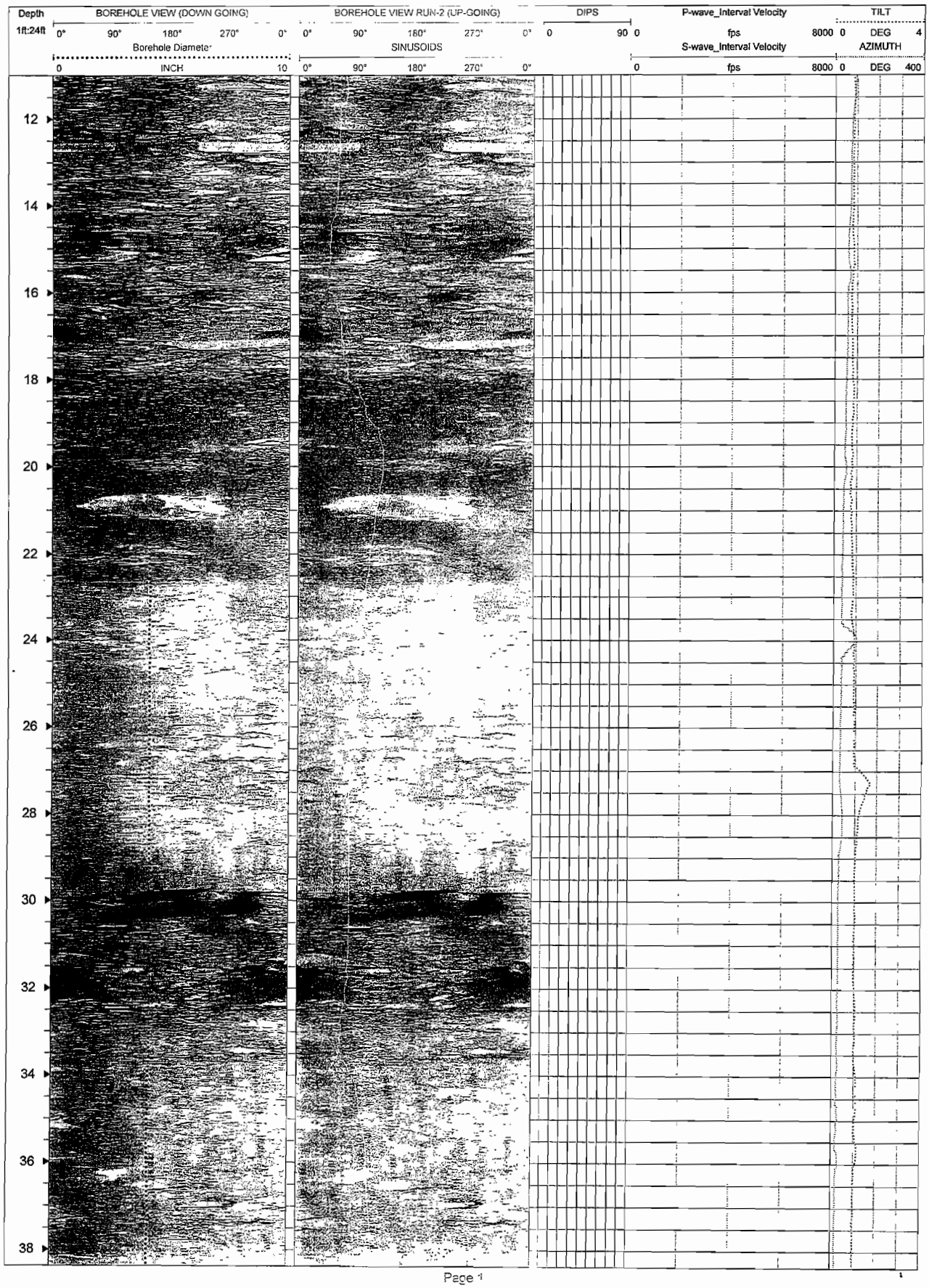
NORCAL

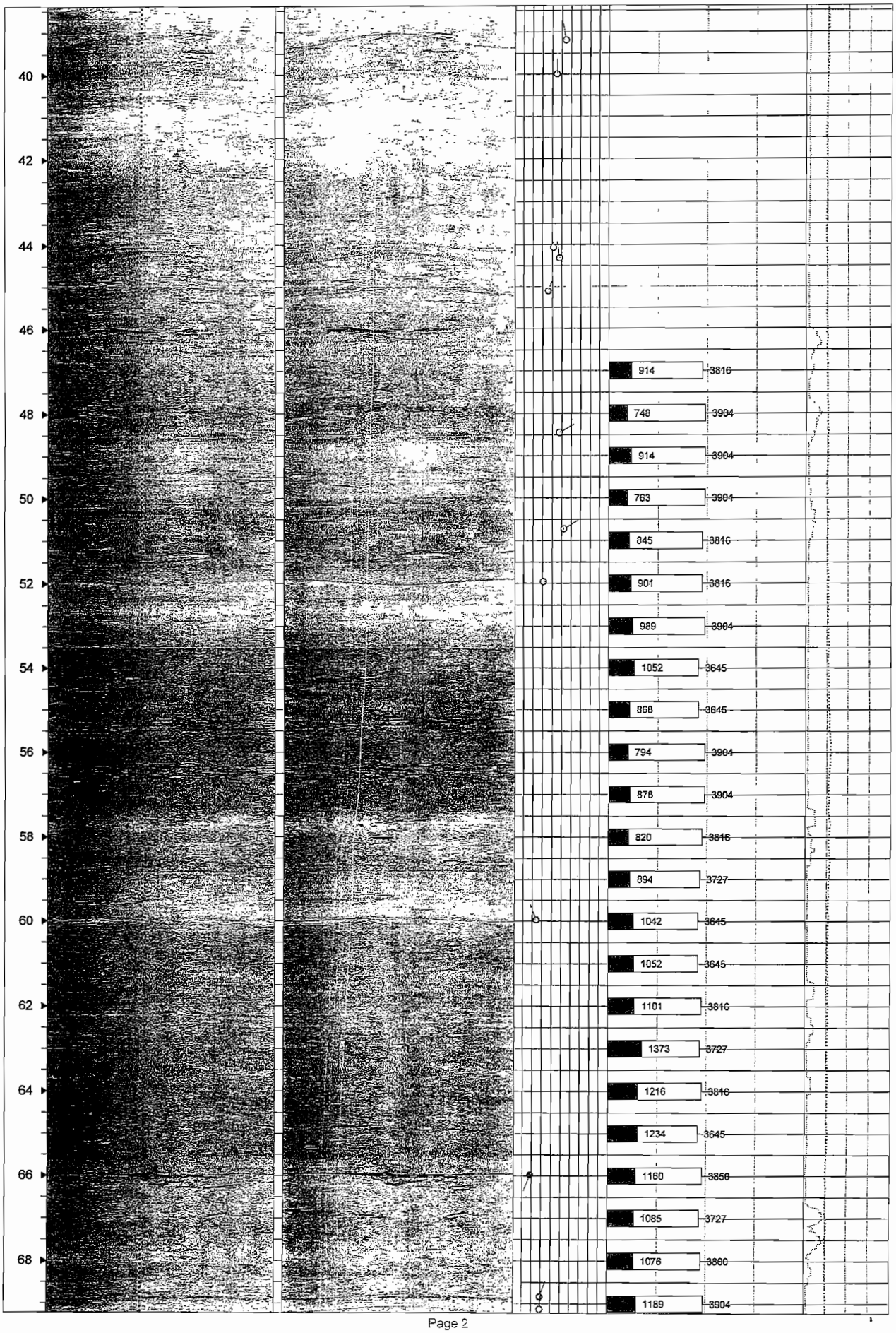
OPTV, CALIPER, SUSPENSION LOG SUMMARY PLOT

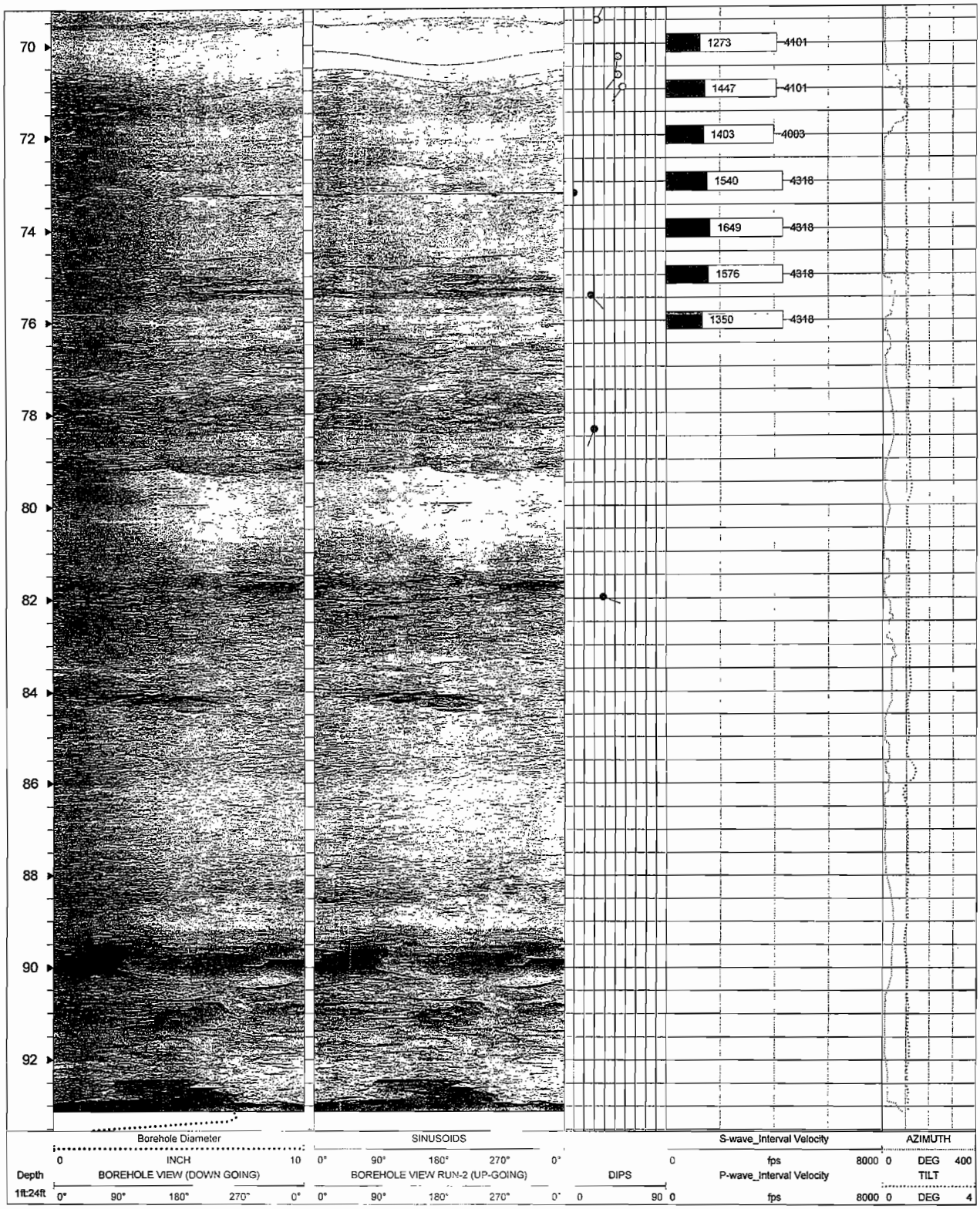
COMPANY: GMU Geotechnical
WELL ID: CH-2
FIELD: PALOS VERDE
COUNTY: LOS ANGELES

DATE: JUNE 28 2010
Borehole Dia. 4 in
JOB NO 10-703 02B
STATE CA

NOTES: Borehole dry to total depth. Added water to borehole during Suspension logging survey




40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
914 3816
748 3904
914 3904
763 3904
845 3816
901 3816
989 3904
1052 3645
868 3645
794 3904
878 3904
820 3816
894 3727
1042 3645
1052 3645
1101 3816
1373 3727
1216 3816
1234 3645
1160 3858
1085 3727
1076 3880
1189 3904


70
72
74
76
78
80
82
84
86
88
90
92
1273
4401
1447
4401
1403
4003
1540
4318
1649
4318
1576
4318
1350
4318
Borehole Diameter
INCH
0
10
BOREHOLE VIEW (DOWN GOING)
0°
90°
180°
270°
0°
SINUSOIDS
BOREHOLE VIEW RUN-2 (UP-GOING)
DIPS
0
90
S-wave_Interval Velocity
P-wave_Interval Velocity
fps
8000
AZIMUTH
TILT
DEG
400
4
Depth
1ft:24ft

APPENDIX D

Discontinuity Tables, CH-1 and CH-2

Boring CH-1 DISCONTINUITY TABLE
PALOS VERDE DRIVE
RANCHO PALOS VERDE, CA

Depth	Azimuth	Dip	Class	Comment
ft. (bgs)	deg	deg	code-color	class
28.95	0.98	39.88	106-green	bedding
35.16	7.77	17.52	106-green	bedding
43.11	259.76	59.59	100-black	fracture
43.93	90.99	56.29	100-black	fracture
53.9	53.21	23.69	106-green	bedding
54.2	53.5	27.13	106-green	bedding
54.78	6.39	27.52	106-green	bedding
55.37	27.73	22.68	107-blue	contact
65.18	277.32	28.41	100-black	fracture
66.25	129.22	32.51	100-black	fracture
66.49	92.97	27.95	100-black	fracture
73.01	357.79	25.36	106-green	bedding
92.31	196.12	25.15	106-green	bedding
93.04	193.68	34.97	106-green	bedding
93.24	186.26	34.49	106-green	bedding
93.58	193.2	29.97	106-green	bedding
93.83	173.41	26.52	106-green	bedding
94.14	179.9	31.3	106-green	bedding
94.68	178.97	24.96	107-blue	contact
96.97	186.73	46.42	100-black	fracture
99.66	45.47	51.54	106-green	bedding
100.49	31.83	43.73	106-green	bedding
100.78	29.59	41.01	106-green	bedding
101.01	34.7	41.97	106-green	bedding
108.75	238.01	51.33	106-green	bedding
109.15	231.68	56.81	106-green	bedding
119.65	176.06	17.81	106-green	bedding
122.05	184.64	15.92	106-green	bedding
122.88	214.63	20.22	106-green	bedding
123.7	207.81	13.87	106-green	bedding
123.82	212.18	11.44	106-green	bedding
124.09	195.59	13.94	106-green	bedding
124.48	227.53	17.52	106-green	bedding
125.17	235.91	16.59	106-green	bedding
125.5	242.22	12.98	106-green	bedding
125.97	236.18	13.99	106-green	bedding
126.41	224.03	14.03	106-green	bedding
127.14	190.57	19.71	106-green	bedding
140.88	228.5	16.25	106-green	bedding
142.19	195.53	17.86	106-green	bedding
142.31	207.04	26.8	106-green	bedding
142.47	210.37	22.23	106-green	bedding
142.95	231.66	24.55	106-green	bedding
143.2	215.7	19.57	106-green	bedding
143.42	243.62	16.71	106-green	bedding
144.28	221	22.87	106-green	bedding

Boring CH-2 DISCONTINUITY TABLE
PALOS VERDE DRIVE
RANCHO PALOS VERDE, CA

Depth	Azimuth	Dip	Class	Comment
ft	deg	deg	code-color	class
39.19	350.49	44.46	106-green	bedding
39.99	1.85	35.24	106-green	bedding
44.06	354.44	31.73	106-green	bedding
44.31	352.47	38.01	106-green	bedding
45.11	19.26	25.89	106-green	bedding
48.45	59.42	37.58	106-green	bedding
50.73	59.07	42.67	106-green	bedding
51.96	182.76	21.15	106-green	bedding
59.97	339.86	14.33	106-green	bedding
65.98	202.32	8.72	100-black	fracture
68.83	19.43	19.19	106-green	bedding
69.13	6.09	19.15	106-green	bedding
69.49	27.41	22.77	106-green	bedding
70.28	188.29	43.75	106-green	bedding
70.67	218.37	43.93	106-green	bedding
70.94	214.39	48.48	106-green	bedding
73.23	194.7	1.08	100-black	fracture
75.44	138.07	17.61	107-contact	contact
78.34	200.41	19.97	107-contact	contact
81.97	109.96	28.99	107-contact	contact

APPENDIX E

P-and S-wave Suspension Velocity Table, CH-1 and CH-2

SUSPENSION LOGGING VELOCITY TABLES

BOREHOLE CH-1

INTERVAL VELOCITIES

Depth	S-wave Velocity	P-wave Velocity
feet	fps	fps
108	1094	3458
110	1101	3471
112	1129	3471
114	1289	3527
116	1485	4403
117	1461	4929
118	1624	5249
120	1513	5167
122	1611	5515
124	1373	5739
126	1941	5755
126	1940	5611
128	1993	5755
130	2431	5755
132	2660	5828
134	2658	5860
135	2615	5860

BOREHOLE CH-2

INTERVAL VELOCITIES

Depth	S-wave Velocity	P-wave Velocity
feet	fps	fps
47	914	3816
48	748	3904
49	914	3904
50	763	3904
51	845	3816
52	901	3816
53	989	3904
54	1052	3645
55	868	3645
56	794	3904
57	878	3904
58	820	3816
59	894	3727
60	1042	3645
61	1052	3645
62	1101	3816
63	1373	3727
64	1216	3816
65	1234	3645
66	1160	3850
67	1085	3727
68	1076	3800
69	1189	3904
70	1273	4101
71	1447	4101
72	1403	4003
73	1540	4318
74	1649	4318
75	1576	4318
76	1350	4318