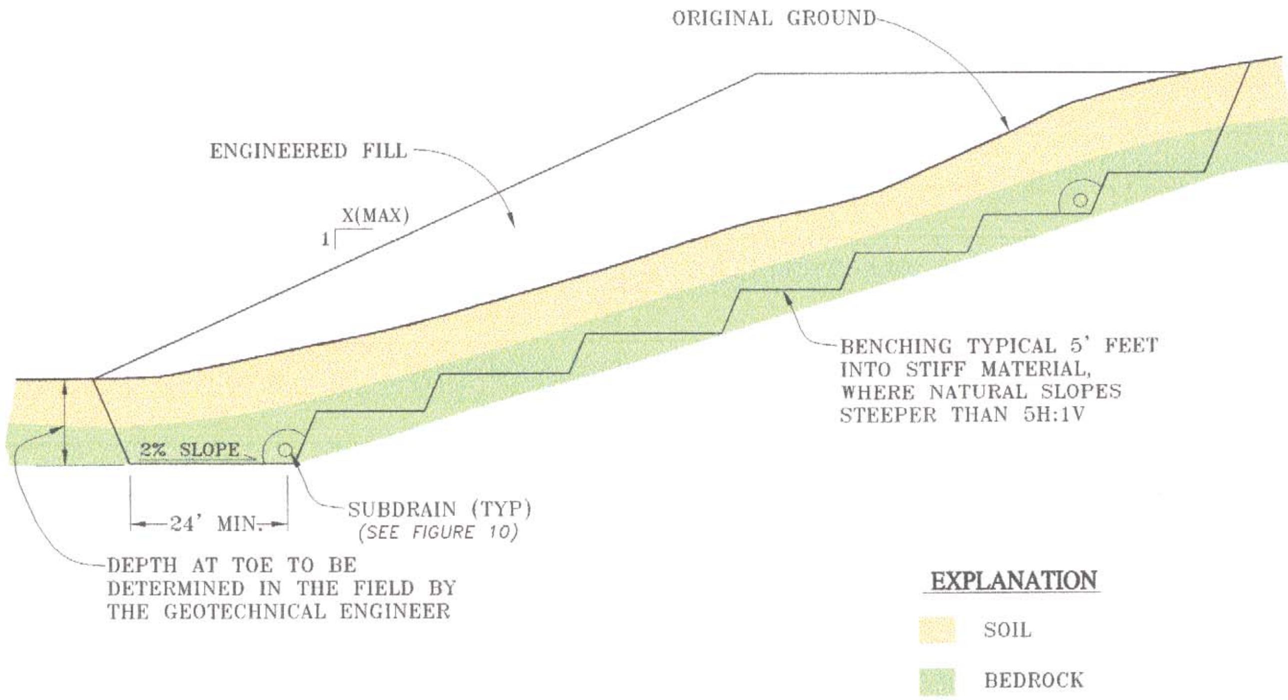

FOR SLOPE HEIGHT AND MAXIMUM SLOPE GRADIENT, REFER TO GRADED SLOPES SECTION OF THE TEXT

NO SCALE

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	TYPICAL KEYWAY AND BENCH DETAIL LAGOON VALLEY RESIDENTIAL/RECREATIONAL DEVELOPMENT VACAVILLE, CALIFORNIA	PROJECT NO.: 5489.2.002.01 DATE: JULY 2003 DRAWN BY: SRP CHECKED BY:	FIGURE NO. 6

ORIGINAL FIGURE PRINTED IN COLOR

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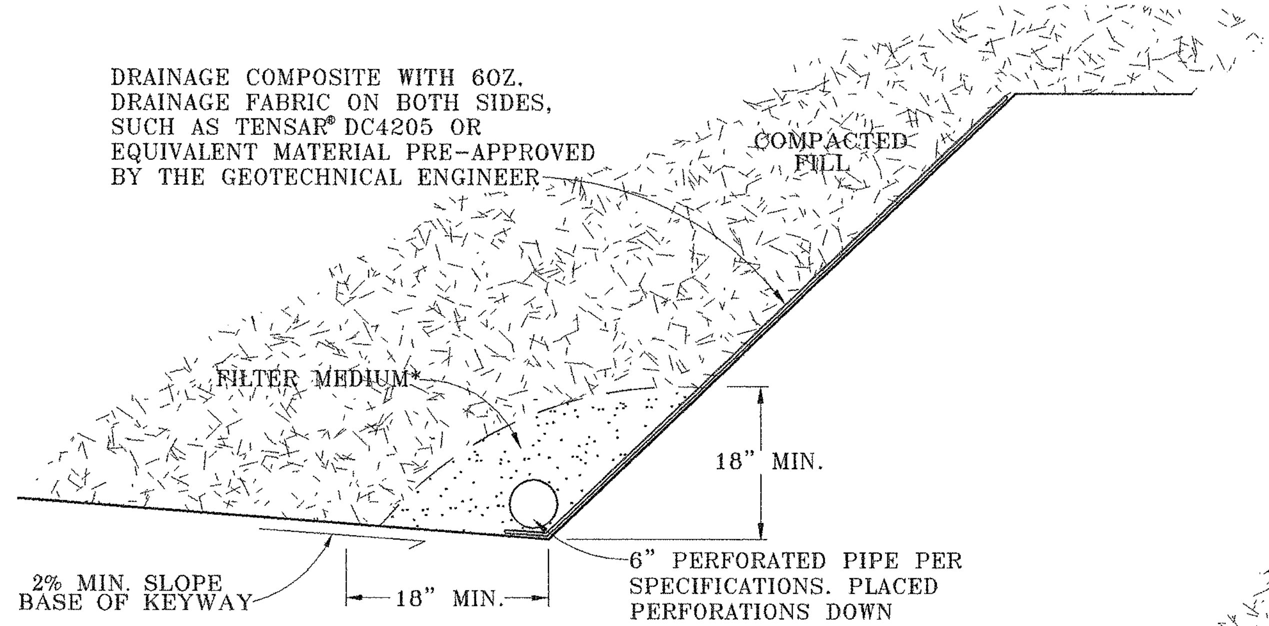
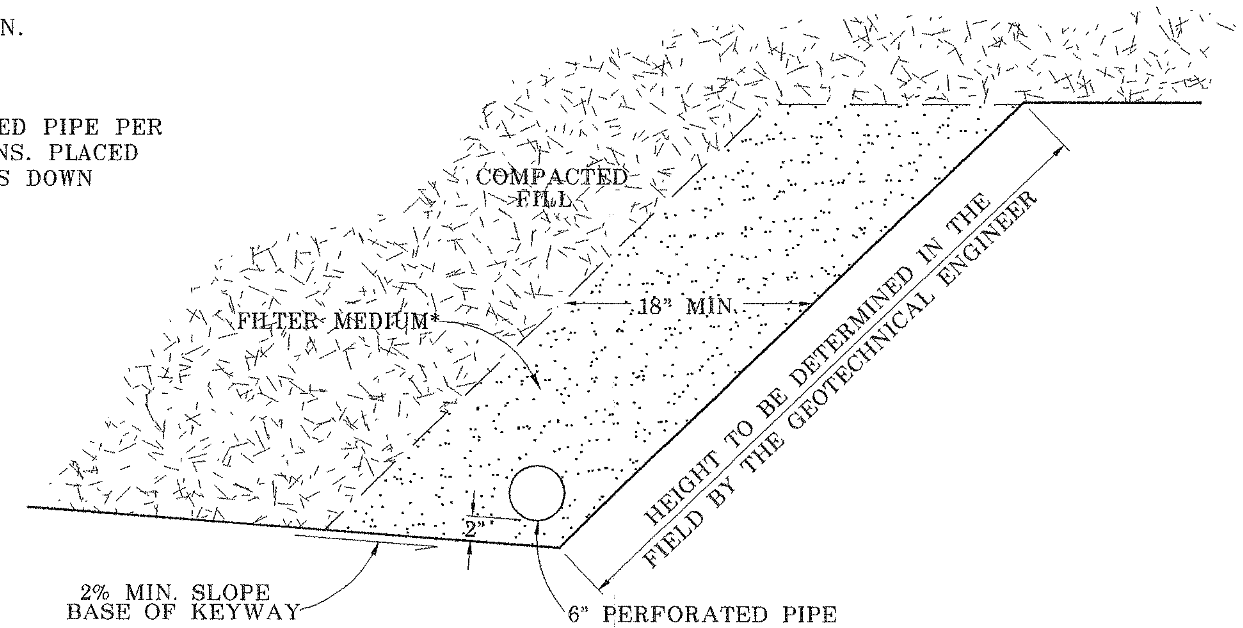
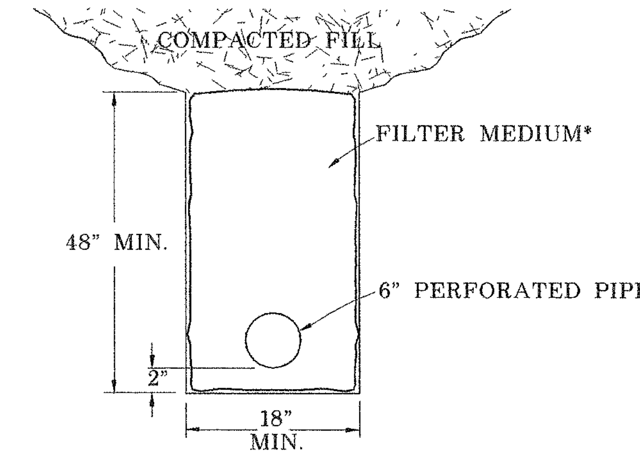


KEYWAY SUBDRAIN - OPTION 1



KEYWAY SUBDRAIN - OPTION 2



SWALE SUBDRAIN

*FILTER MEDIUM

ALTERNATIVE A

CLASS 2 PERMEABLE MATERIAL

MATERIAL SHALL CONSIST OF CLEAN, COARSE SAND AND GRAVEL OR CRUSHED STONE, CONFORMING TO THE FOLLOWING GRADING REQUIREMENTS:

SIEVE SIZE	% PASSING SIEVE
1"	100
3/4"	90–100
3/8"	40–100
#4	25–40
#8	18–33
#30	5–15
#50	0–7
#200	0–3

ALTERNATIVE B

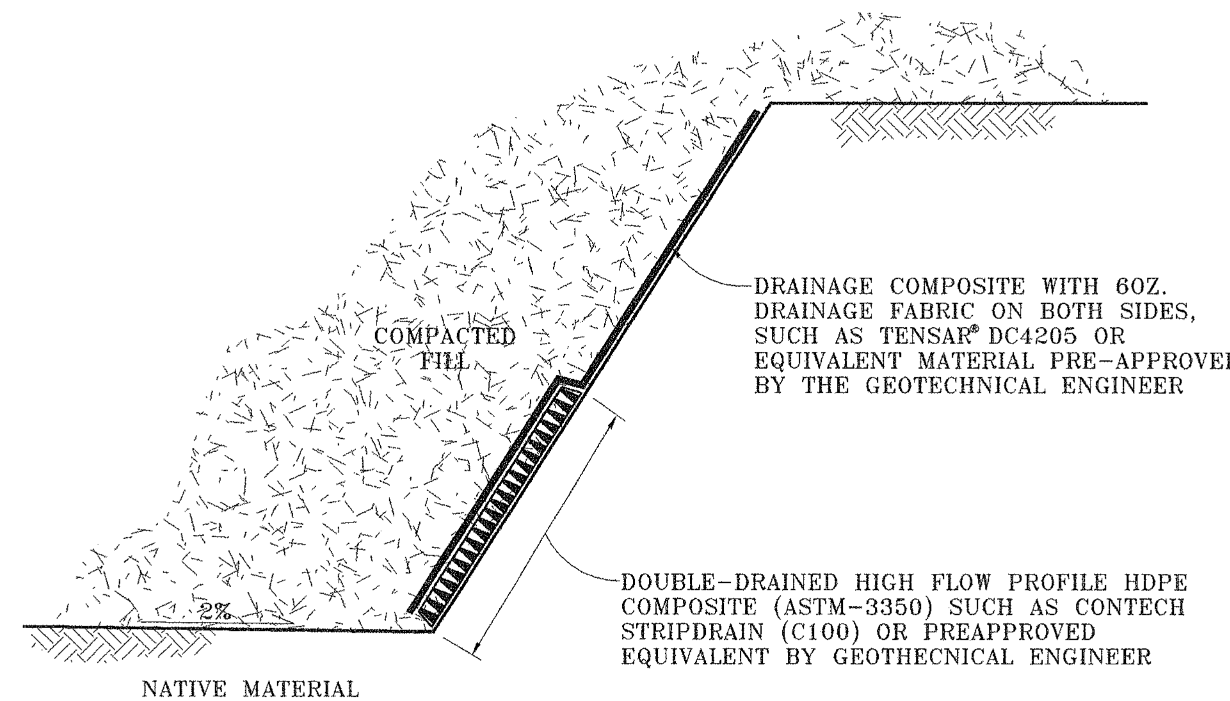
CLEAN CRUSHED ROCK OR GRAVEL WRAPPED IN FILTER FABRIC

ALL FILTER FABRIC SHALL MEET THE FOLLOWING MINIMUM AVERAGE ROLL VALUES UNLESS OTHERWISE SPECIFIED BY ENGEO:

GRAB STRENGTH (ASTM D-4632)	180 lbs
MASS PER UNIT AREA (ASTM D-4751)	6 oz/yd^2
APPARENT OPENING SIZE (ASTM D-4751)	70-100 U.S. STD. SIEVE
FLOW RATE (ASTM D-4491)	80 gal/min/ft
PUNCTURE STRENGTH (ASTM D-4833)	80 lbs

NOTES:

1. *ALL PIPE JOINTS SHALL BE GLUED*
2. *ALL PERFORATED PIPE PLACED PERFORATIONS DOWN*
3. *1% FALL (MINIMUM) ON ALL TRENCHES AND DRAIN LINES*



ALTERNATE KEYWAY SUBDRAIN - OPTION 3
(FOR DEPTHS LESS THAN 30 FEET)

NO SCALE

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	TYPICAL SUBDRAIN LAGOON VALLEY RESIDENTIAL/RECREATIONAL DEVELOPMENT VACAVILLE, CALIFORNIA	PROJECT NO.: 5489.2.002.01 DATE: JULY 2003 DRAWN BY: SRP / CHECKED BY:	FIGURE NO. 7

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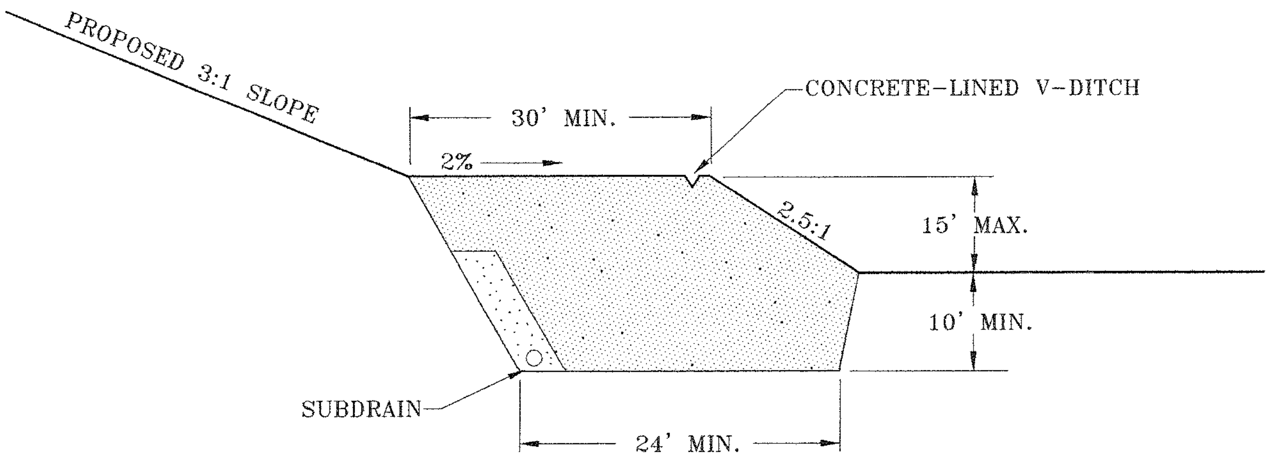

ACTUAL SIZE AND DEPTH OF KEYWAY TO BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL ENGINEER

NO SCALE

ENGEO INCORPORATED *EXCELLENT SERVICE SINCE 1971*	DEBRIS BENCH DETAIL LAGOON VALLEY RESIDENTIAL/RECREATIONAL DEVELOPMENT VACAVILLE, CALIFORNIA	PROJECT NO.: 5489.2.002.01 DATE: JULY 2003 DRAWN BY: SRP	CHECKED BY:	FIGURE NO. 8

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APPENDIX A

ENGEO, Incorporated – Boring Logs (2003)

Anderson Consulting Group – Boring Logs (1990)

Anderson Consulting Group – Trenching Figures (1991)

DATE OF BORING: May 28, 2003

SURFACE ELEVATION: Approx. 258 feet (79 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				Gravel covered.				
		1-1-1		SILTY CLAY (CH), dark brown, very stiff, moist. (FILL)	28	2.5*	109	19.6
5	1	1-2-1		SILTY CLAY (CH), brown, damp, very stiff, trace sand..	45			
10	2, 3	1-3-1		SILTY CLAY (CL), brown, mottled olive, damp, hard, manganese-oxide staining, trace sand, weak bedrock.	77			
15	4, 5	1-4-1		CLAYEY SAND (SC), dark yellowish brown, mottled olive, medium dense, moist, claystone fragments. ▽	35	2.25*		
20	6	1-5-2 1-5-1		SILTY CLAY with sand (CL), dark yellowish brown, mottled olive, moist, hard.	57	4.0*		
25	7, 8	1-6-1			59			
30	9, 10			Bottom of boring at approximately 26 $^{1}/_{2}$ feet. Groundwater encountered at 16 feet during drilling.				
35								

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-1

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY SJ

FIGURE NO. A-1

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Gravel covered.				
			SILTY CLAY (CH), very dark brown, very stiff, moist.				
		2-1-1		19	2.25*		
	1						
5			SILTY CLAY with fine sand (CL), dark brown, very stiff, moist.				
	2	2-2-1		33	3.5*		
			SILTY CLAY (CL), red brown, mottled orange, very stiff, moist, with trace sand.				
10	3						
		2-3-1		52	3.75*		
	4						
15		2-4-1	SILTY CLAY (CL), orange brown, mottled olive, hard, manganese-oxide staining, trace claystone fragment.	50/6"			
	5						
20	6						
		2-5-1		76			
	7						
25			Moist.				
	8	2-6-2 2-6-1		82			
	9		▽				
30			Very stiff, wet.				
		2-7-1		37	2.0*		
			Bottom of boring at approximately 31 1/2 feet. Groundwater encountered at 29 feet during drilling.				
	10						
35							

DATE OF BORING: May 28, 2003

SURFACE ELEVATION: Approx. 280 feet (85 meters)

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-2

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY SL

FIGURE NO. A-2

ENGEO BORELOG 548920020I LAGOONVALLEY.GPJ 7/3/03

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: May 28, 2003 SURFACE ELEVATION: Approx. 245 feet (75 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				Gravel covered. SILTY CLAY (CH), very dark brown, very stiff, moist. (FILL)				
		3-1-1			21	4.25*		
	1			SILTY CLAY (CH), olive green, very stiff, moist. (FILL)				
5								
	2	3-2-2 3-2-1		CLAYEY SILTSTONE, orange brown, mottled grey, moderately weathered, closely fractured, weak. (FILL)	38	2.5*		
				SANDY SILTY CLAY (CL), yellowish brown, mottled orange, brown, stiff, wet, manganese-oxide staining.				
10	3	3-3-1			20	1.3	111	19.4
	4							
15	5	3-4-1		Very stiff.	54	3.5*		
20	6	3-5-2 3-5-1		Very stiff.	49	3.5*		
	7			SANDY SILTY CLAY (CL), orange brown, mottled olive brown, very stiff, moist, manganese-oxide staining.				
25	8	3-6-1			59			
30	9			CLAYEY SAND (SC), orange brown, mottled olive brown, medium dense.				
		3-7-2 3-7-1		SANDY CLAY (CL), orange brown, mottled olive brown, stiff. CLAYEY SAND (SC), orange brown, mottled olive brown.	26	2.0*		
	10	3-8-1			31			
35				SANDY SILTY CLAY (CL), orange brown, mottled olive brown, wet, hard, manganese-oxide staining.				

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-3

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY

FIGURE NO. A-3

ENGEO_BORELOG 548920201 LAGOONVALLEY.GPJ 7/3/03

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: May 28, 2003 / SURFACE ELEVATION: Approx. 245 feet (75 meters) / DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
35	11	3-9-1		SANDY SILTY CLAY (CL), orange brown, mottled olive brown, wet, very stiff, manganese-oxide staining.	40	2.0*		
40	12	3-10-1		Hard.	45	4.5*		
	13			Bottom of boring at approximately 41 $^1/_2$ feet. Groundwater encountered at 4 feet during drilling.				
45	14							
50	15							
	16							
55	17							
	18							
60	19							
65	20							
	21							
70								

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-3

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY SJ

FIGURE NO. A-3

DATE OF BORING: May 29, 2003

SURFACE ELEVATION: Approx. 266 feet (81 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Grass covered. SILTY CLAY with sand (CH), olive brown, mottled orange, very stiff, damp.				
		4-1-1		28	3.25*		
	1						
5			SANDY CLAY with silt (CL), olive brown, mottled orange, damp, hard, manganese-oxide staining.				
		4-2-1		50/6			
	2		SILTY CLAY with sand (CL), orange brown, damp, hard, manganese-oxide staining, trace coarse sand.				
10	3						
		4-3-1		92/11"			
			Same as above.				
	4						
15			Moist.				
	5	4-4-1		56	4.25*		
20	6		SILTY CLAY (CL), olive brown, moist, hard, trace gravel, claystone clasts, manganese-oxide staining.				
		4-5-1		58			
	7		CLAYSTONE/SILTSTONE, interbed olive brown and orange brown, slightly weathered, closely fractured, weak.				
25							
	8	4-6-1		90/9"			
			Bottom of boring at approximately 26 ½ feet. Groundwater not encountered during drilling.				
	9						
30							
	10						
35							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-4

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY SL

FIGURE NO. A-4

ENGEO_BORELOG 548920020l_LAGOONVALLEY.GPJ 7/3/03

DATE OF BORING: May 29, 2003

SURFACE ELEVATION: Approx. 280 feet (85 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Gravel covered.				
			SILTY CLAY (CH), dark brown, stiff, damp, trace sand.				
			No recovery. (NR)	30	5.0	115	16.9
	1						
5		5-1-2			3.75*		
	2	5-1-1	SILTY CLAY with sand (CH), olive brown, mottled orange, moist, hard.	51	4.0*		
			Fine SANDY CLAY (CH), brown, stiff, moist, trace coarse sand, manganese-oxide staining.				
10	3	5-2-1		17	1.25*		
	4		Easier drilling.				
15	5	5-3-1	▼ SILTY CLAY (CH), olive brown, mottled orange, very stiff, moist, manganese-oxide staining, trace coarse sand.	36	2.25*		
			▽ SILTY CLAY with sand (CH), orange brown, stiff, moist.				
20	6		CLAYEY SAND (SC), orange brown, moist, medium dense.				
		5-4-1	SANDY CLAY (CH), orange brown, moist, very stiff, trace gravel.	35	3.5*	115	16.9
	7						
25			SILTY CLAY (CH), orange brown, stiff, moist, trace claystone clasts, manganese-oxide staining.				
	8	5-5-1		32	2.0*		
	9		SILTY CLAY with sand (CH), orange brown, wet, stiff, trace gravels, and claystone fragments, manganese-oxide staining.				
30		5-6-1		21	1.0*		
	10						
35							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-5

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY SL

FIGURE NO. A-5

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: May 29, 2003 SURFACE ELEVATION: Approx. 280 feet (85 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
35	11	5-7-1		CLAYEY SAND with gravel (SC), brown, wet, medium dense.	31			
40	12	5-8-1		CLAYSTONE, olive brown, moderately weathered, very closely fractured, weak.	89/10"			
	13			Bottom of boring at approximately 41 1/2 feet. Groundwater encountered at 19 feet during drilling. Groundwater level at 16 feet after drilling.				
45	14							
50	15							
	16							
55	17							
	18							
60	19							
65	20							
70	21							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-5

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY

FIGURE NO. A-5

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: May 29, 2003 SURFACE ELEVATION: Approx. 318 feet (97 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				Grass covered. SILTY CLAY with sand (CL), dark brown, damp, hard.				
	1	6-1-1			51			
5				CLAYEY SAND with gravel (SC), reddish brown, moist, medium dense.				
	2	6-2-1			20		110	15.4
10	3			SILTY CLAY with sand (CH), brown mottled orange, moist, stiff, manganese-oxide staining, trace coarse sand and organics. ▽				
		6-3-1			25	2.0*		
	4							
15				SILTY CLAY with sand (CH), olive brown, mottled orange, wet, hard, trace coarse sand, manganese oxide staining.				
	5	6-4-1			51	4.0*		
20	6			SILTY CLAY (CH), olive brown, mottled orange, stiff, wet.				
		6-5-1			20	2.0*		
	7			SANDY CLAY (CL), olive mottled orange brown, stiff, wet, manganese-oxide staining, trace gravels.				
25	8	6-6-1			22	1.5*		
30	9	6-7-1			39		111	19.1
	10			Bottom of boring at approximately 31 $^1/_2$ feet. Groundwater encountered at 11 feet during drilling.				
35								

ENGEO INCORPORATED
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LAGOON VALLEY

VACAVILLE, CALIFORNIA

BORING NO.: B-6

LOGGED BY: M. Harrell

PROJ. NO.: 5489.2.002.01

CHECKED BY: SL

FIGURE NO. A-6

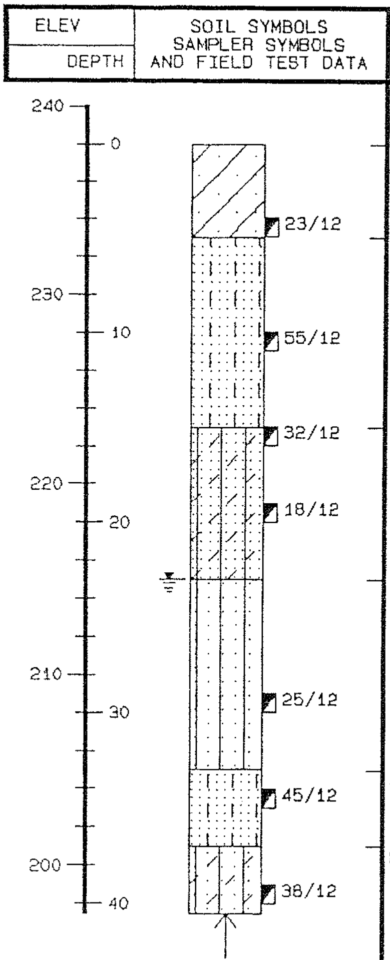
ENGEO_BORELOG 5489200201_LAGOONVALLEY.GPJ 7/3/03

LOG OF BORING

Project: Lagoon Valley — Boring: 1

File: 2568-1 — Elevation: 238' +/-

Date: 13 March 1990 — Water encountered: 23 feet



USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
CL	Light brown, slightly moist, stiff to very stiff, fine sandy CLAY				
SM	Light brown, dense, cemented, silty SAND		1-1	109.9	11.7
		Sand has iron nodules and some iron-stained fractures	1-2	117.5	11.3
ML-SM	Light brown, moist, mod. dense to dense, fine sandy SILT to silty fine SAND with clay	Drills easier	1-3	107.2	11.6
		Black mottling and less than 1' medium sand lenses present in Sample 1-4	1-4	104.0	21.9
ML-SP	Interbedded, mod. dense, fine sandy SILT w/ saturated, clean medium SAND lenses	Water at 23' during & after drilling; sand grades finer as silt increases w/ depth Some zones are cemented			
			1-6	121.6	17.7
SP	Brown, wet, dense, coarse SAND with some silt		1-7	106.9	20.9
ML	Light brown, moist, dense, sandy SILT with trace clay		1-8	109.3	20.9
		Boring terminated at 40.5 feet			

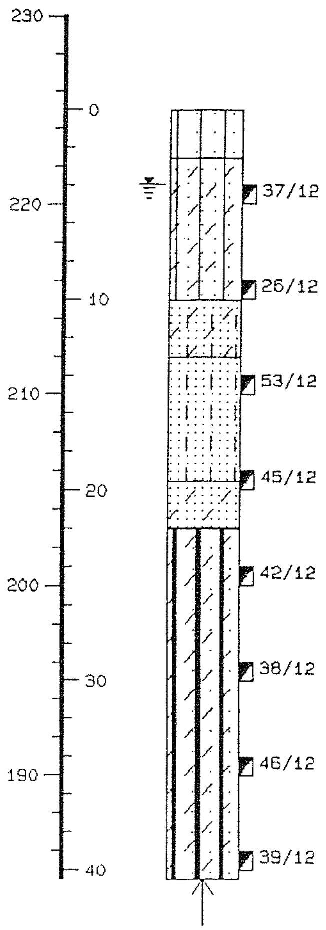
Figure Number 2

LOG OF BORING

Project: Lagoon Valley Boring: 2

File: 2568-1 Elevation: 225' +/-

Date: 28 March 1990 Water encountered: 4 feet



USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
ML	Dark brown, slightly moist, sandy SILT				
SM-ML	Mottled light brown and gray, moist, fine sandy SILT to silty fine SAND with clay	Some wet zones in sand Water at 4 feet after drilling Saturated between 5 and 10 feet; clean sand zone at 9 feet	2-1	110.9	18.7
			2-2		
SC	Mottled gray and lt. brown, sl. moist, dense, clayey fine SAND with silt				
SM	Mottled red-brown and brown, saturated, very dense silty SAND		2-3	115.9	18.0
			2-4		
SC	Mottled gray and red-brown, slightly moist, dense, clayey fine SAND				
MH	Grades to mottled gray, red-brown and black, slightly moist, clayey SILT with sand		2-5	116.1	19.3
			2-6		
			2-7		
		Boring terminated at 40.5 feet	2-8		

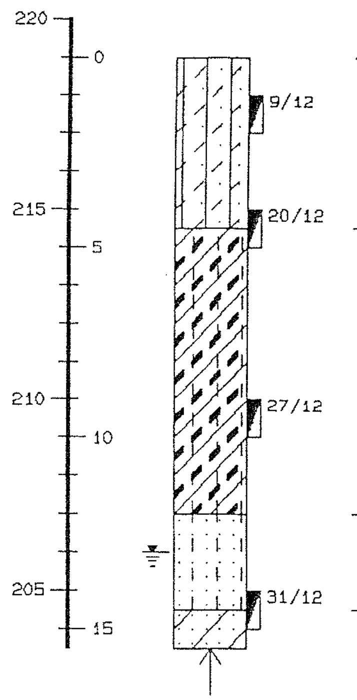
Figure Number 3

LOG OF BORING

Project: Lagoon Valley　　　　Boring: 3

File: 2568-1　　　　Elevation: 219' +/-

Date: 28 March 1990　　　　Water encountered: 13 feet



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
	9/12	ML	Dark brown, moist, stiff, clayey SILT with sand		3-1		
	20/12			Water at 3.5 feet after drilling	3-2	83.5	35.9
		CL-CH	Purple to black, slightly moist, very stiff, silty CLAY; some organics present				
	27/12				3-3		
		SM	Light brown, saturated, silty fine SAND	Water at 13 feet during drilling			
	31/12				3-4		
		CL	Mottled gray and red-brown, slightly moist, hard, fine sandy CLAY	Boring terminated at 15.5 feet			

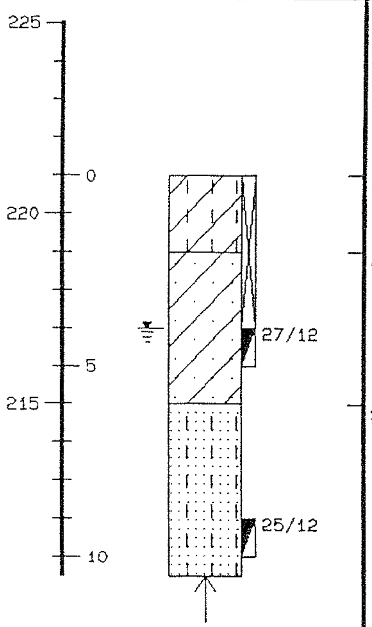
Figure Number 4

LOG OF BORING

Project: Lagoon Valley — Boring: 4

File: 2568-1 — Elevation: 221' +/-

Date: 28 March 1990 — Water encountered: 4' (after)



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		CL	Dark brown, slightly moist, silty CLAY		CB-4		
2		CL	Light brown, slightly moist, coarse, sandy CLAY				
4	27/12			Water at 4 feet after drilling	4-1		
6		SM	Mottled light brown and gray, saturated, mod. dense, silty fine SAND (manganese mottling)				
9	25/12				4-2		
10.5				Boring terminated at 10.5 feet			

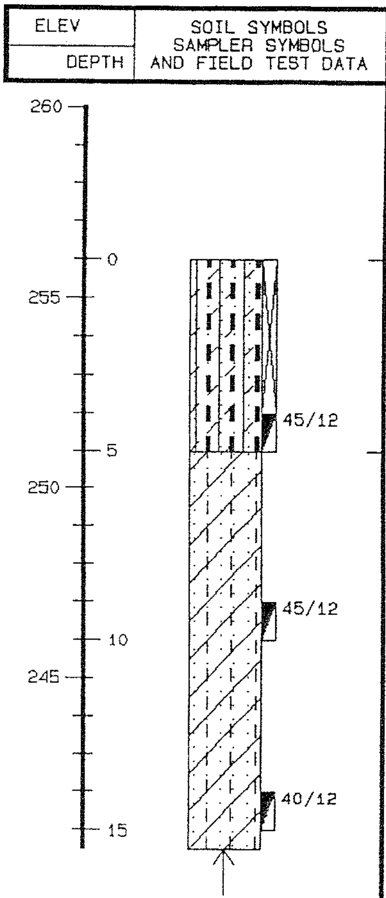
Figure Number 5

LOG OF BORING

Project: Lagoon Valley — Boring: 5

File: 2568-1 — Elevation: 256' +/-

Date: 28 March 1990 — Water encountered: none



USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
ML-MH	Dark brown, slightly moist, hard, clayey SILT with fine sand (possible fill?)		CB-5		
			5-1		
CL	Light brown, dry, hard, sandy CLAY with silt (old ground surface); dk br clay in cracks				
			5-2	106.9	10.4
		Sand increases; drilling becomes slower			
		Sample 5-3 has sandstone/ siltstone rock fragments	5-3		
		Boring terminated at 15.5 feet			

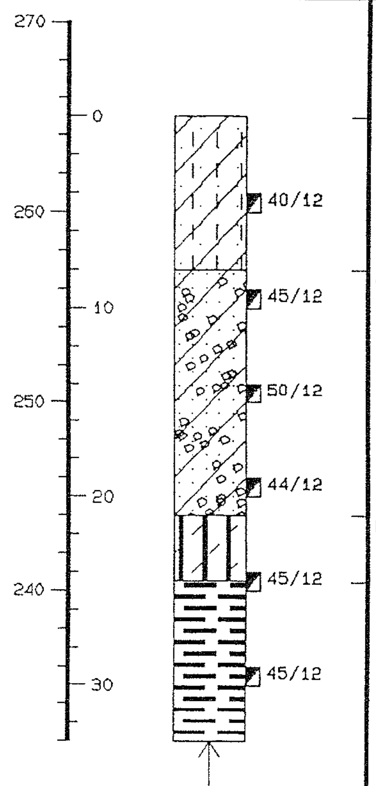
Figure Number 6

LOG OF BORING

Project: Lagoon Valley | Boring: 6

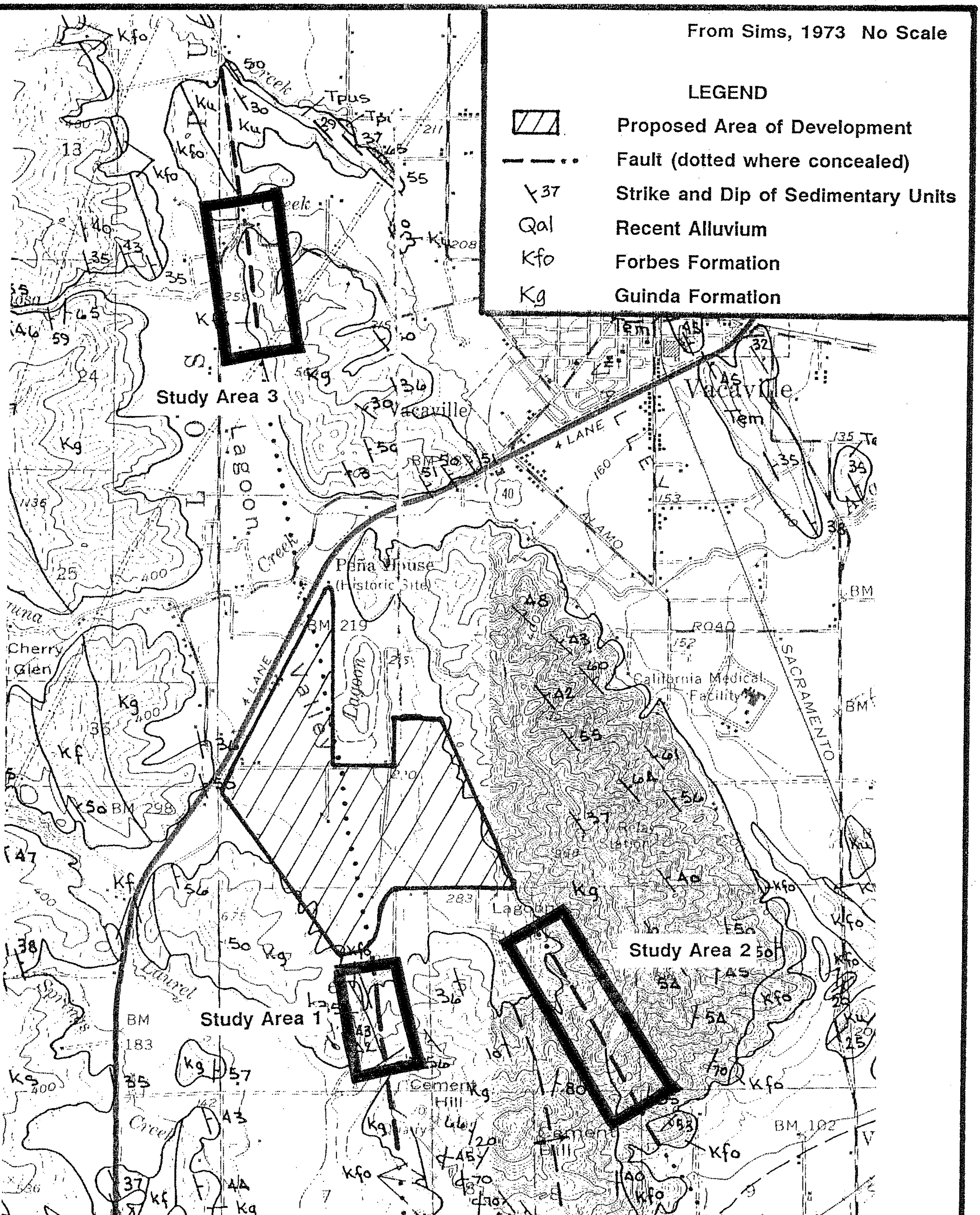
File: 2568-1 | Elevation: 265' +/-

Date: 28 March 1990 | Water encountered: none



Field Test Data	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
	CL	Dark brown, slightly moist, hard, silty CLAY with sand				
40/12			Slightly lighter brown color with depth No recovery for Sample 6-1 Slow drilling below 5 feet	6-1		
45/12	CL	Grades to slightly reddish brown, slightly moist, hard, sandy CLAY w/ rock fragments		6-2		
50/12			Generally more sand, less clay between 15-20 feet	6-3		
44/12			No recovery for Sample 6-4	6-4		
	MH	Light brown to yellow, sl. moist, clayey SILT				
45/12		Light brown, well indurated, SILTSTONE with sandstone stringers		6-5		
45/12			Siltstone is well indurated in Sample 6-6 Very slow drilling Boring terminated at 33 feet due to refusal in hard siltstone	6-6		

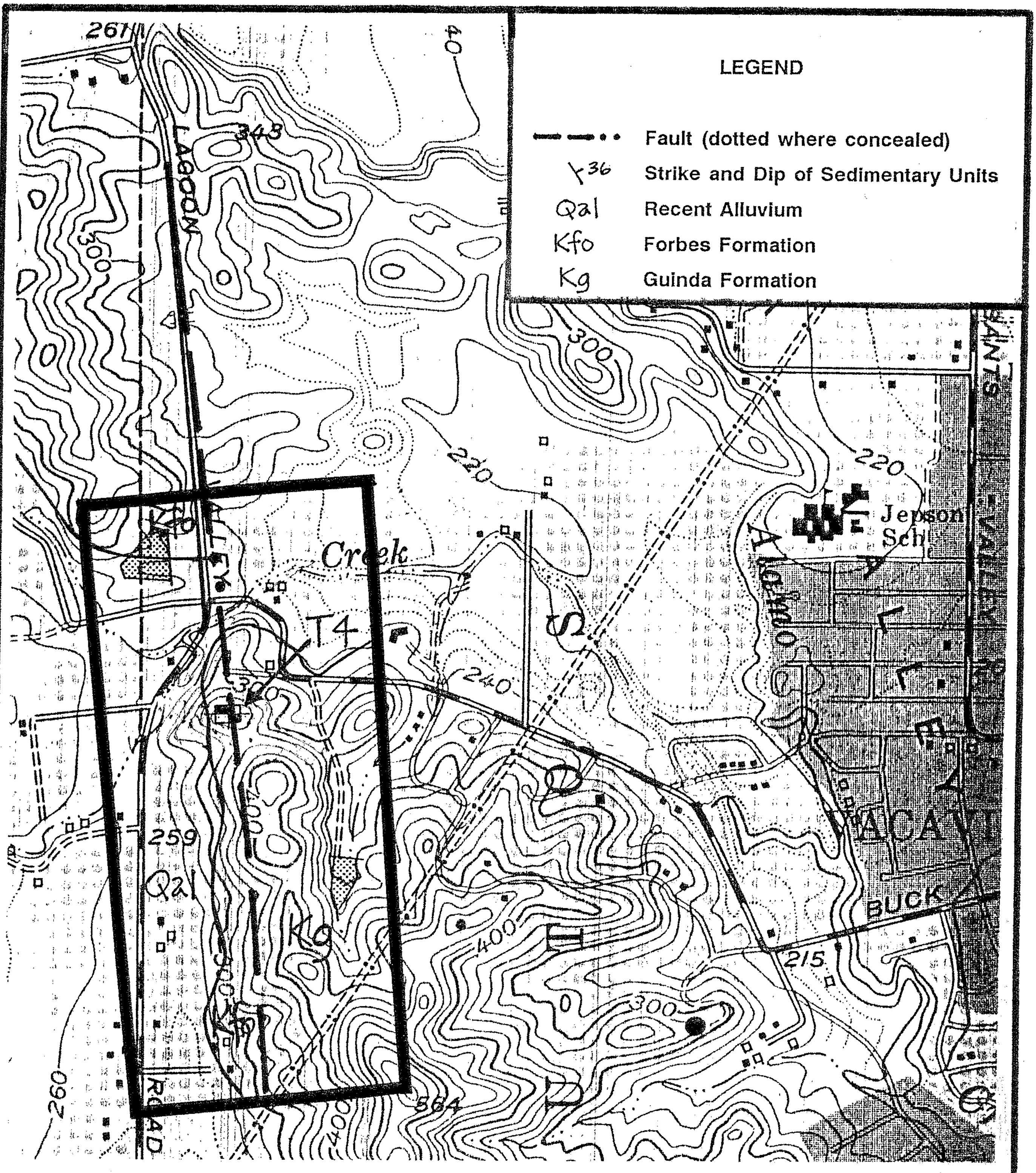
Figure Number 7



LOCATION/REGIONAL GEOLOGIC MAP
LAGOON VALLEY FAULT STUDY
VACAVILLE, CALIFORNIA

ANDERSON CONSULTING GROUP
Roseville (916) 786-8883
Grass Valley (916) 273-SOIL

2568-66	FEBRUARY 1991	FIGURE 1



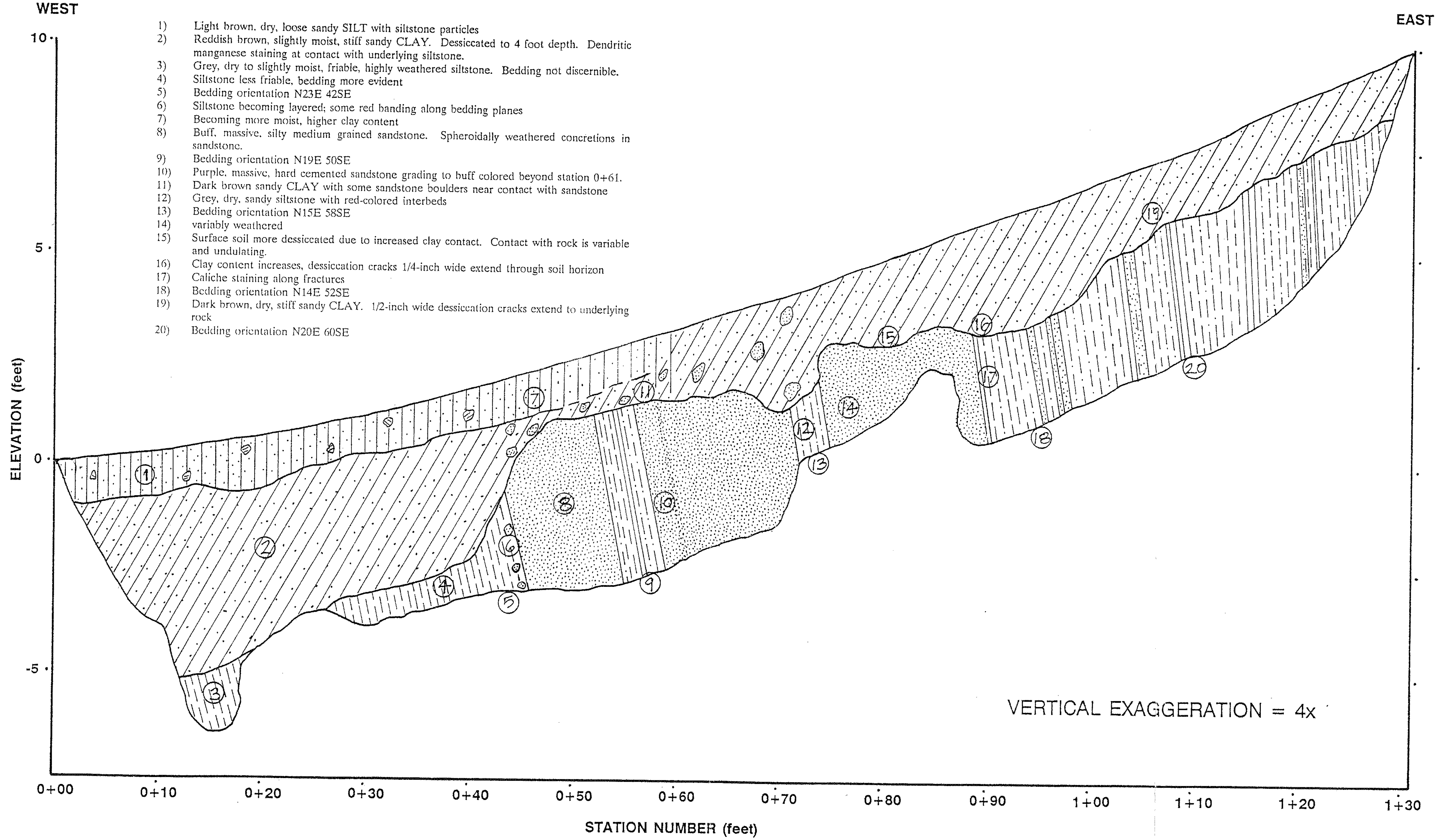
GEOLOGIC MAP FOR STUDY AREA 3
LAGOON VALLEY FAULT STUDY
VACAVILLE, CALIFORNIA

ANDERSON CONSULTING GROUP
Roseville (916) 786-8883
Grass Valley (916) 273-SOIL

2568-66	FEBRUARY 1991	FIGURE 2

TRENCH 1

1) Light brown, dry, loose sandy SILT with siltstone particles
2) Reddish brown, slightly moist, stiff sandy CLAY. Dessiccated to 4 foot depth. Dendritic manganese staining at contact with underlying siltstone.
3) Grey, dry to slightly moist, friable, highly weathered siltstone. Bedding not discernible.
4) Siltstone less friable, bedding more evident
5) Bedding orientation N23E 42SE
6) Siltstone becoming layered; some red banding along bedding planes
7) Becoming more moist, higher clay content
8) Buff, massive, silty medium grained sandstone. Spheroidally weathered concretions in sandstone.
9) Bedding orientation N19E 50SE
10) Purple, massive, hard cemented sandstone grading to buff colored beyond station 0+61.
11) Dark brown sandy CLAY with some sandstone boulders near contact with sandstone
12) Grey, dry, sandy siltstone with red-colored interbeds
13) Bedding orientation N15E 58SE
14) variably weathered
15) Surface soil more dessiccated due to increased clay contact. Contact with rock is variable and undulating.
16) Clay content increases, dessiccation cracks 1/4-inch wide extend through soil horizon
17) Caliche staining along fractures
18) Bedding orientation N14E 52SE
19) Dark brown, dry, stiff sandy CLAY. 1/2-inch wide dessiccation cracks extend to underlying rock
20) Bedding orientation N20E 60SE

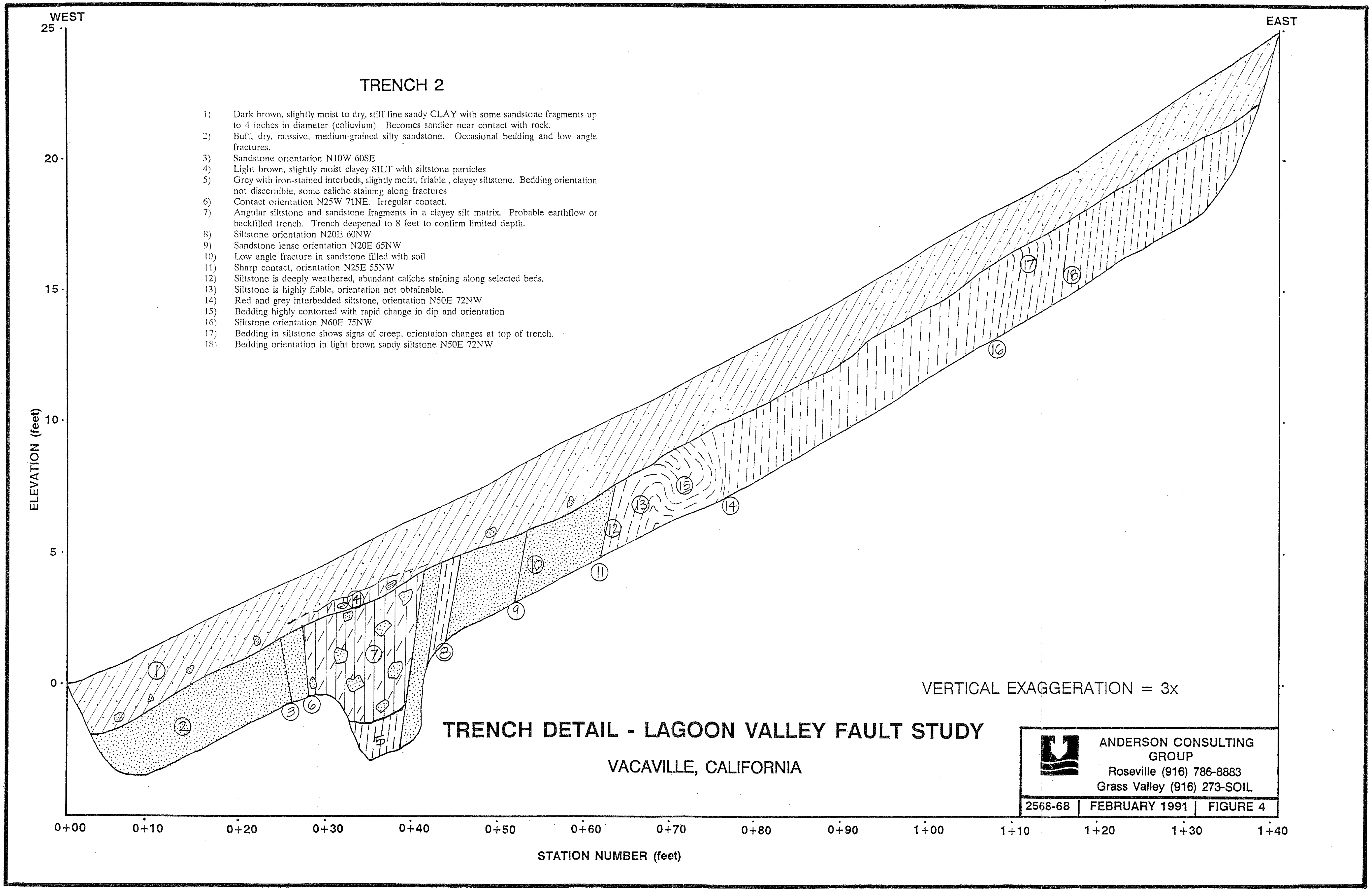


TRENCH DETAIL - LAGOON VALLEY FAULT STUDY

VACAVILLE, CALIFORNIA

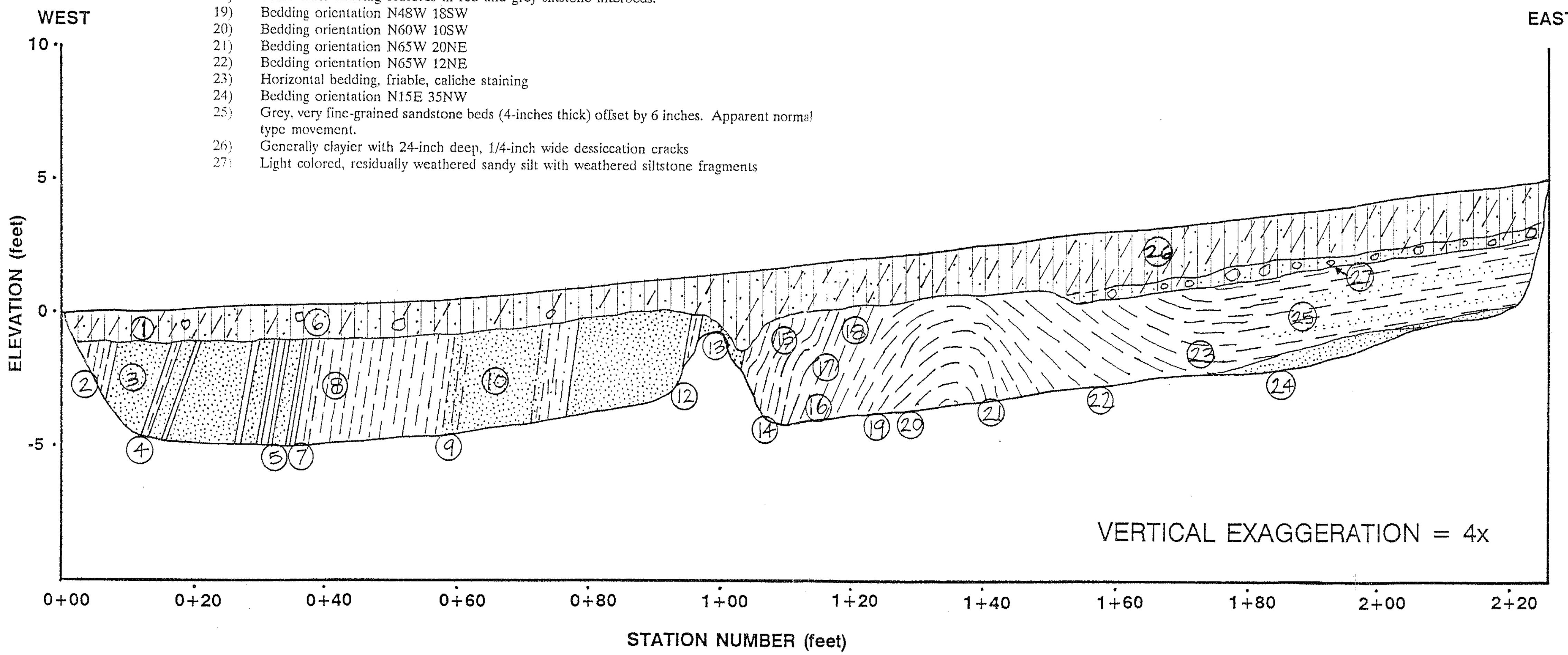
ANDERSON CONSULTING GROUP
Roseville (916) 786-8883
Grass Valley (916) 273-SOIL

2568-68 | FEBRUARY 1991 | FIGURE 3


WEST
EAST
TRENCH 2
1) Dark brown, slightly moist to dry, stiff fine sandy CLAY with some sandstone fragments up to 4 inches in diameter (colluvium). Becomes sandier near contact with rock.
2) Buff, dry, massive, medium-grained silty sandstone. Occasional bedding and low angle fractures.
3) Sandstone orientation N10W 60SE
4) Light brown, slightly moist clayey SILT with siltstone particles
5) Grey with iron-stained interbeds, slightly moist, friable , clayey siltstone. Bedding orientation not discernible, some caliche staining along fractures
6) Contact orientation N25W 71NE. Irregular contact.
7) Angular siltstone and sandstone fragments in a clayey silt matrix. Probable earthflow or backfilled trench. Trench deepened to 8 feet to confirm limited depth.
8) Siltstone orientation N20E 60NW
9) Sandstone lense orientation N20E 65NW
10) Low angle fracture in sandstone filled with soil
11) Sharp contact, orientation N25E 55NW
12) Siltstone is deeply weathered, abundant caliche staining along selected beds.
13) Siltstone is highly fiable, orientation not obtainable.
14) Red and grey interbedded siltstone, orientation N50E 72NW
15) Bedding highly contorted with rapid change in dip and orientation
16) Siltstone orientation N60E 75NW
17) Bedding in siltstone shows signs of creep, orientaion changes at top of trench.
18) Bedding orientation in light brown sandy siltstone N50E 72NW
ELEVATION (feet)
25
20
15
10
5
0
0+00
0+10
0+20
0+30
0+40
0+50
0+60
0+70
0+80
0+90
1+00
1+10
1+20
1+30
1+40
STATION NUMBER (feet)
VERTICAL EXAGGERATION = 3x
TRENCH DETAIL - LAGOON VALLEY FAULT STUDY
VACAVILLE, CALIFORNIA
ANDERSON CONSULTING GROUP
Roseville (916) 786-8883
Grass Valley (916) 273-SOIL
2568-68
FEBRUARY 1991
FIGURE 4

TRENCH 3

1) Dark brown, dry, stiff clayey SILT with sand and rock fragments
2) Light brown to grey siltstone with red-brown to red siltstone interbeds. Orientation N40W 55SW.
3) Buff, dry, massive to slightly bedded, medium grained sandstone with fractures subangular to bedding.
4) Contact orientation N15W 45SW
5) Contact orientation N32W 62SW
6) Brown, dry sandy Silt with clay; minor dessiccation cracks
7) Bedding orientation N28W 58SW
8) Grey, dry, friable siltstone with 1 to 3 inch interbeds. Some interbeds caliche stained. Rock easily excavatable with rock hammer
9) Contact with sandstone, orientation N38W 64SW
10) Buff, massive, medium grained sandstone with rounded sandstone concretions up to 6-inch diameter. Concretions have iron oxide coatings.
11) Caliche staining in fractures and along bedding
12) Contact orientation N25W 60SW
13) Sandstone orientation N8W 70SW
14) Siltstone orientation NS 48W
15) Contorted bedding; abundant caliche staining
16) Siltstone bedding undulating. Bedding orientation N38W 30SW
17) Individual siltstone beds becoming thinner (on the order of 1/4 inch)
18) Some cross bedding features in red and grey siltstone interbeds.
19) Bedding orientation N48W 18SW
20) Bedding orientation N60W 10SW
21) Bedding orientation N65W 20NE
22) Bedding orientation N65W 12NE
23) Horizontal bedding, friable, caliche staining
24) Bedding orientation N15E 35NW
25) Grey, very fine-grained sandstone beds (4-inches thick) offset by 6 inches. Apparent normal type movement.
26) Generally clayier with 24-inch deep, 1/4-inch wide dessiccation cracks
27) Light colored, residually weathered sandy silt with weathered siltstone fragments

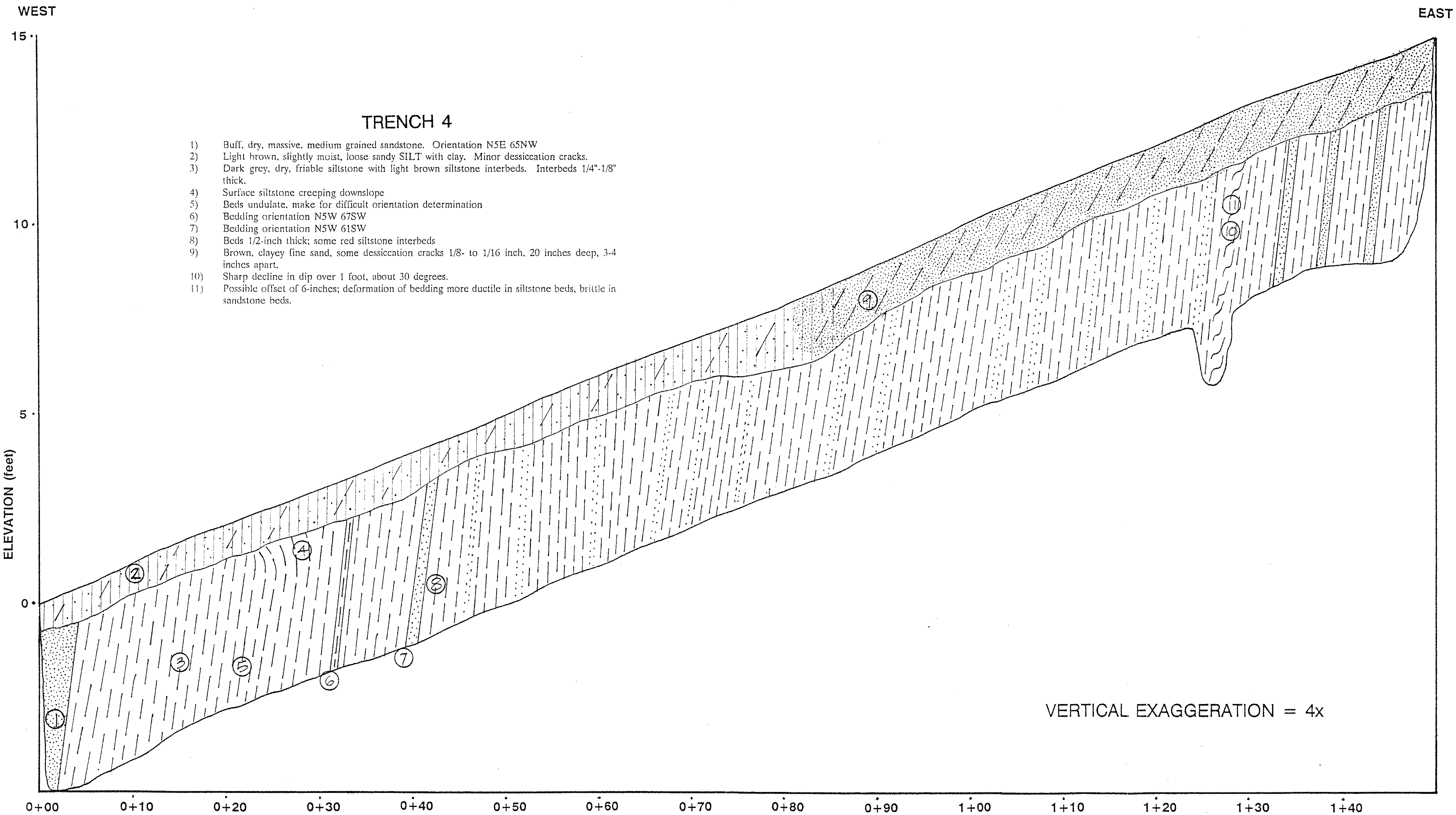


TRENCH DETAIL - LAGOON VALLEY FAULT STUDY

VACAVILLE, CALIFORNIA

ANDERSON CONSULTING GROUP
Roseville (916) 786-8883
Grass Valley (916) 273-SOIL

2568-68	FEBRUARY 1991	FIGURE 5



TRENCH 4

1) Buff, dry, massive, medium grained sandstone. Orientation N5E 65NW
2) Light brown, slightly moist, loose sandy SILT with clay. Minor dessiccation cracks.
3) Dark grey, dry, friable siltstone with light brown siltstone interbeds. Interbeds 1/4"-1/8" thick.
4) Surface siltstone creeping downslope
5) Beds undulate, make for difficult orientation determination
6) Bedding orientation N5W 67SW
7) Bedding orientation N5W 61SW
8) Beds 1/2-inch thick; some red siltstone interbeds
9) Brown, clayey fine sand, some dessiccation cracks 1/8- to 1/16 inch, 20 inches deep, 3-4 inches apart.
10) Sharp decline in dip over 1 foot, about 30 degrees.
11) Possible offset of 6-inches; deformation of bedding more ductile in siltstone beds, brittle in sandstone beds.

TRENCH DETAIL - LAGOON VALLEY FAULT STUDY

VACAVILLE, CALIFORNIA

ANDERSON CONSULTING GROUP
Roseville (916) 786-8883
Grass Valley (916) 273-SOIL

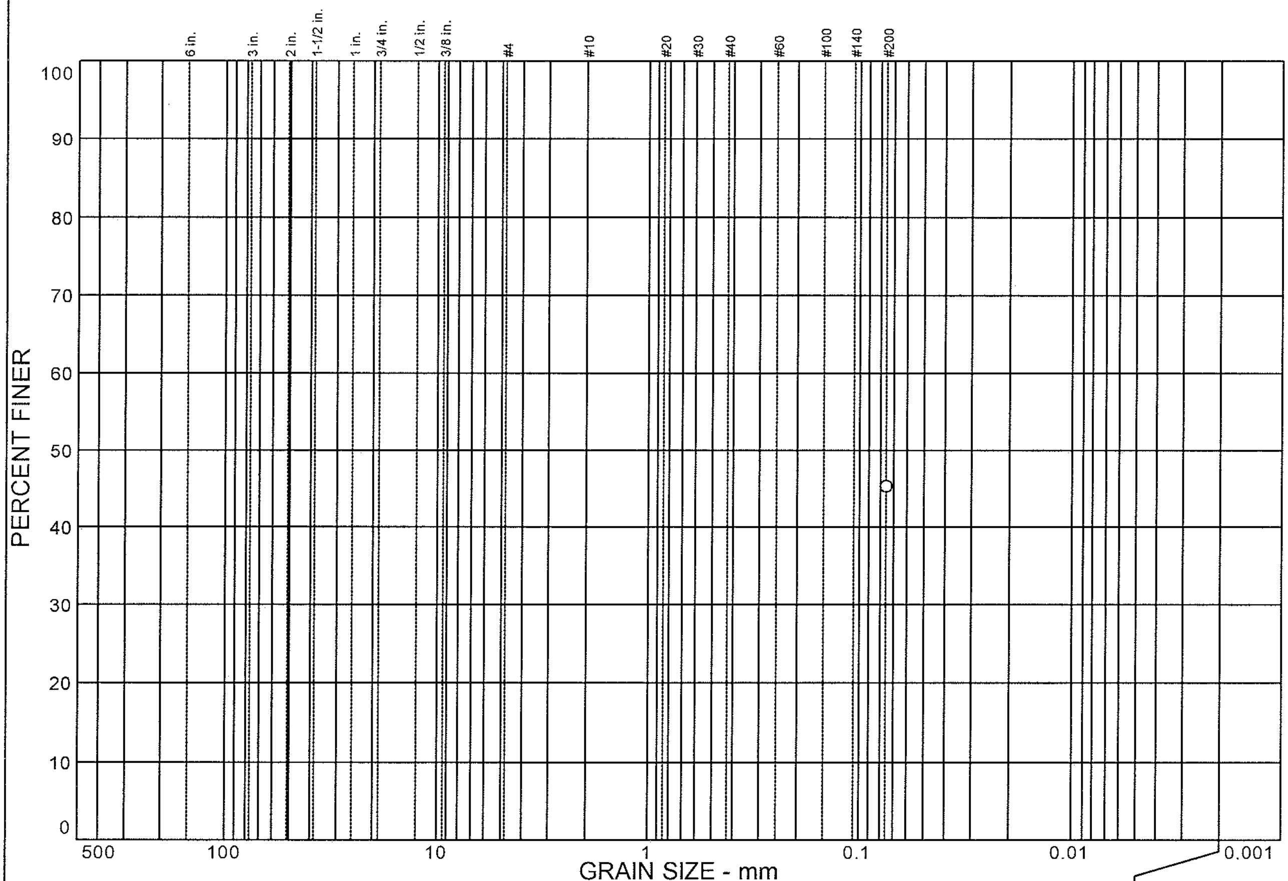
2568-68 | FEBRUARY 1991 | FIGURE 6

APPENDIX B

ENGEO Incorporated - Laboratory Test Results (2003)

Anderson Consulting Group – Laboratory Test Results (1990)

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			45.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	45.3		

* (no specification provided)

Soil Description

Dark yellowish brown clayey Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

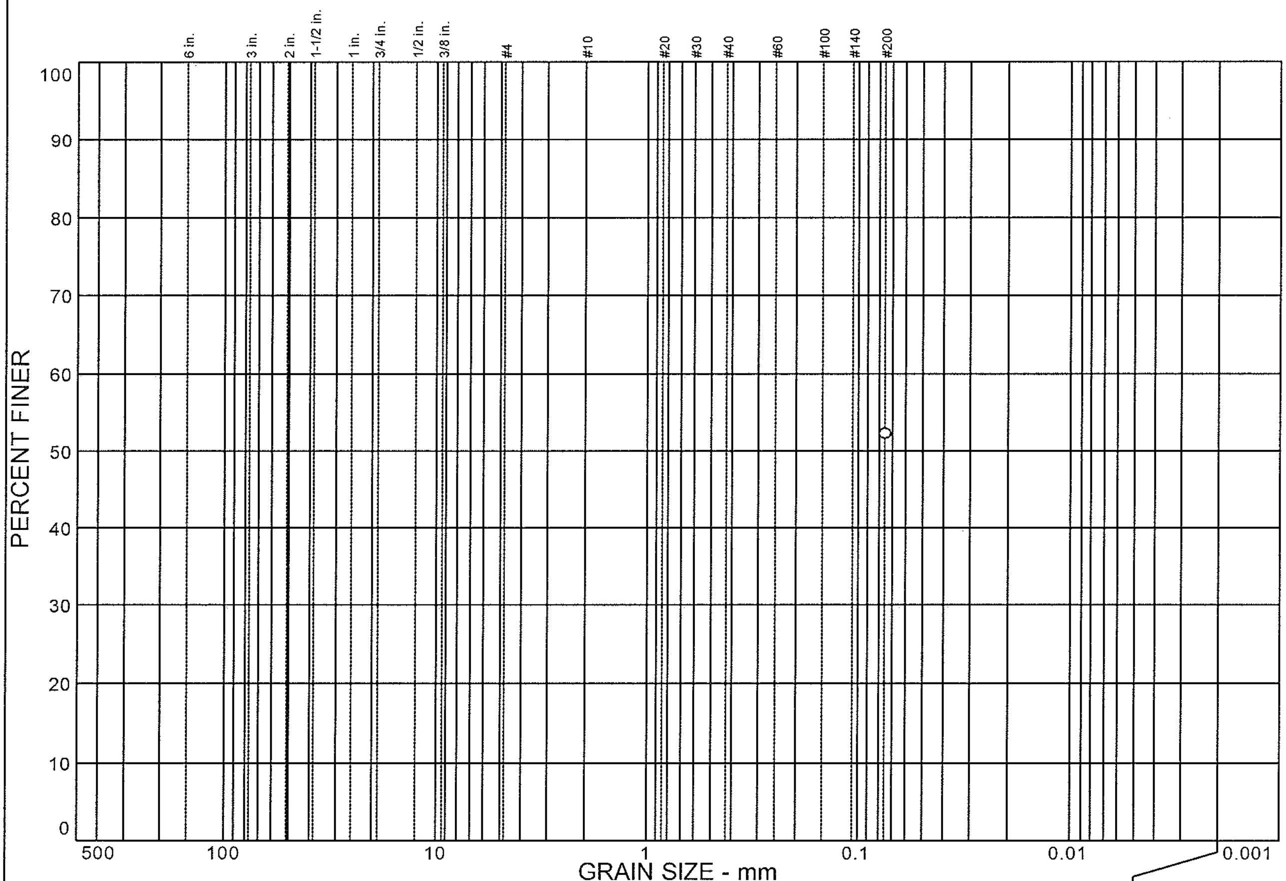
Remarks

Sample No.: 1-4-1 **Source of Sample:** %200 **Date:** 06-16-03
Location: **Elev./Depth:**

ENGEO INCORPORATED — GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Client:
Project: Lagoon Valley, Vacaville
Project No: 5489.2.002.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			52.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	52.2		

* (no specification provided)

Soil Description

Yellowish brown sandy silty Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

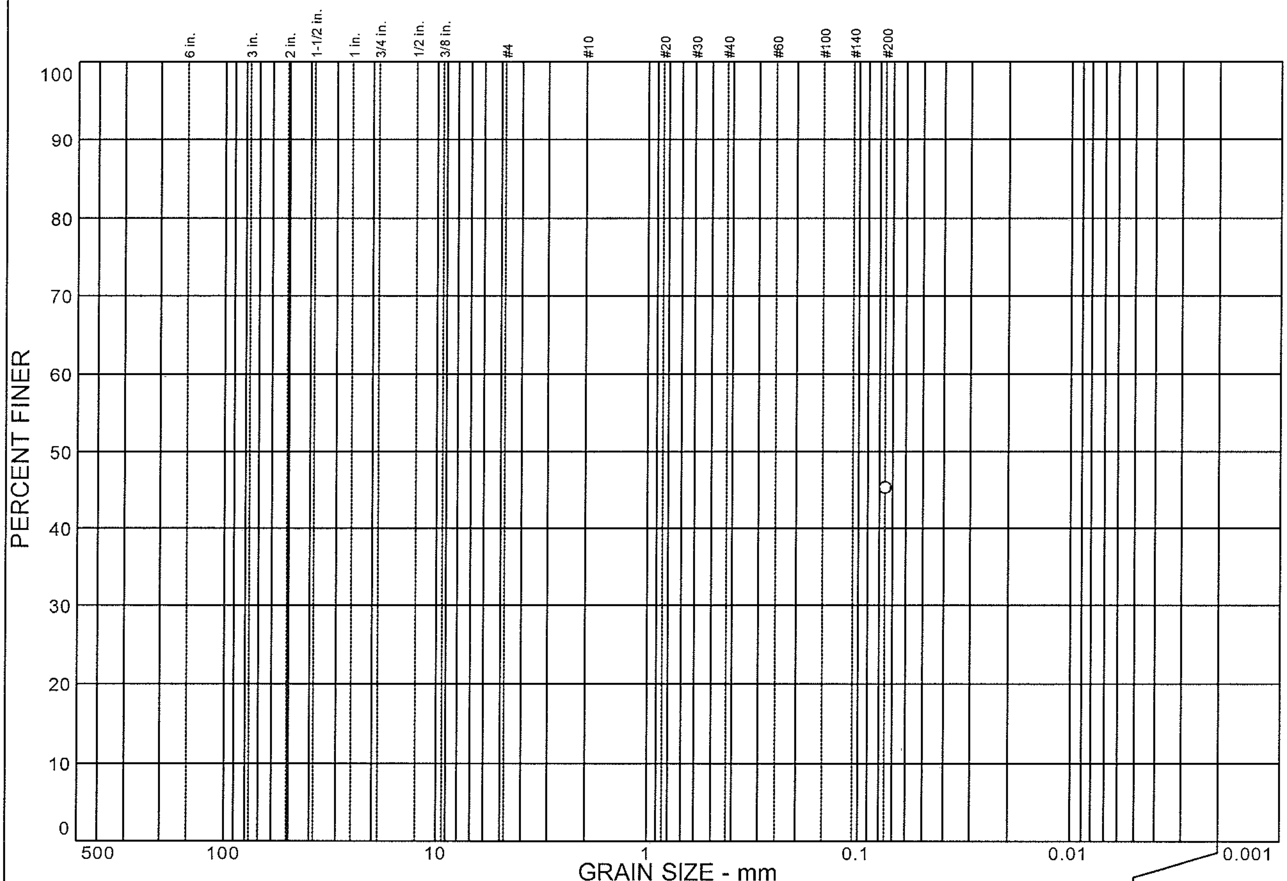
Sample No.: 5-4-1 **Source of Sample:** %200 **Date:** 06-16-03
Location: **Elev./Depth:**

ENGEO INCORPORATED — GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Client:
Project: Lagoon Valley, Vacaville

Project No: 5489.2.002.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			45.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	45.3		

* (no specification provided)

Soil Description

Dark yellowish brown clayey Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

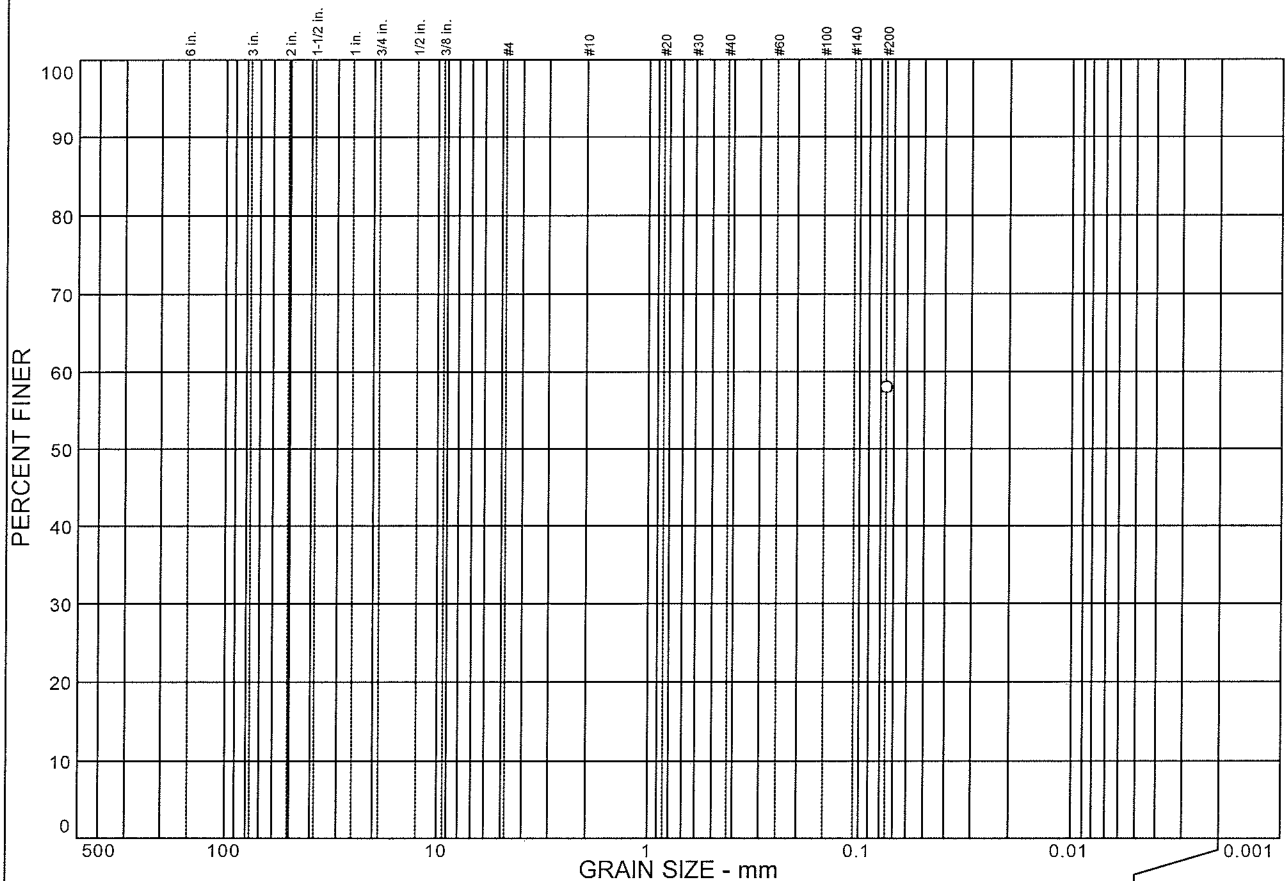
Remarks

Sample No.: 6-2-1 **Source of Sample:** %200 **Date:** 06-16-03
Location: **Elev./Depth:**

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Lagoon Valley, Vacaville
Project No: 5489.2.002.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			57.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	57.9		

* (no specification provided)

Soil Description

Light olive brown sandy silty Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

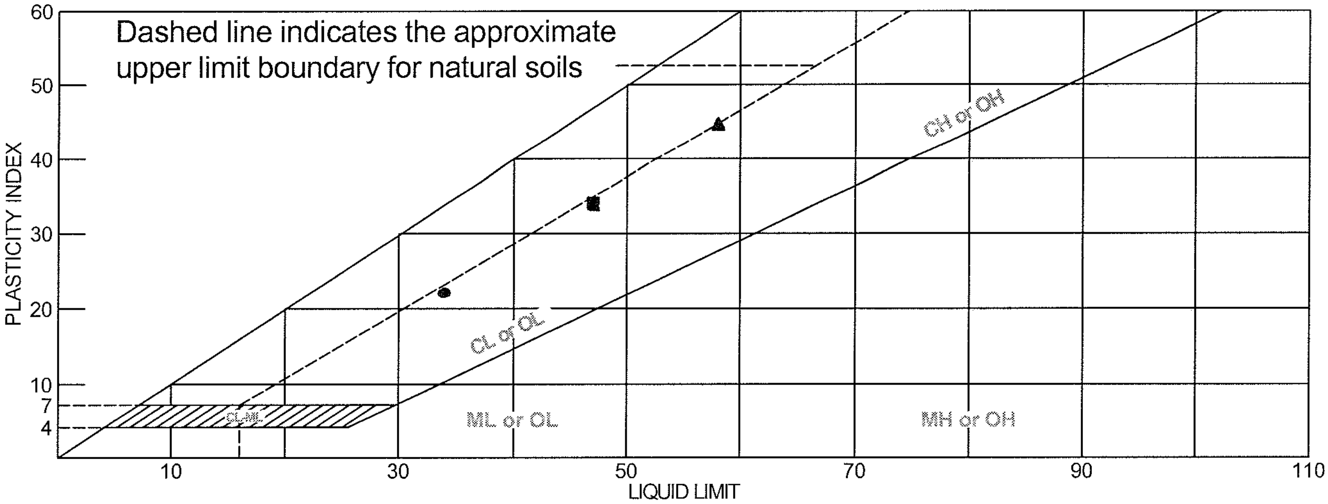
Remarks

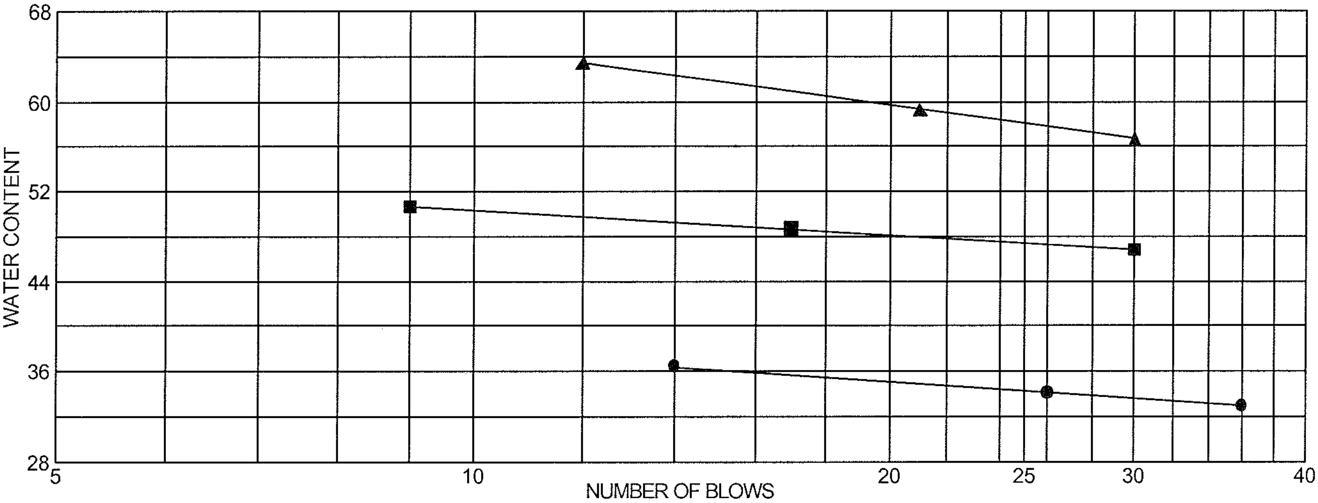
Sample No.: 6-7-1 **Source of Sample:** %200 **Date:** 06-16-03
Location: **Elev./Depth:**

ENGEO INCORPORATED — GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS — MATERIALS TESTING

Client:
Project: Lagoon Valley, Vacaville
Project No: 5489.2.002.01

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark yellowish brown silty Clay with fine sand	34	12	22			CL
■	Mottled very dark gray and olive gray silty Clay with fine sand	47	13	34			CL
▲	Light olive brown Clay	58	13	45			CH

Project No. 5489.2.002.01 **Client:**

Project: Lagoon Valley, Vacaville

● **Source:** PI **Sample No.:** 1-3-1

■ **Source:** PI **Sample No.:** 2-2-1

▲ **Source:** PI **Sample No.:** 5-3-1

ENGEO INCORPORATED — GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

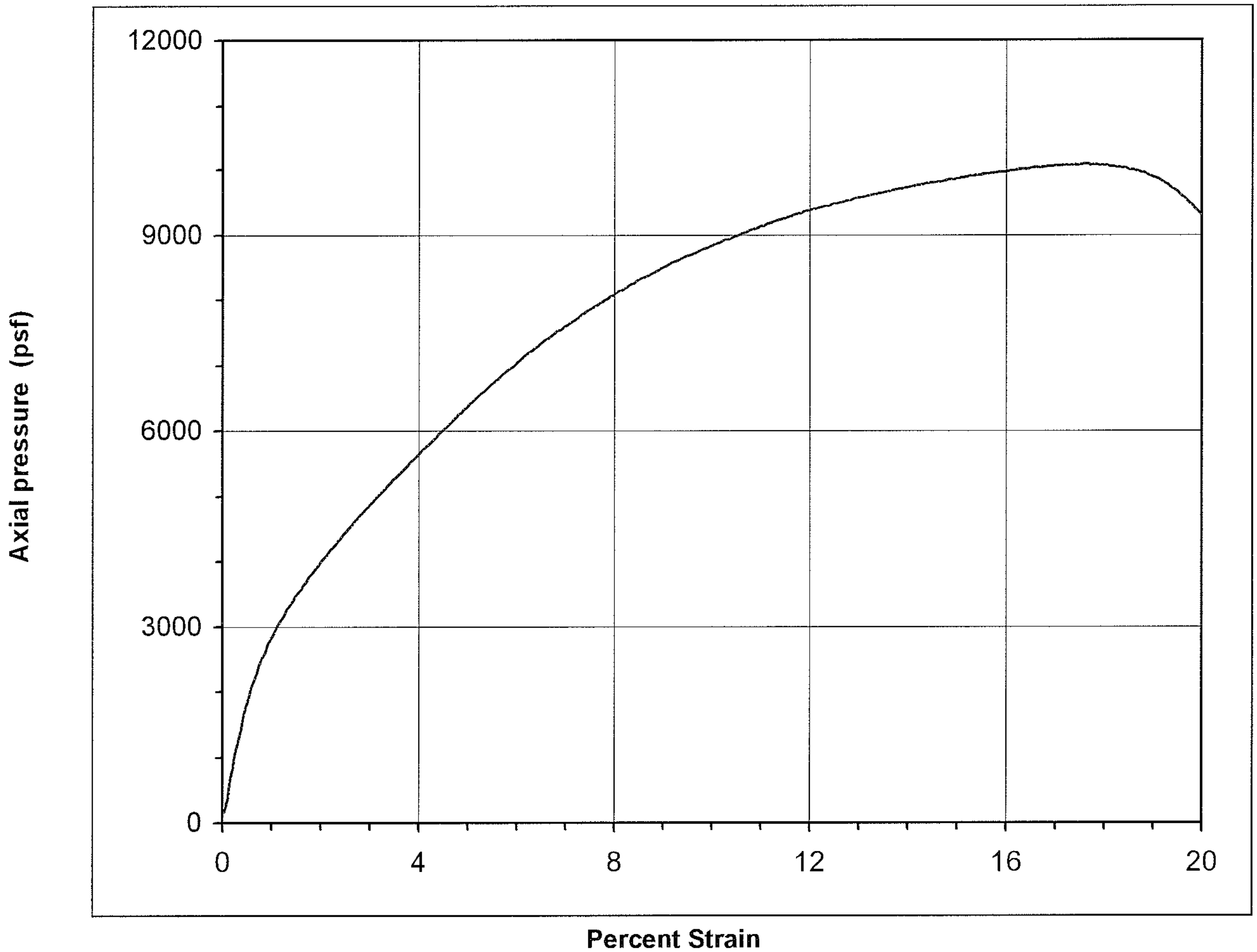
Remarks:

● (1-3-1)

■ (2-2-1)

▲ (5-3-1)

Unconfined Compression Test
ASTM Test Method D2166



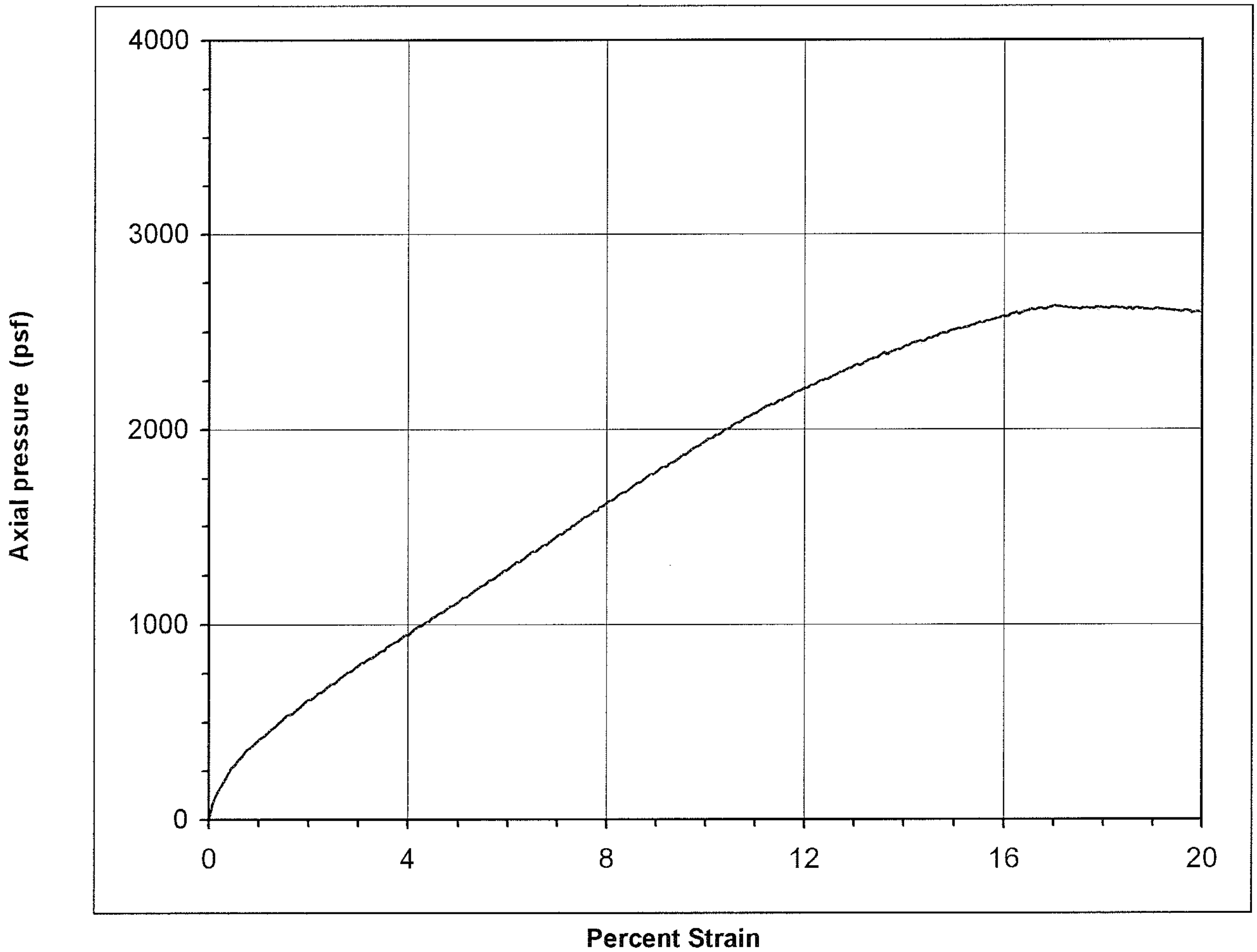
Unconfined Compressive Strength: 10040 psf 5.0 tsf

Sample Description: Dark grayish brown Clay with fine sand

Initial Diameter:	2.375	in.	Sample Number:	5-1-1	
Initial Height:	5.00	in.	Dry Unit Weight:	115.1	pcf
Strain Rate:	1.541	%/min	Moisture Content:	16.9	%
Total Strain:	20.02	%	Depth of Sample:		ft.

ENGEO INCORPORATED	LAGOON VALLEY Vacaville, California	Job No.:	5489.2.002.01
		Sample Number:	5-1-1
		Date:	6/5/2003

Unconfined Compression Test
ASTM Test Method D2166



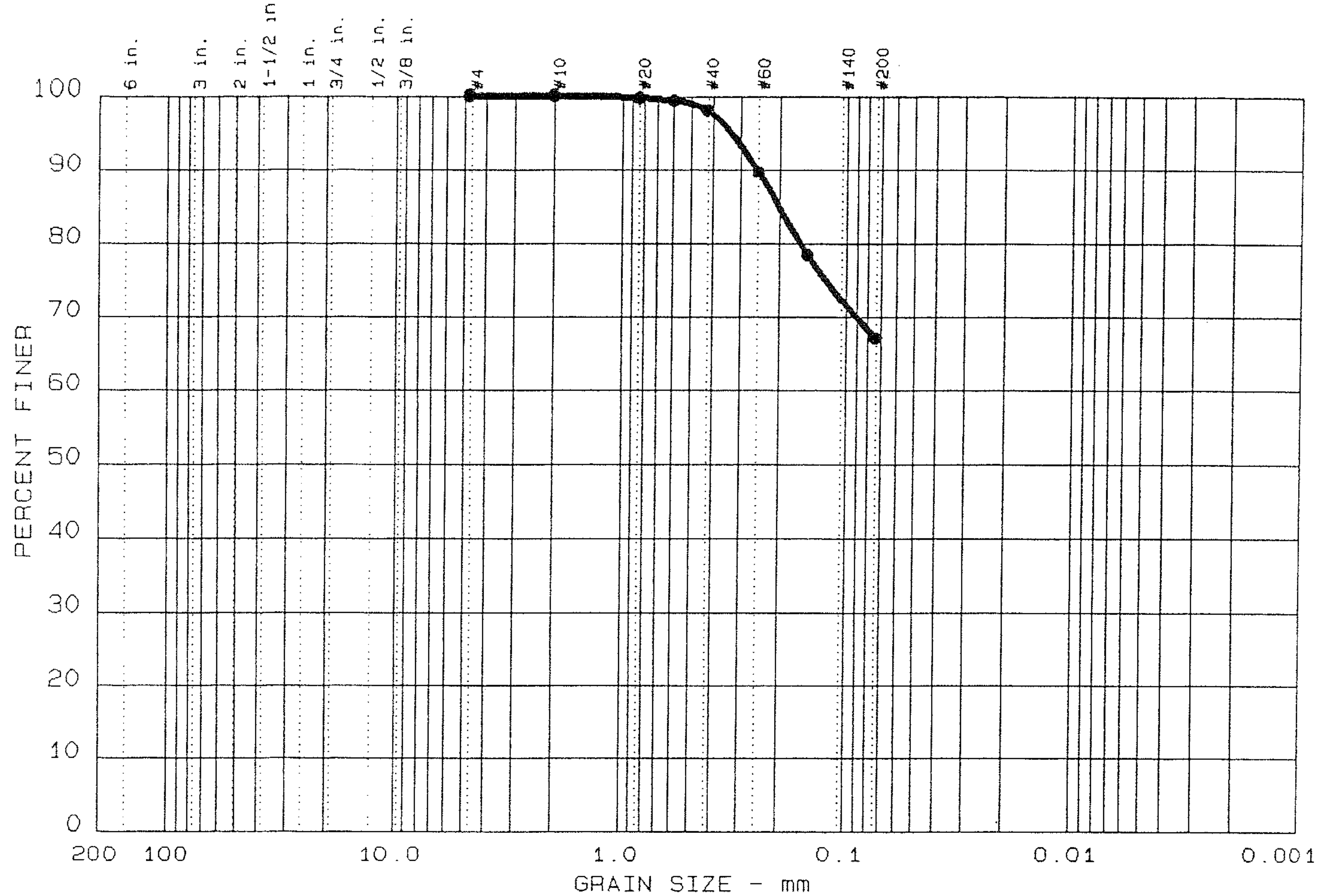
Unconfined Compressive Strength: 2620 psf 1.3 tsf

Sample Description: Yellowish brown fine sandy silty Clay

Initial Diameter:	2.375	in.	Sample Number:	3-3-1	
Initial Height:	5.00	in.	Dry Unit Weight:	110.7	pcf
Strain Rate:	1.583	%/min	Moisture Content:	19.4	%
Total Strain:	20.02	%	Depth of Sample:		ft.

ENGEO INCORPORATED	LAGOON VALLEY	Job No.:	5489.2.002.01
		Sample Number:	3-3-1
	Vacaville, California	Date:	6/5/2003

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	32.8	67.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.20							

MATERIAL DESCRIPTION	USCS	AASHTO
● SANDY SILT WITH CLAY	ML	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 1-3

Date: APRIL 1990

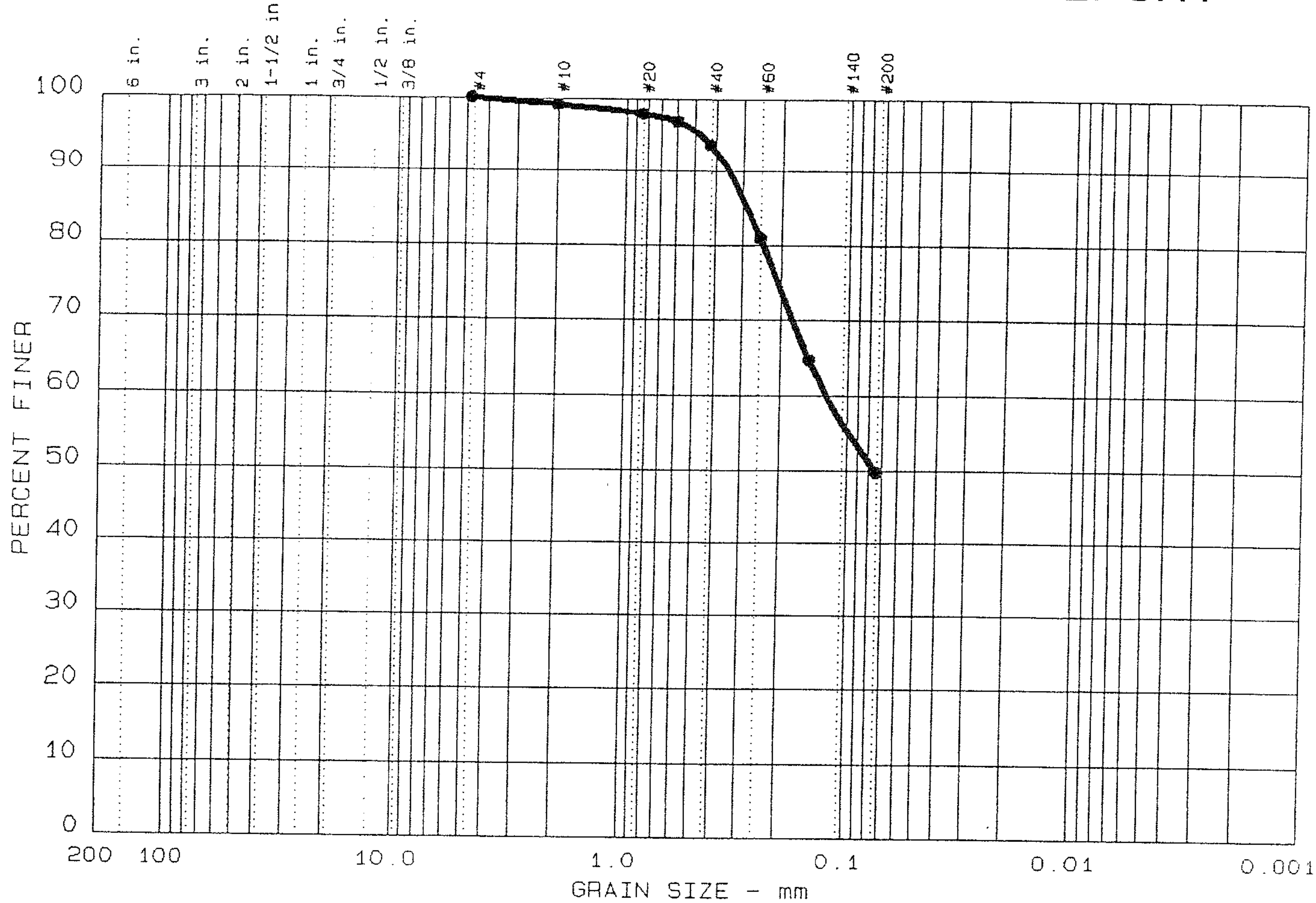
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Figure No. 11

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	50.3	49.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.29	0.12	0.07					

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY SAND WITH CLAY	SM	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 1-4

Date: APRIL 1990

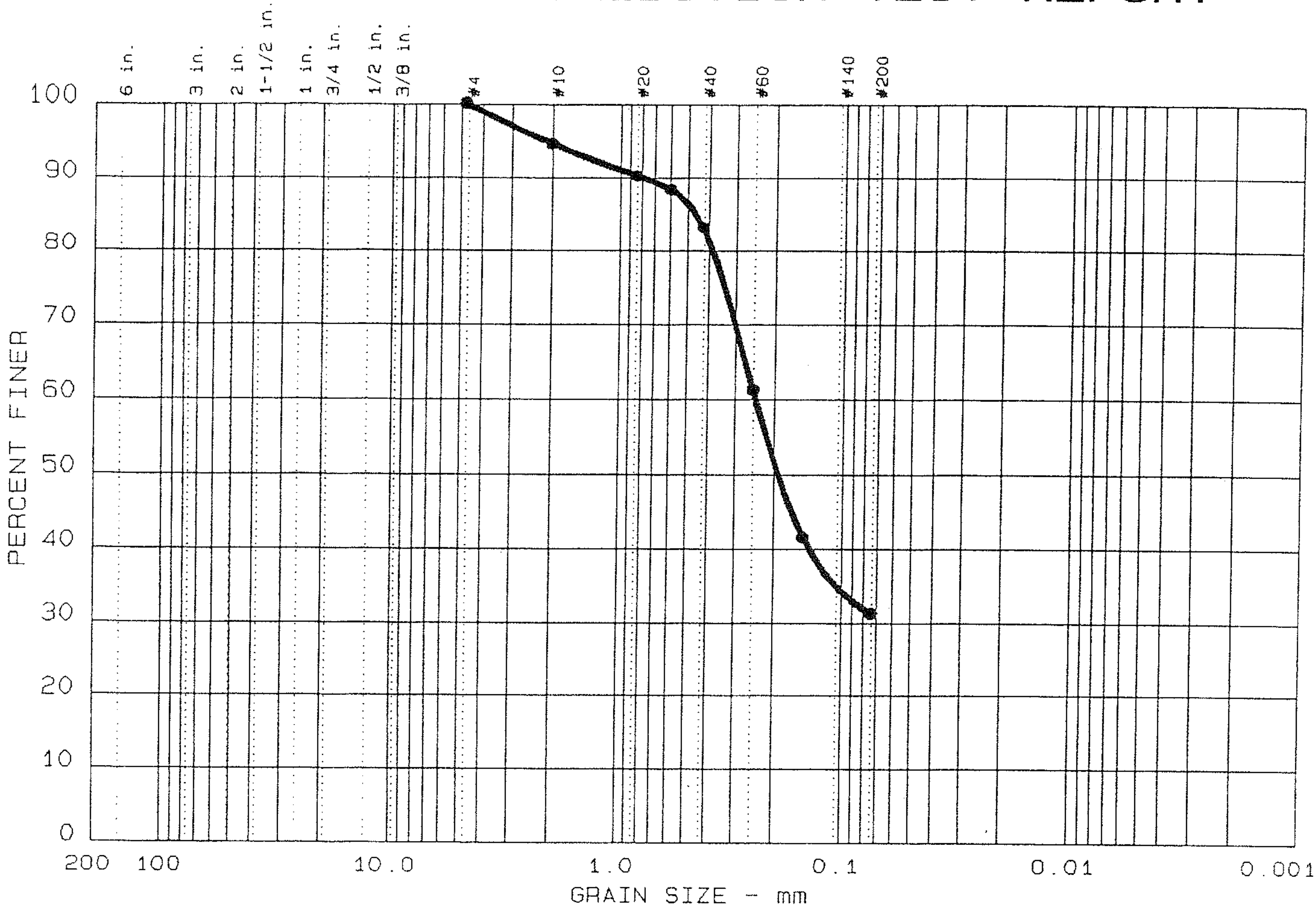
GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Remarks:

Figure No. 12

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	68.8	31.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.45	0.24	0.19					

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY SAND WITH CLAY	SM	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 1-6

Date: APRIL 1990

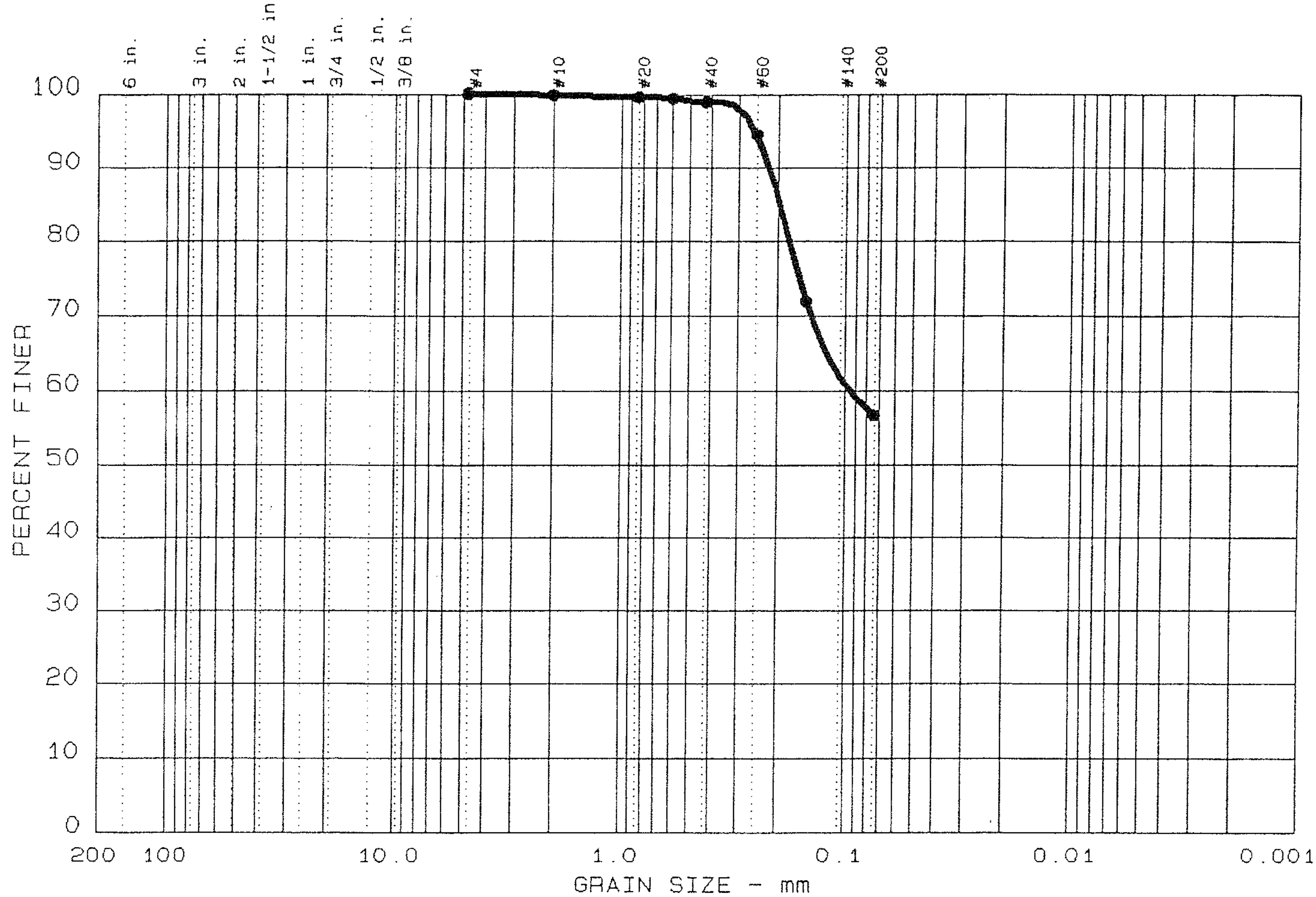
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Figure No. 13

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	43.4	56.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.20	0.09						

MATERIAL DESCRIPTION	USCS	AASHTO
● SANDY SILT WITH CLAY	ML	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 1-8

Date: APRIL 1990

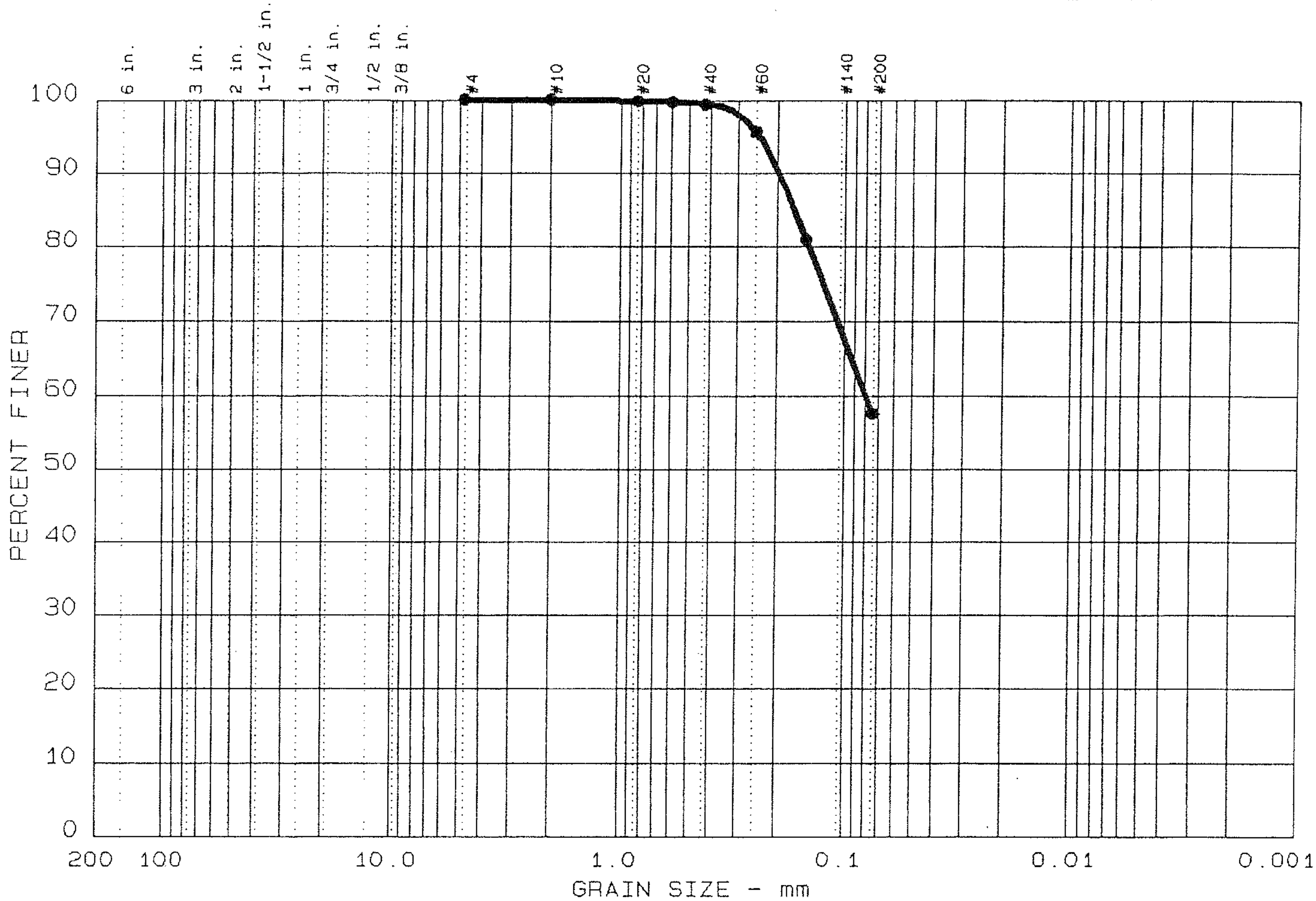
GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Remarks:

Figure No. 14

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	42.4	57.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.17	0.08						

MATERIAL DESCRIPTION	USCS	AASHTO
● SANDY SILT WITH CLAY	ML	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 2-1

Date: APRIL 1990

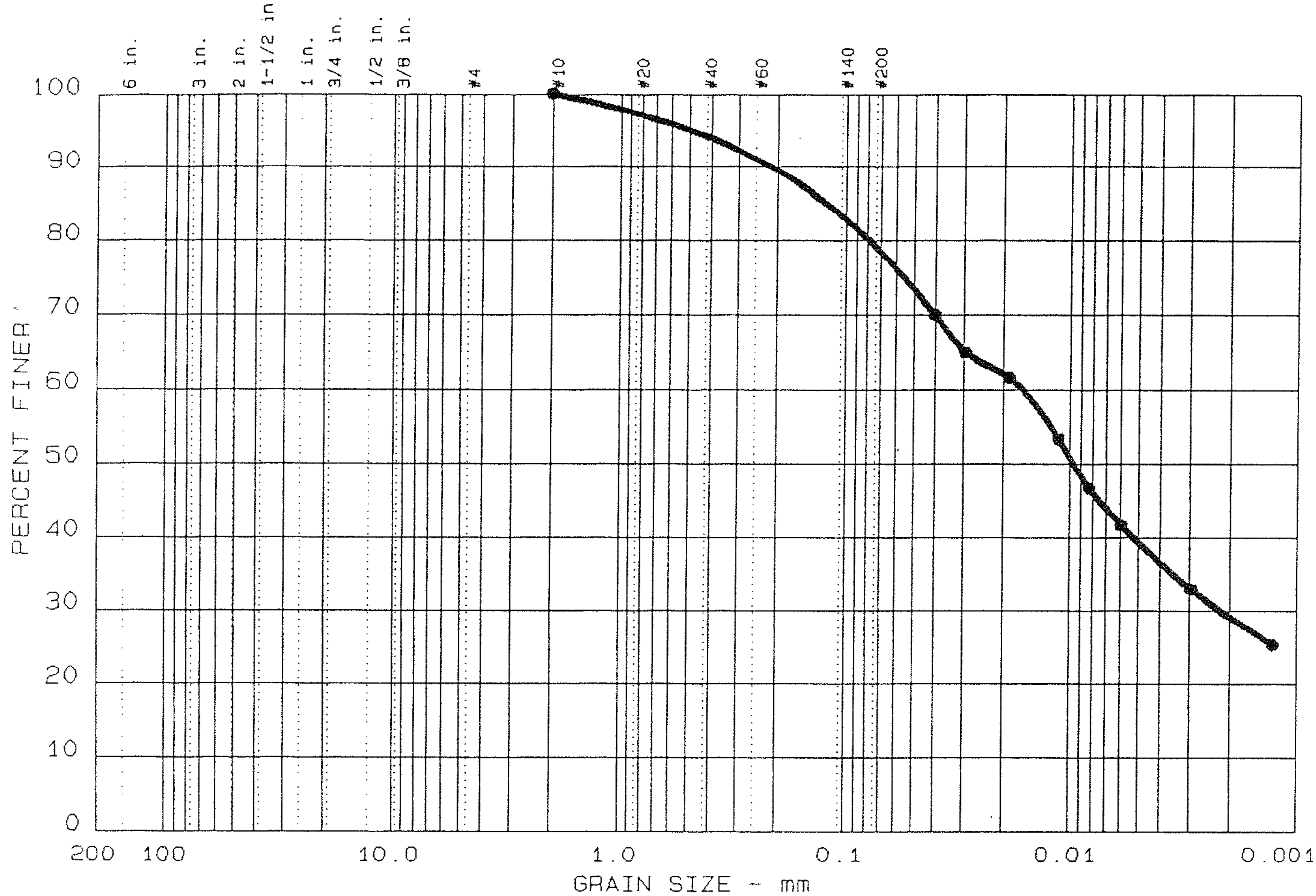
GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Remarks:

Figure No. 15

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	20.8	39.9	39.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.12		0.01	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● CLAYEY SILT	ML	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 2-5

Date: APRIL 1990

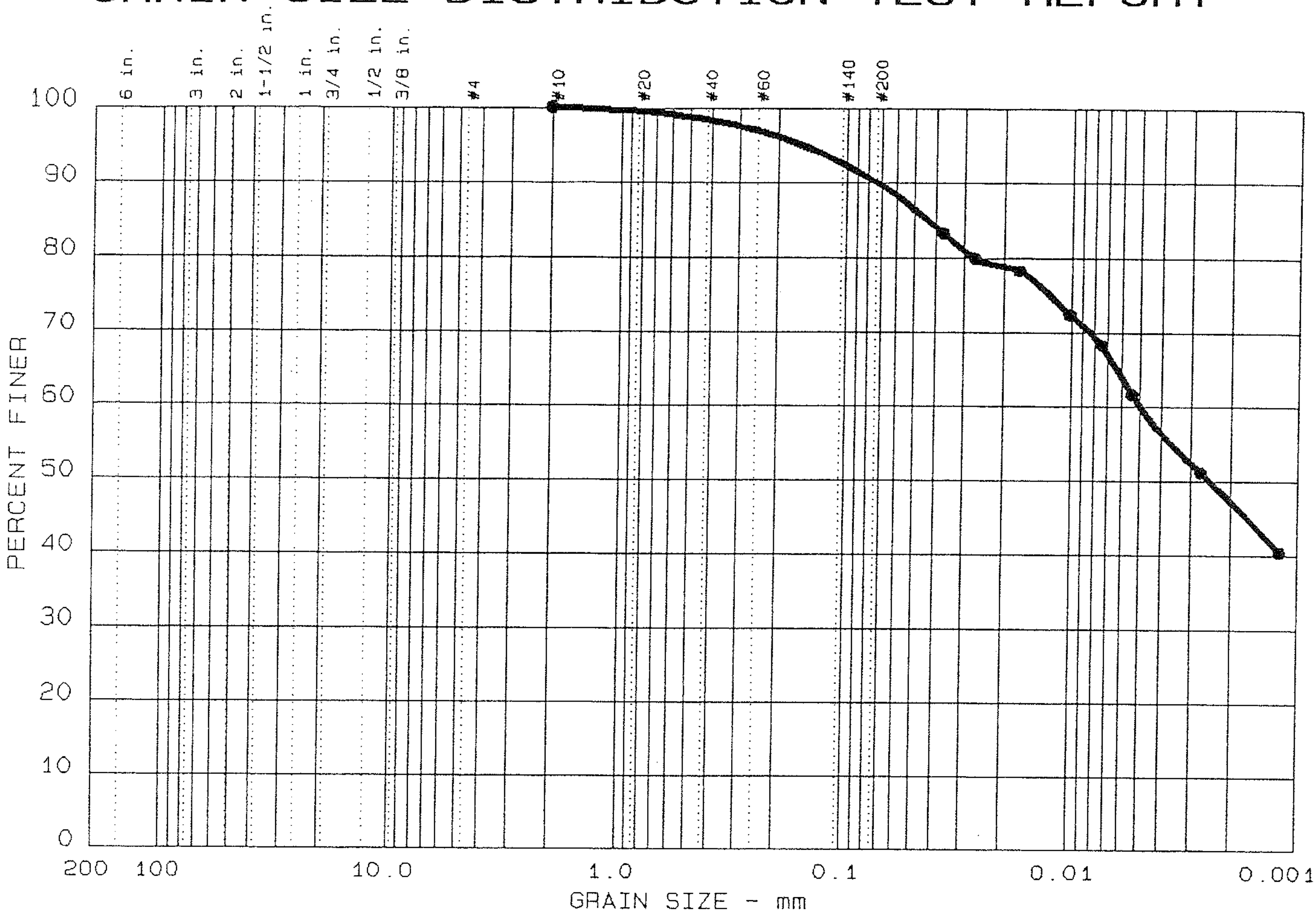
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Figure No. 16

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	9.9	30.1	60.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.00	0.040	0.0050			

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY CLAY	CL	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 3-2

Date: APRIL 1990

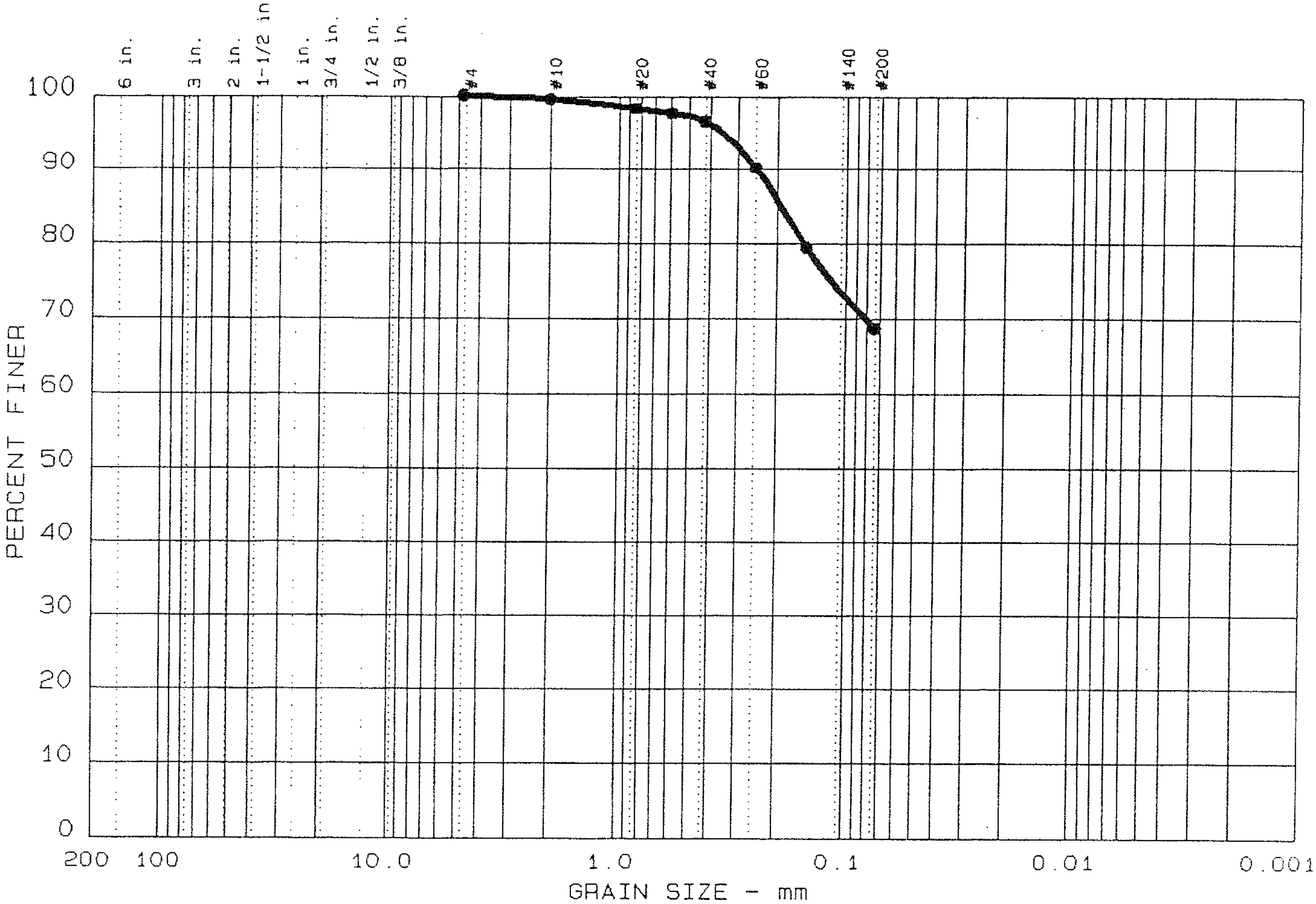
GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Remarks:

Figure No. 17

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	31.3	68.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.19							

MATERIAL DESCRIPTION	USCS	AASHTO
● SANDY CLAY WITH SILT	CL	

Project No.: 2568-1
Project: LAGOON VALLEY
● Location: 5-2

Date: APRIL 1990

GRAIN SIZE DISTRIBUTION TEST REPORT

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

Remarks:

Figure No. 18

APPENDIX C

Norcal Geophysical Consultants, Inc. - Seismic Refraction Survey Report

NORCAL GEOPHYSICAL CONSULTANTS, INC.

June 4, 2003

ENGEO, Inc.
Quarters N. 522 Walnut Avenue
Mare Island, Vallejo, California 94582

Subject: Seismic Refraction Survey
Lagoon Valley
Vacaville, California

Attention: Mr. Jason Bariel

Gentlemen:

This report presents the findings of a seismic refraction survey performed by NORCAL Geophysical Consultants in Vacaville, California. The seismic refraction survey is part of an on-going geotechnical investigation being performed by ENGEO for Triad Development. The seismic refraction survey was performed on May , 2003 by NORCAL Geophysicists William E. Black with the assistance of Geophysical Technicians Travis W. Black and Jeffrey H. Blom. Mr. Bob Boeche of ENGEO provided background information and site logistical support.

SITE DESCRIPTION

The project site covers a portion of the Lagoon Valley Ranch in Solono County, California. The ranch is located on the south side of Lagoon Valley Road, approximately one mile east of Interstate Highway 80. The study area is characterized by relatively flat terrain with a cover of short grass. The site is bisected by a north-south trending creek and is bordered on the north and east by barbed wire fences and on the south and west by rolling hills. An existing gas pipeline parallels Lagoon Valley Road on the east side of the site. At the time of the seismic refraction survey, the study area was being grazed by cattle.

The seismic refraction survey consisted of two lines oriented perpendicular to the creek at a point where the creek meanders west, then east before resuming a north-south trend. This is also the point where the projected trace of the north-northwest trending Lagoon Valley Fault intercepts the creek. Information provided by ENGEO indicates that the study area is probably underlain by alluvium which in turn overlies undifferentiated sedimentary rocks of the Great Valley Sequence.

PURPOSE

Information provided by ENGEO indicates that a residential development will be constructed on the site. In order to determine the proper set-back for the proposed structures, it is necessary to define the location of fault as accurately as possible. Ultimately, the fault trace location will be determined by ENGEO through exploratory trenching. The purpose of the seismic refraction survey is to measure the depth, configuration, and velocity of subsurface seismic layers. We understand that these data will be used by ENGEO, along with surface geologic mapping and air photo interpretation, to help determine the optimum location of the exploratory trenches, and to minimize their lateral extent.

1350 INDUSTRIAL AVENUE, SUITE A • PETALUMA, CA 94952 • TELEPHONE (707) 763-1312 • FAX (707) 762-5587
www.norcalgeophysical.com

DATA ACQUISITION

We obtained seismic refraction data along two seismic lines labeled Line 1 and Line 2, as shown on the Location Map, Plate 1. This is a topographic map that also shows the location of the shot points, the fences and the roads. The seismic lines were positioned so that they slightly overlapped each other along an approximate east-west alignment centered on the mapped trace of the Lagoon Valley Fault.

Each seismic line consisted of seven shot points and 24 geophones distributed at 20-ft intervals in a collinear array (spread). On each line, three of the shot points were evenly distributed within the geophone array (interior shot points), two shot points were located at both ends of the array 20-ft beyond the end geophones (end shot points), and two shot points were offset approximately 300-ft beyond both ends of the array (offset shot points). The end shot points are the minimum that is required for standard seismic refraction data analysis. The interior shot points provide additional information on near surface velocities. The offset shot points provide additional information on the target refractor (competent bedrock). Together, the seven shot points are required for the data analysis technique used for this project (see Data Analysis, below). The 20-ft geophone spacing and 20-ft end shot point offset resulted in Line lengths (end shot point to end shot point) of 500 ft for each seismic line. Since the two seismic lines overlap by approximately 100-ft, the total length of the profile formed by the two lines is approximately 900-ft.

We produced seismic compressional (P) wave energy at each shot point using small explosive charges buried at depths of three to four ft. The charges consisted of 1/3 to 2/3 pounds of binary explosive detonated by instantaneous electrical blasting caps. We detected the resulting P-waves using Mark Products geophones with a natural frequency of 10 Hz. The detected seismic signals were digitized and recorded using a Geometrics 24-channel Strataviewer seismograph. The data were recorded on an internal hard drive and also were printed out on paper strip charts (seismic records).

We used a Trimble Pro XRS global positioning system (GPS) to determine the location and elevation of each seismic refraction line. We also used the GPS to map a segment of Lagoon Valley Road for reference.

DATA ANALYSIS

We downloaded the seismic refraction data from the seismograph to a desk top computer. We then used the computer program Firstpix, by Interpex Ltd, to identify the compressional (P) wave arrivals at each geophone. These arrivals, also referred to as "first breaks", are represented by the point at which the wave trace recorded from a given geophone changes from a straight line to a sinusoidal waveform. The time at which the first break occurs represents the shot point to geophone travel time.

We plotted the P-wave travel times versus the respective shot point to geophone distances to form time vs. distance graphs for each line. By fitting straight line segments to the plotted data points, we determined the number of seismic velocity layers for each line, and the travel times associated with each seismic layer. These data, along with the location and elevation of each shot point and geophone, were then entered into the computer program Gremix by Interpex. The locations and elevations were determined by correlating the GPS data with the topographic map shown on Plate 1. The computer program Gremix is based on the generalized reciprocal method (GRM)[1]. This method has the advantage over standard seismic refraction interpretation techniques of being able to define lateral variations in seismic velocity within a given seismic layer. The software also computes the depth of the seismic layers beneath each shot point and geophone. We then plotted the velocities and depths on two-dimensional (2D) cross-sections representing each seismic line. We used the computer program Surfer by Golden Software to grid and contour the velocities, and to assign colors to the various velocity ranges. The resulting sections show the ground surface, the locations of the interior and end shot points, the depth and configuration of the seismic layers, and their velocity ranges.

RESULTS

The results of the seismic refraction survey are represented by the seismic velocity cross-sections shown on Plates 2 and 3. Our interpretation of the seismic refraction data resolves the subsurface into three seismic velocity layers. The layers are designated, according to increasing depth and velocity, as V1 through V3. The velocity, depth range, and assumed lithology of the three seismic layers are listed in the following table:

Layer	Vp (ft/sec)	Depth Range* (ft)	Assumed Lithology
V1	1050 - 1750	surface	loose, dry surficial deposits (alluvium).
V2	2100 - 5400	4 - 22	more compacted, more moist alluvium; deeply to deeply weathered rock
V3	7600 - 7750	20 - 49	moderately weathered to slightly weathered rock

*to top of layer

SEISMIC VELOCITIES

The velocity range represented by the three seismic layers (V1 - V3) are color coded on Plates 2 and 3. Variations in velocity within each layer are represented by variations in the shade of the assigned color. The higher the velocity, the lighter the shade. There are some cases where the

[1] Palmer, Derecke, 1980, The Generalized Reciprocal Method of Seismic Refraction Interpretation, Society of Exploration Geophysicists, Tulsa, OK

velocity of V2 is so low that it falls into the range of V1. This occurs primarily at the ends of the Lines and may be related to a loss of V2 definition in those areas. However, in most areas, V2 is considerably higher than V1. Similarly, V3 is considerably higher than V2. The average velocities of the three layers are as follows:

V1 = 1325 ft/sec
V2 = 3800 ft/sec
V3 = 7650 ft/sec

INTERPRETATION

Fault traces can be manifest in seismic refraction data in a variety of ways. If a fault causes a vertical offset in a geologic layer (e.g. bedrock) there may be a similar offset in the corresponding seismic interface. If a fault produces a lateral change in geologic properties, or juxtaposes two different rock types, there may be a lateral change in seismic velocity. In either case, the offset or lateral velocity change may result in a travel-time anomaly.

The V2/V3 interface, which we interpret to be the bedrock surface, does not show any abrupt vertical offsets that we would interpret as being fault related. The interface does undulate, but these variations in bedrock elevation could be erosional. We would expect any velocity variations caused by faulting to be within the V3 (bedrock) layer. However, the velocity of V3 is very uniform and only varies by 150 ft/sec. The greatest variation in velocity occurs within the V2 layer which we interpret to be part of the alluvial sequence. The V2 velocity variations are probably caused by changes in the compaction and/or moisture content of the alluvium. Alternatively, the higher velocities in the V2 velocity range may correlate with deeply weathered bedrock. Finally, the seismic refraction data are very uniform and do not exhibit travel time anomalies that are indicative of faulting.

STANDARD CARE AND WARRANTY

The scope of services for this project consisted of using the seismic refraction method to define subsurface seismic velocities and depths. The accuracy of our findings is subject to specific site conditions and limitations inherent to the seismic refraction technique. We performed our services in a manner consistent with the level of skill 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.

We appreciate the opportunity to provide our services to ENGEO, Inc. for this project. Should you require additional geophysical services or have questions regarding this survey, please do not hesitate to call.

Sincerely,

NORCAL Geophysical Consultants, Inc.

William E. Black
Geophysicist GP-843

WEB/jm

Enclosures: Plates 1- 3

REGISTERED GEOPHYSICIST
WILLIAM E. BLACK
EXPIRES 7-04
NO. 843
STATE OF CALIFORNIA

PRELIMINARY
GEOTECHNICAL EXPLORATION

COMMERCIAL DEVELOPMENT
LAGOON VALLEY

VACAVILLE, CALIFORNIA

SUBMITTED

TO

TRIAD GROUP

VALLEJO, CALIFORNIA

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 5489.2.003.01

AUGUST 14, 2003

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Project No.
5489.2.003.01

August 14, 2003

Mr. Tom Egidio
Triad Development
1095 Hiddenbrooke Parkway
Vallejo, CA 94591

Subject: Commercial Development
Lagoon Valley
Vacaville, California

PRELIMINARY GEOTECHNICAL EXPLORATION

Dear Mr. Egidio:

With your authorization, ENGEO Incorporated has conducted a preliminary geotechnical exploration to be used in preparation of an Environmental Impact Report (EIR) for the planned commercial development at Lagoon Valley in Vacaville, California. The accompanying report presents the results of our site exploration and planning-level conclusions and recommendations appropriate for site development.

Based on our study, it is our opinion that the currently proposed development is feasible from a geotechnical standpoint provided the recommendations included in this report are incorporated into development plans and implemented during construction. Once details regarding building types and layout, structural loads, grading for planned commercial uses at this site have been developed, it is recommended that design-level geotechnical explorations should be performed to address details regarding geotechnical aspects of the planned development. We are pleased to provide our services to you on this project and look forward to consulting further with you and your design team.

Very truly yours,

ENGEO INCORPORATED

Stefanos A. Papadopulos
Staff Engineer

Robert Boeche, RG
Project Geologist
sp/rb/jd:pregex

Reviewed by:

Theodore P. Bayham, GE, CEG
Principal

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INTRODUCTION

Purpose and Scope

The purpose of this geotechnical study has been to characterize geologic hazards and soil conditions at this site to provide planning-level geotechnical conclusions and recommendations pertinent to future planned uses of this property for commercial development.

The scope of our exploration included the following:

- Review of pertinent geologic maps and literature.
- Examination of stereographic aerial photographs covering the site.
- Geologic reconnaissance of the site.
- Drilling and logging of 4 exploratory borings.
- Laboratory testing of soil and bedrock materials including moisture content, dry density, Atterberg limits, fines content, and hydrometer analysis.
- Analysis of the geological and geotechnical data.
- Preparation of this report summarizing our findings, conclusions and recommendations for future site development.

This report was prepared for the exclusive use of Triad Development and its design team consultants. In the event that any changes are made in the character, design, or layout of the development, the conclusions and recommendations contained in this report should be reviewed by ENGEO Incorporated to determine whether modifications to the report are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without the express written consent of ENGEO Incorporated.

Site Location and Description

The project site is located in Vacaville, California. The subject 88-acre site is bounded to the north and west by Interstate 80 (I-80), east by Lagoon Lake, and south by Lagoon Valley Road as shown on Figure 1. The planned development area primarily consists of undeveloped open land with portions are occupied by ranching property to the north. The ranching property is named Ranchotel and consists of a one-story building with open space parking around it with ancillary structures including barns, stables and corrals.

Proposed Development

Details regarding the planned commercial uses at the site are preliminary at this time. However, we understand that preliminary development plans are to include a number of commercial building structures and related access roads and parking within the 88-acre property. Although the number of buildings has not been specified, we understand that approximately one million square feet of commercial space is envisioned. This may include both small and large buildings with multiple levels. Structural building loads and footprints have not been determined at this time; however, based on other commercial developments, these may range from light to heavy foundation loads and include floor slabs-on-grade.

Previous Work

Anderson Geotechnical Consultants had performed geotechnical investigation for Lagoon Valley property circa 1990. Previous exploratory borings were located adjacent to the south and to the west of the proposed commercial development area. In addition, ENGEO completed a preliminary geotechnical study for the Lagoon Valley Residential/Recreational development in 2003 including areas adjacent to the south of the proposed Lagoon Valley commercial development area, as described in the References.

GEOLOGY AND SEISMICITY

Geologic Setting

As mapped by Graymer (2002) on the Regional Geologic Map, Figure 2, the geologic setting of this region has included episodes of tectonic uplift, tilting, folding and faulting, followed by episodes of deposition of alluvium. The majority of this uplift and tilting is believed to have occurred during Pleistocene time, beginning around 2 million years ago. Deposition of Pleistocene alluvium along the southern portion of the site covered the bedrock basement units with unconsolidated sand, silt, clay and gravel (Qpf). There have been subsequent deposition of more recent Holocene alluvium (Qha) comprising clays, silts and sands primarily mapped along the west and north side of the property, and Holocene age alluvial fan deposits (Qhf) along the central and west side of the property, overlying areas of older Pleistocene alluvium.

Faulting and Seismicity

The site is not located within a State of California Earthquake Fault Zone. No active faults are mapped on the property. The nearest active fault is the Great Valley fault, located about 5 miles east of the site. Although the Great Valley fault is close to the site, the activity status of the active Concord-Green Valley fault, located 9.8 miles west, suggests that it presents a greater seismic risk to the site (Figure 3).

The Working Group on California Earthquake Probabilities (WGEP, 1999) evaluated the 30-year probability of a M6.7 or greater earthquake occurring on the known active fault systems in the Bay Area, including the nearby Concord-Green Valley fault. The WGEP calculated an overall probability of 70 percent for the Bay Area as a whole. The Concord-Green Valley fault is assigned a 30-year probability of 6 percent.

A postulated concealed fault, known as the Lagoon Valley fault has been mapped by Sims (1973), and Graymer (2002), shown to traverse the northeastern portion of the site, as depicted on Figure 2. This fault has been mapped as two subparallel traces to the south of the site. The westernmost extension of the fault trace has been mapped as concealed by the alluvium underlying sediments of Lagoon Valley. Also, a mapped eastern trace is shown to terminate south of the subject site. Anderson Geotechnical Consultants (AGC) previously performed geologic exploration where the fault had been previously mapped to the south (1990, 1991) and projecting where the fault had been shown to extend as a concealed feature across Lagoon Valley. The AGC study found no evidence of the extension of the fault as previously mapped by others. Additionally, in June 2003, ENGEO performed a preliminary geotechnical study for the Lagoon Valley Residential/Recreational Development located immediately adjacent to the south of the proposed planned commercial development area. The June 2003 ENGEO study included further geophysical evaluation of the previously mapped concealed fault trace using seismic refraction methods for any suggested evidence of anomalies possibly related to a concealed fault requiring further exploration. No evidence suggestive of faulting within alluvial soils explored was identified in the supplemental geophysical work. Based on previous work by AGC and findings of the recent ENGEO study, it was concluded that there were no indications of active or potentially active fault traces traversing the planned residential development area, as previously postulated.

It should be noted that concurrent with this study, ENGEO performed additional geophysical exploration also traversing the alignment of the previously mapped concealed fault trace to evaluate any evidence suggestive of faulting (Figure 4). According to preliminary geophysical results, these seismic lines showed no discernable anomalies suggestive of fault traces within alluvial soils. The final results will be issued in a separate letter. Based on the preliminary information, it is concluded that no indications of active or potentially active fault traces traverse the planned commercial development area, as previously postulated.

GEOTECHNICAL EXPLORATION

The field exploration for this study was conducted on July 30, 2003, and consisted of drilling four exploratory borings to depths ranging from 26.5 to 41.5 feet deep. The approximate boring locations are shown on Figure 4. These areas of subsurface exploration were located by pacing from existing features, and the elevations were estimated from the plans provided at the time of our study.

The borings were drilled using a truck-mounted drill rig equipped with 4-inch-diameter solid flight augers. An ENGEO Geologist logged the boreholes in the field and collected soil samples using a 1½-inch O.D. Standard Penetration Test (SPT) sampler or a 3-inch O.D. California-type split-spoon sampler fitted with 6-inch-long brass liners. The 3-inch-diameter split-spoon sampler was advanced by a 140-pound cat-head hammer with a 30-inch drop. The penetration of the sampler into the native materials is field recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. Results on the boring logs are recorded as the number of blows required for the last one foot of penetration. No correction factors have been applied to field blow counts presented on the borelogs.

The field logs were used to develop the boring logs as presented in Appendix A. The logs depict subsurface conditions within the borings for the date of drilling; however, subsurface conditions may vary with time. The boreholes were backfilled to the ground surface with site soil on the day of the field exploration.

Laboratory Testing

Following drilling, we re-examined the samples in our laboratory to confirm field classifications. Representative samples recovered from our borings were tested for the following physical characteristics:

Characteristic	Test Method	Location of Results Within this Report
Natural Unit Weight	ASTM D-2216	Appendix A
Natural Moisture Content	ASTM D-2216	Appendix A
Gradation (% Fines)	ASTM D-422-63	Appendix B
Hydrometer Analysis	ASTM D- 422-63	Appendix B
Atterberg Limits	ASTM D-4318	Appendix B

Subsurface Conditions

Existing Uncontrolled Fills. Deposits of undocumented fill are apparent in topographic mounds evident at the site associated with previous grading for existing site improvements including roads, earthen berms, stock ponds, etc. These uncontrolled fills can be expected to consist of mixtures of soil, rock fragments, and contain possible debris and other deleterious matter.

Holocene Alluvium. Deposits of alluvium from the Holocene period occur on the central and eastern portions of the site. These deposits typically consist of unconsolidated sediments comprising silts, clays, sands and gravels. At Boring B-3, a near-surface layer of dark brown stiff clay was encountered extending to depths of approximately 5 feet. This material was underlain by yellowish brown stiff silty clay with some sand.

.

Holocene Alluvial Fans. Alluvial fans of the Holocene age appear to occur along the west and north limits of the site. These fans were created by water deposits consisting of silty clays, clays, silts, clayey sands and clayey gravel, with minor lenses of sand. At Borings B-2 and B-4, soils generally consist of silty clay and clay deposits extending to depths of approximately 30 feet.

Pleistocene Alluvium. The southern flat-lying portion of the site consists of alluvium, as shown on Figure 4. The Pleistocene alluvium deposits can be expected to consist of sand, silt, clay and gravel. At Boring B-1, a near-surface stiff clay layer was approximately 3 feet thick. The clay is directly underlain by interbedded layers of silty sands and silty clays. Occasional layers of silty and clayey sands we encountered at increased depths.

Groundwater

In Borings B-1, B-2, B-3, and B-4, groundwater was encountered at depths of about 8 feet below the existing ground surface. Groundwater conditions are expected to vary depending on factors such as weather conditions, time of year, and irrigation practices

SEISMIC HAZARDS

General

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. Secondary seismic hazards include ground shaking, ground lurching, soil liquefaction and lateral spreading. These hazards are discussed in the following sections.

Seismic Hazards

Ground Rupture. Since there are no known active faults crossing the site and the property is not within an Earthquake Fault Special Study Zone, the likelihood of primary fault ground rupture is considered low at this site.

Ground Shaking. An earthquake of moderate to high magnitude generated within the San Francisco Bay Region, similar to that which has occurred in the past, could cause considerable ground shaking at the site. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the latest Uniform Building Code (UBC) requirements as a minimum.

Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead and live loads. The code prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage.

Based on the subsurface soil conditions encountered and the Concord-Green Valley fault seismic source, the site may be characterized for design based on Chapter 16 of the 1997 UBC using the following information:

Categorization/Coefficient	Design Value
Soil Profile Type (Table 16-J)	S_D
Seismic Zone (Figure 16A-2)	4
Seismic Zone Factor (Table 16-I)	0.4
Seismic Source Type (Table 16-U)	B
Near Source Factor N_a (Table 16-S)	1.0
Near Source Factor N_v (Table 16-T)	1.0
Seismic Coefficient C_a (Table 16-Q)	0.44 N_a
Seismic Coefficient C_v (Table 16-R)	0.64 N_v

Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur, in the event of a maximum magnitude earthquake. However, it is reasonable to expect that a well-designed and well-constructed structure will not collapse in a major earthquake (SEAOC, 1996). The structures should be designed by a Structural Engineer and in accordance with current UBC requirements to address the nature of the site specific soils, seismicity and near source effects.

Lurching. Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form. The potential for the formation of these cracks is considered greater at contacts between deep alluvium and bedrock. While such an occurrence is possible at the site as in other locations in the Bay Area, the offset or strain is expected to be minor.

Seismically-Induced Landslides. Seismically-induced landslides are triggered by earthquake ground shaking. Given the relatively gently sloping topography at this site it is our opinion that the hazard of seismically-induced landslides to the proposed structures is low.

Liquefaction. Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary, but essentially total, loss of shear strength because of pore pressure build-up under the reversing cyclic shear stresses associated with earthquakes. Based on the material types and densities (blow counts) of granular materials encountered in our borings, some of the sand layers could be marginally liquefiable and should be further characterized in connection with the planned development. Seismically induced settlements are discussed in further detail under the Conclusions section of this report.

Lateral Spreading. Lateral spreading is a failure within a nearly horizontal soil zone (possibly due to liquefaction) which causes the overlying soil mass to move toward a free face, or down a gentle slope. In general, recorded blow counts of the silty sand layers encountered in our boring suggest lateral spreading is not likely at this site; however, depending on findings of design level studies, further evaluation of lateral spreading should be characterized as it relates to the planned commercial development.

Seiches. Lagoon Valley Lake is located immediately to the east of the proposed development and it provides a natural drainage basin for the entire site. Water elevation in the lake are shown to be at approximately 212 feet above mean sea level datum (msl), and an earthen berm along the lake is shown at elevation 217 feet. Preliminary grading plans of the site show elevations of 218 feet at the northern limits of the development. In March 1986, records indicate that the lake water level rose to within 1.5 feet of the top of the berm. An evaluation of the adequacy of the earthen berm to retain lake water considering long-term conditions has not been included in the scope of this study. Such an evaluation is appropriate given free water levels with respect to preliminary site grades at the commercial development area. It is recommended that the adequacy of the earthen berm be evaluated in connection with the areas of planned development adjacent to the lake.

Soil Corrosivity Potential

Alkali soils observed in the main valley suggest that some of the alluvial soils may have high corrosion potential. It is recommended that site-specific characterization of corrosion potential of the on-site soils be evaluated in conjunction with future geotechnical exploration for the project.

CONCLUSIONS

Based on the results of this preliminary study, it is our opinion that the proposed development is feasible from a geotechnical standpoint provided that conclusions and recommendations presented in this report are addressed in future design-level geotechnical studies, and incorporated into planning and design for the project. The main geotechnical concerns for the planned site development are: (1) presence of discontinuous sandy soil deposits encountered at depths ranging between about 8 to 31 feet, which could be considered marginally susceptibility to seismically induced settlements (i.e., liquefaction) depending on their density, fine content, depth and occurrence; (2) presence of near-surface expansive soils considered susceptible to volume changes (shrink and swell) with fluctuation in moisture content; and (3) presence of undocumented man-made fill materials within areas of planned development considered susceptible to excessive total and differential settlements. These concerns as well as other preliminary geotechnical engineering issues that should be addressed in future studies are discussed in the following sections of this report.

Seismically Induced Settlements

Borings B-1 and B-2 drilled on the central and southern portions of the site encountered some layers of medium dense silty and clayey sands, which appeared to be discontinuous. These materials were encountered below free groundwater levels at depths ranging between 8 and 31 feet. The thickness of these layers varied from about 5 to 15 feet. Depending on specific variations in fine content, thickness of layers, in situ densities, and groundwater levels, the sandy layers may be considered marginally susceptible to seismically induced deformations, such as liquefaction and even possibly lateral spreading. Potential settlements and related hazards of liquefiable soils could impact foundation support of overlying structures, result in excessive settlement and cause damage to other related site improvements if the on-site soils are liquefiable, depending on its occurrence and level of severity. As such, it is recommended that design-level geotechnical exploration further characterize liquefaction potential for the planned commercial development and potential related seismically induced deformations. Such studies should include appropriate exploratory methods such as rotary wash drilling methods and/or cone penetrometer testing (CPT) to address potential liquefaction to provide appropriate mitigation, as deemed necessary for the planned development.

Expansive Soils

A significant geotechnical concern is the expansive nature of the native soils in the proposed development area. The clayey soils in this region have moderate plasticity and moderate expansion potentials with Plasticity Indices of 16 to 19. However, in our investigation to the south of the site we encountered clayey soils with Plasticity Indices of 22 to 45, which are highly expansive. Expansive soils shrink and swell as a result of seasonal fluctuation in moisture content. This can cause heaving and cracking of slabs-on-grade, pavements and structures founded on shallow foundations. Building damage due to volume changes associated with expansive soils can be reduced through proper grading and foundation design.

Successful construction on expansive soils requires special attention during construction. It is imperative that exposed soils be kept moist by watering for several days before placement of concrete. It is extremely difficult to remoisturize clayey soils without excavation, moisture conditioning and recompaction. Mitigation measures should include the prevention of moisture variation.

Existing Undocumented Fills

As discussed earlier, areas of uncontrolled existing fills were mapped on the site. Depths and extent of these fills may vary at the site. In general, uncontrolled fills are considered susceptible to excessive total and differential settlements. To reduce settlements resulting from unsuitable fills, where these fills will be located below structures or improvements, they should be completely over-excavated and replaced with engineered fill. The actual extent of the existing unsuitable fills should be determined during grading.

In general, if existing fills are cleared of unsuitable debris and rubble, oversized-rock fragments, and any hazardous or deleterious materials (if encountered), these materials are anticipated, from a geotechnical standpoint, to be suitable for reuse as engineered fill.

Grading Concepts

As mentioned above, a geotechnical exploration of the site should be performed to further evaluate the geologic conditions described in this report; to characterize the engineering properties of soil. The recommendations presented herein are for planning purposes and will be refined as part of the geotechnical investigation.

In general, graded slopes should be no steeper than 2:1 (horizontal:vertical). Detailed fill placement recommendations will be provided based on laboratory testing and analysis performed in conjunction with a design-level geotechnical exploration for the project.

Successful construction on expansive soils requires special attention during construction. It is imperative that exposed soils be kept moist by watering for several days before placement of concrete. It is extremely difficult to remoisturize clayey soils without excavation, moisture conditioning and recompaction. Mitigation measures should include the prevention of moisture variation.

Conceptual Foundation Design

Several considerations may affect appropriate foundation design for this project. These include risk of seismically induced settlements, potential expansive soils, building types, footprints and anticipated foundation loads. Regarding swell potential, shallow type foundations such as shallow continuous and spread column footings may be suitable provided these are deepened to extend below depths of seasonal moisture fluctuation. Floor slabs underlain by expansive soils may require replacement with a layer of low expansive materials, or treatment of expansive soils with lime amendment to reduce expansion potential. Alternatively, depending on local severity of the expansive soils in building area, other treatments to reduce adverse effects of expansion may include moisture conditioning and pre-saturation of soils prior to foundation construction.

If further studies determine that seismically-induced settlements pose risks to planned development, then foundation design should consider acceptable degrees of deflection/settlement in these areas to determine whether or not shallow footing systems fall within tolerable ranges for deflection anticipated. If shallow foundations are determined not to be suitable for the planned structure based on estimated deflections, then alternate foundation systems such as stiff reinforced mat foundations or possible deep foundations such as drilled piers or driven piles may be appropriate. Also, depending upon actual foundation loading scenarios of commercial structures, appropriate foundation systems should be considered in design-level geotechnical studies.

Secondary Slab-on-Grade Construction

Secondary slabs include exterior walkways, access drives and steps. In order to allow slab movement to occur with minimal foundation distress, secondary slabs-on-grade should be constructed structurally independent of the foundation system. Differential movement between secondary slabs and foundation elements should be expected. An expansion joint material should be provided between architectural/structural elements constructed on adjacent secondary and foundation slabs to allow for each element to move independently and with minimal distress to the adjacent element. Where slab-on-grade construction is anticipated, care must be exercised in attaining a near-saturation condition of the subgrade soil before concrete placement.

Secondary slabs-on-grade should be designed specifically for their intended use and loading requirements. Some of the site soils have a moderate expansion potential; therefore, cracking of the slabs should be expected. Frequent control joints should be provided during slab construction for control of cracking.

Exterior slabs may be constructed with thickened edges extending at least 6 inches into compacted soil to minimize water infiltration, and they should slope away from the building to prevent water from flowing toward the structure. In general, secondary slabs-on-grade should have a minimum thickness of 4 inches and should be underlain by a 4-inch-thick layer of clean, crushed rock or gravel. As a minimum requirement, slabs-on-grade should be reinforced with No. 3 bars spaced 16 inches on center each way for control of cracking. The actual slab reinforcement should be designed by the Structural Engineer. In our experience, welded wire mesh may not be sufficient to control slab cracking.

Preliminary Pavement Design

The exploratory test borings exposed sandy and silty clays near the surface of the site. Based on the field exploration, we have assumed a Resistance Value (R-value) of 5 for the street subgrades in calculating pavement sections. The following preliminary pavement sections have been determined for a Traffic Index of 4.5, 5, 6, 7, 8 and the assumed R-value of 5 in accordance to methods contained in Topic 608 of Highway Design Manual by Caltrans.

Traffic Index	R-Value	Asphaltic Concrete	AB Rock (R=78 minimum)
4.5	5	2.5 inches	10 inches
5	5	3.0 inches	10 inches
6	5	3.5 inches	13 inches
7	5	4.0 inches	16 inches
8	5	5.0 inches	18 inches

Pavement materials and construction should conform to the specifications and requirements of the Standard Specifications by the Division of Highways, Department of Public Works, State of California, latest edition, City of Vacaville requirements.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is issued with the understanding that it is the responsibility of the owner to transmit the information and recommendations of this report to developers, contractors, buyers, architects, engineers, and designers for the project so that the necessary steps can be taken by the contractors and subcontractors to carry out such recommendations in the field. The conclusions and recommendations contained in this report are solely professional opinions.

The professional staff of ENGEO Incorporated strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. There are risks of earth movement and property damages inherent in land development. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our work.

This report is based upon field and other conditions discovered at the time of preparation of ENGEO's work. This document must not be subject to unauthorized reuse, that is, reuse without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time. Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's work. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include on-site construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims, including, but not limited to claims arising from or resulting from the performance of such services by other persons or entities, and any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

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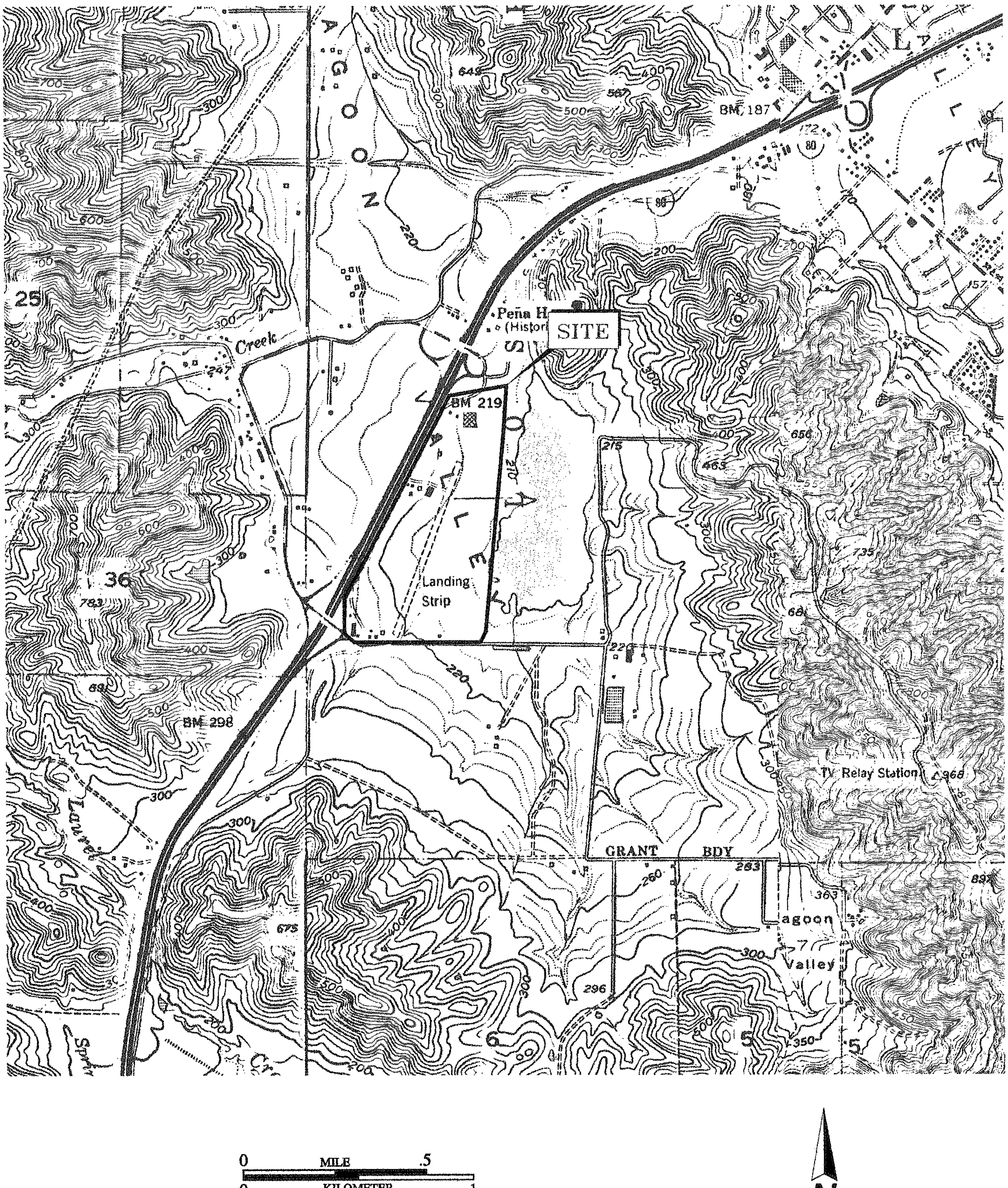
LIST OF FIGURES



BASE MAP SOURCE: USGS

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

VICINITY MAP

COMMERCIAL DEVELOPMENT LAGOON VALLEY

VACAVILLE, CALIFORNIA

PROJECT NO.: 5489.2.003.01

DATE: AUGUST 2003

DRAWN BY: CLL

CHECKED BY: SAP

FIGURE NO. 1

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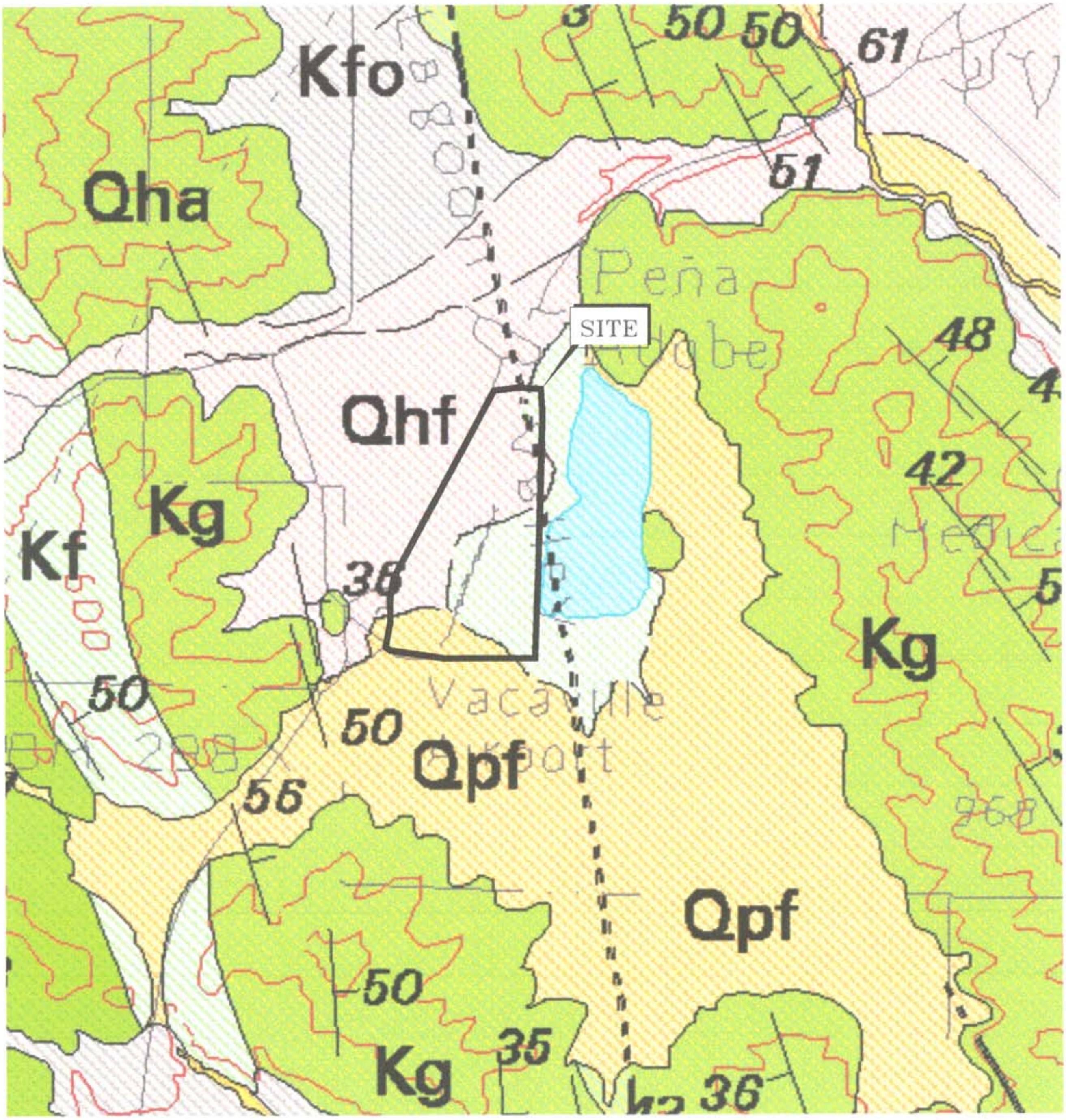

EXPLANATION

Kg	GUINDA FORMATION (LATE CRETACEOUS)
Qha	ALLUVIUM (HOLOCENE)
Qhf	ALLUVIAL FAN DEPOSIT (HOLOCENE)
Qpf	ALLUVIAL FAN DEPOSITS (PLEISTOCENE)

FAULT–DASHED WHERE APPROXIMATELY LOCATED SHORT DASHED WHERE INFERRED, DOTTED WHERE CONCEALED, QUERIED WHERE LOCATION IS UNCERTAIN

0 MILE .5
0 KILOMETER 1

N

BASE MAP SOURCE: GRAYMER, 2002

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

REGIONAL GEOLOGIC MAP
COMMERCIAL DEVELOPMENT LAGOON VALLEY
VACAVILLE, CALIFORNIA

PROJECT NO.: 5489.2.003.01		FIGURE NO. 2
DATE: AUGUST 2003		
DRAWN BY: CLL	CHECKED BY: SAP	

ORIGINAL FIGURE PRINTED IN COLOR

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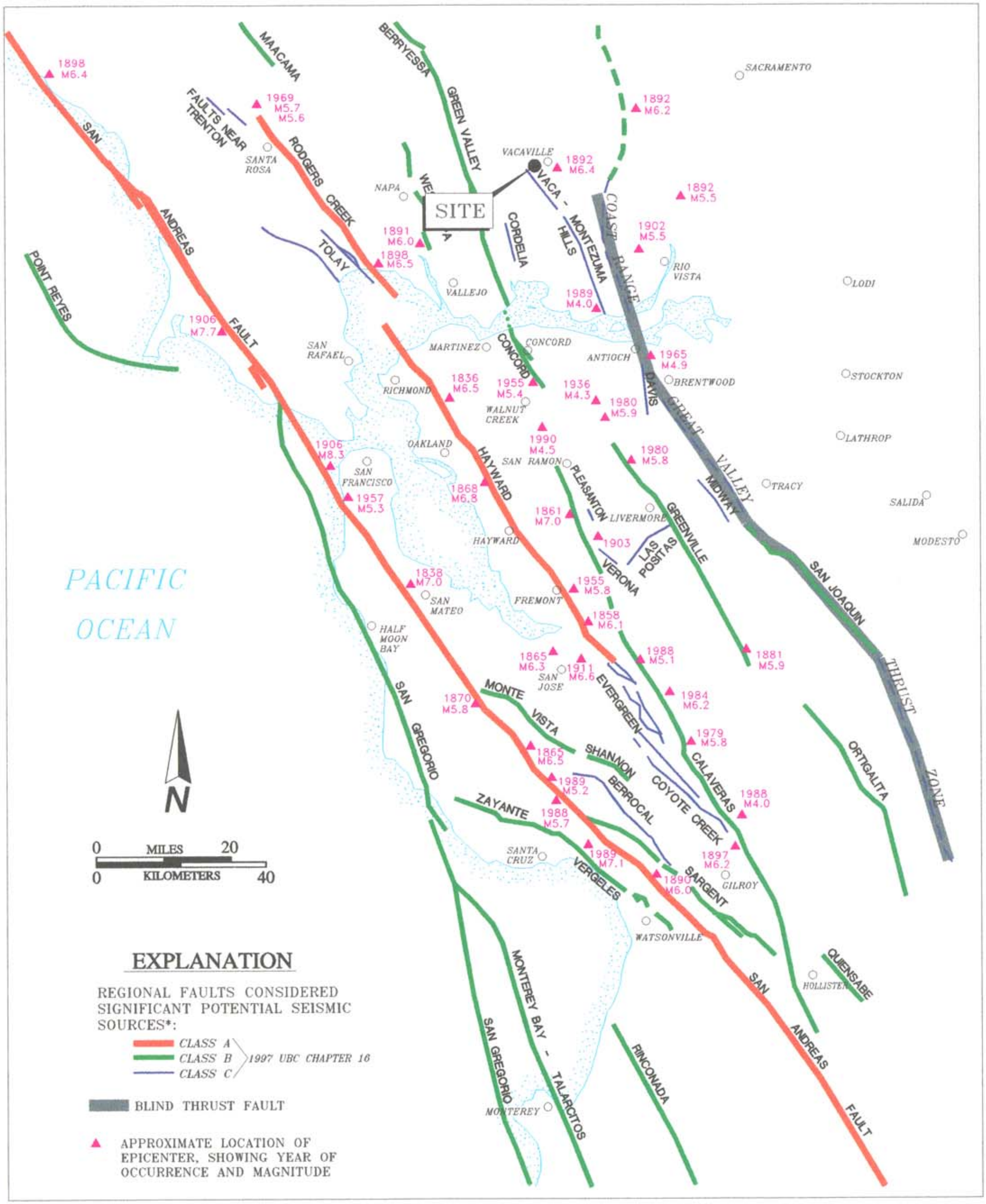

*BASED ON USGS OPEN FILE 96-706

ENGEO INCORPORATED — EXCELLENT SERVICE SINCE 1971	REGIONAL FAULTING AND SEISMICITY COMMERCIAL DEVELOPMENT LAGOON VALLEY VACAVILLE, CALIFORNIA	PROJECT NO.: 5489.2.003.01 DATE: AUGUST 2003 DRAWN BY: CLL CHECKED BY: SAP	FIGURE NO. 3

ORIGINAL FIGURE PRINTED IN COLOR

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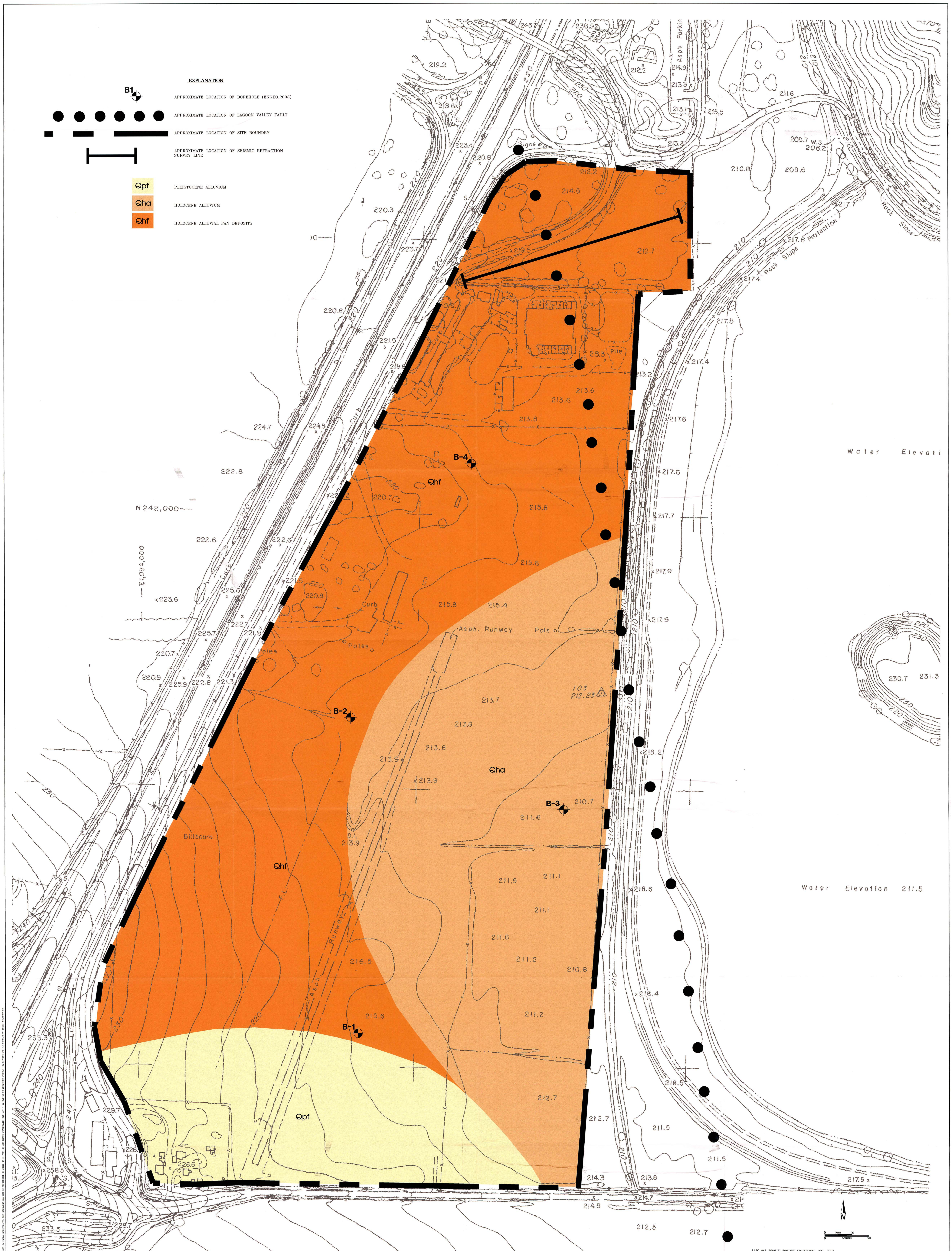

BASE MAP SOURCE: PHILLIPPI ENGINEERING, INC., 2002

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	PRELIMINARY GEOLOGIC MAP COMMERCIAL DEVELOPMENT LAGOON VALLEY VACAVILLE, CALIFORNIA	PROJECT NO.: 5489.2.003.01 DATE: AUGUST 2003 DRAWN BY: CLL CHECKED BY: SAP	FIGURE NO. 4

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APPENDIX A

Boring Logs

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW - Well graded gravels or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Inorganic silt with high plasticity CH - Inorganic clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE: 200 — 40 — 10 — 4
CLEAR SQUARE SIEVE OPENINGS: 3/4 " — 3" — 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*	BLOWS/FOOT (S.P.T.)
VERY SOFT	0-1/4	0-2
SOFT	1/4-1/2	2-4
MEDIUM STIFF	1/2-1	4-8
STIFF	1-2	8-15
VERY STIFF	2-4	15-30
HARD	OVER 4	OVER 30

MOISTURE CONDITION

DRY	Absence of moisture, dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater
SATURATED	Below the water table

MINOR CONSTITUENT QUANTITIES (BY WEIGHT)

TRACE	Particles are present, but estimated to the less than 5%
SOME	5 to 15%
WITH	15 to 30%
........Y	30 to 50%

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Continuous Core
- Bag Samples
- NR No Recovery

LINE TYPES

- ________ Solid - Layer Break
- \- - - - - - Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- ▽ Groundwater level during drilling
- ▼ Stabilized groundwater level

ENGEO INCORPORATED
1971-2001 * 30 YEARS OF EXCELLENCE

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

DATE OF BORING: July 30, 2003

SURFACE ELEVATION: Approx. 215 feet (66 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			TOPSOIL.				
			SILTY CLAY (CL), dark grey, stiff to very stiff, dry.				
		1-1-1		22	3.5*		
	1		CLAY (CL), light brown, very stiff, moist, trace fine to coarse sand.				
		1-2-1		30	2.5*		
5	2						
			CLAYEY SAND (SC), yellowish brown, medium dense, moist, with clay.				
		1-3-1		17	1.5*		
			▽				
10	3		SILTY SAND (SM), yellowish brown, medium dense, wet.				
		1-4		15			
	4						
15	5	1-5-1 1-5-2	SILTY SAND (SM), brown, medium dense, moist.	25			
20	6		SILTY SAND (SM), brown, medium dense, moist to wet.				
		1-6-1 1-6-2		14			
	7		SILTY CLAY (CL), dark yellowish brown, stiff, with trace of sand.				
25			CLAY (CL), yellowish brown, very stiff, moist, sand pockets with medium sand.				
	8	1-7		46	3.5*		
			Bottom of boring at approximately 26 1/2 feet. Groundwater encountered at approximately 9 1/2 feet.				
30	9						

ENGEO_BORELOG 5489200301_LAGOONVALLEY.GPJ 8/20/03

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 1

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

CHECKED BY SJ

FIGURE NO. A1

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: July 30, 2003 SURFACE ELEVATION: Approx. 215 feet (66 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				TOPSOIL.				
	1	2-1-1		SILTY CLAY (CL), dark brown, very stiff, dry, trace fine sand.	34			
5	2	2-2-1		SILTY CLAY (CL), dark brown, very stiff, dry.	45	3.0*		
		2-3-2		▽ Grades dark gray, stiff, with trace of organics.	19	1.0*		
10	3							
	4	2-4-1		Grades to light brown and increasing fine sand, content, becoming very stiff.	29	2.0*		
15	5							
		2-5-1		SANDY CLAY (CL), light brown, very stiff, moist, with lenses of fine sand.	38	2.75*		
20	6	2-6-1		SANDY CLAY (CL), light brown, very stiff, moist to wet, with lenses of fine sand.	41	2.0*		
	7							
25	8	2-7-1		SILTY SAND (SM), brown, medium dense, wet, fine to medium, organic odor.	12			
30	9							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 2

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

CHECKED BY SJ

FIGURE NO. A2

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: July 30, 2003 SURFACE ELEVATION: Approx. 215 feet (66 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
30		2-8-2 2-8-1		SILTY SAND (SM), brown, loose to medium dense, wet.	19			
	10			CLAY (CH), mottled light gray and yellowish brown, stiff, dry, some fine to medium sand.				
35	11	2-9-2 2-9-1		CLAY (CH), mottled light gray and yellowish brown, very stiff, moist, trace coarse sand, some fine to medium sand.	25			
40	12			CLAY (CH), light yellowish brown, some light gray pockets, very stiff, moist, trace medium sand.	23			
	13			Bottom of boring at approximately 41 1/2 feet. Groundwater encountered at approximately 8 feet.				
45	14							
50	15							
	16							
55	17							
60	18							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 2

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

CHECKED BY SJ

FIGURE NO. A2

ENGEO_BORELOG 5489200301_LAGOONVALLEY.GPJ 8/20/03

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
			DATE OF BORING: July 30, 2003 SURFACE ELEVATION: Approx. 211 feet (64 meters)				
0			TOPSOIL.				
	1	3-1-1	CLAY (CL), dark gray to black, very stiff, dry, trace fine white sand pockets.	37	3.0*		
5	2	3-2-1	CLAY (CL), yellowish brown mottled light brown, very stiff, dry, some pockets of white fine sand,	32	1.75*		
		3-3-1	▽ CLAY (CH), grayish brown, very stiff, moist.	27	1.5*		
10	3	3-4-1	CLAY (CL), yellowish brown, stiff, moist, trace sand seams.	16	1.0*		
	4						
15	5	3-5-1	SILTY CLAY (CL), yellowish brown mottled black, stiff, moist, with layers and seams of fine silty sand.	18	0.5*		
20	6	3-6	SILTY SAND (SC), yellowish brown, medium dense, wet, fine to medium grained.	24			
25	7						
	8	3-7-2 3-7-1	CLAY (CL), yellowish brown, stiff, moist, trace fine sand in seams.	14			
30	9						

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 3

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

CHECKED BY SL

FIGURE NO. A3

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: July 30, 2003 SURFACE ELEVATION: Approx. 211 feet (64 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
30		3-8		SANDY CLAY (CL), yellowish brown, very stiff, moist, with lenses of fine sand.	21			
	10							
35	11	3-9		SANDY CLAY (CL), light yellowish brown, hard wet, with layers of fine sand seams.	31			
				Bottom of boring at approximately 36 $^1/_2$ feet. Groundwater encountered at approximately 8 feet during drilling.				
40	12							
	13							
45	14							
50	15							
	16							
55	17							
60	18							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 3

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

CHECKED BY SL

FIGURE NO. A3

ENGEO_BORELOG 5489200301_LAGOONVALLEY.GPJ 8/20/03

DATE OF BORING: July 30, 2003

SURFACE ELEVATION: Approx. 215 feet (66 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			TOPSOIL.				
	1	4-1-1	CLAY (CH), dark brown, very stiff, with pockets of light brown clay seams, dry, with roots.	31	+4.5*		
5	2	4-2-1	CLAY (CH), light brown, stiff, dry.	20	3.5*		
10	3	4-3-2	SILTY CLAY (CL), light brown, medium stiff, moist, with fine sand lenses. ∇	11	1.0*		
	4	4-4	CLAY (CH), light brown, medium stiff, moist, trace fine sand.	12			
15	5	4-5-2	CLAY (CH), light gray, stiff, trace laminations of fine sand.	26			
20	6	4-6-1	CLAY (CH), light brown mottled black, medium stiff, moist.	12	0.5*		
25	7, 8	4-7	CLAY (CH), light brown, moist to wet, trace pockets of black organic clay.	12			
30	9						

ENGEO INCORPORATED

1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 4

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

CHECKED BY

FIGURE NO. A4

ENGEO_BORELOG 5489200301_LAGOONVALLEY.GPJ 8/20/03

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: July 30, 2003 SURFACE ELEVATION: Approx. 215 feet (66 meters) DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
30		4-8		SILTY CLAY (CL), yellowish brown, very stiff, moist, some lenses of fine sand/silt.	18			
	10			Bottom of boring at approximately 31 $^{1}/_{2}$ feet. Groundwater encountered at approximately 9 feet.				
35	11							
40	12							
	13							
45	14							
50	15							
	16							
55	17							
60	18							

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

LAGOON VALLEY

VALLEJO, CALIFORNIA

BORING NO.: 4

LOGGED BY: J. Kan

PROJ. NO.: 5489.2.003.01

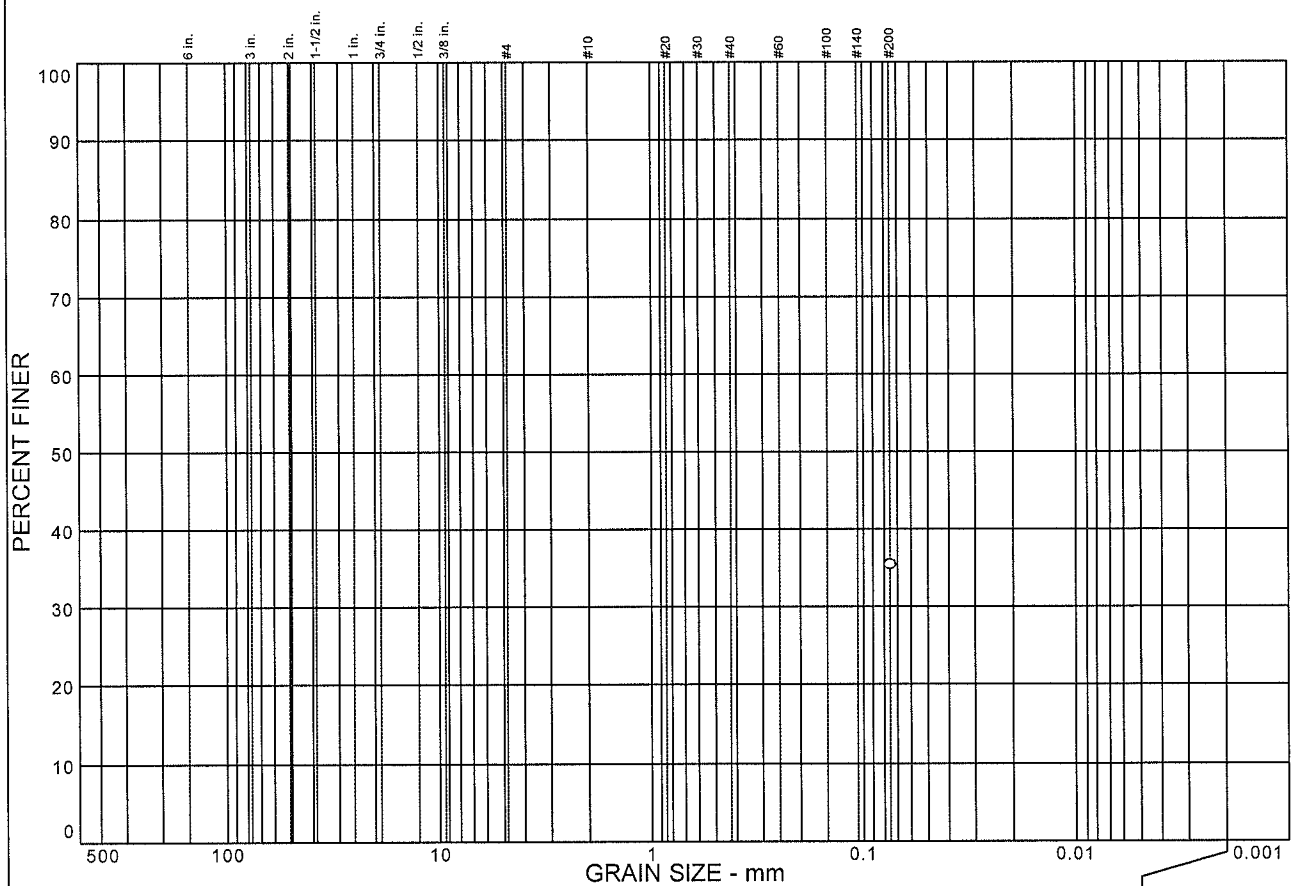
CHECKED BY SL

FIGURE NO. A4

APPENDIX B

Laboratory Test Results

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			35.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	35.4		

* (no specification provided)

Soil Description

Dark yellowish brown silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

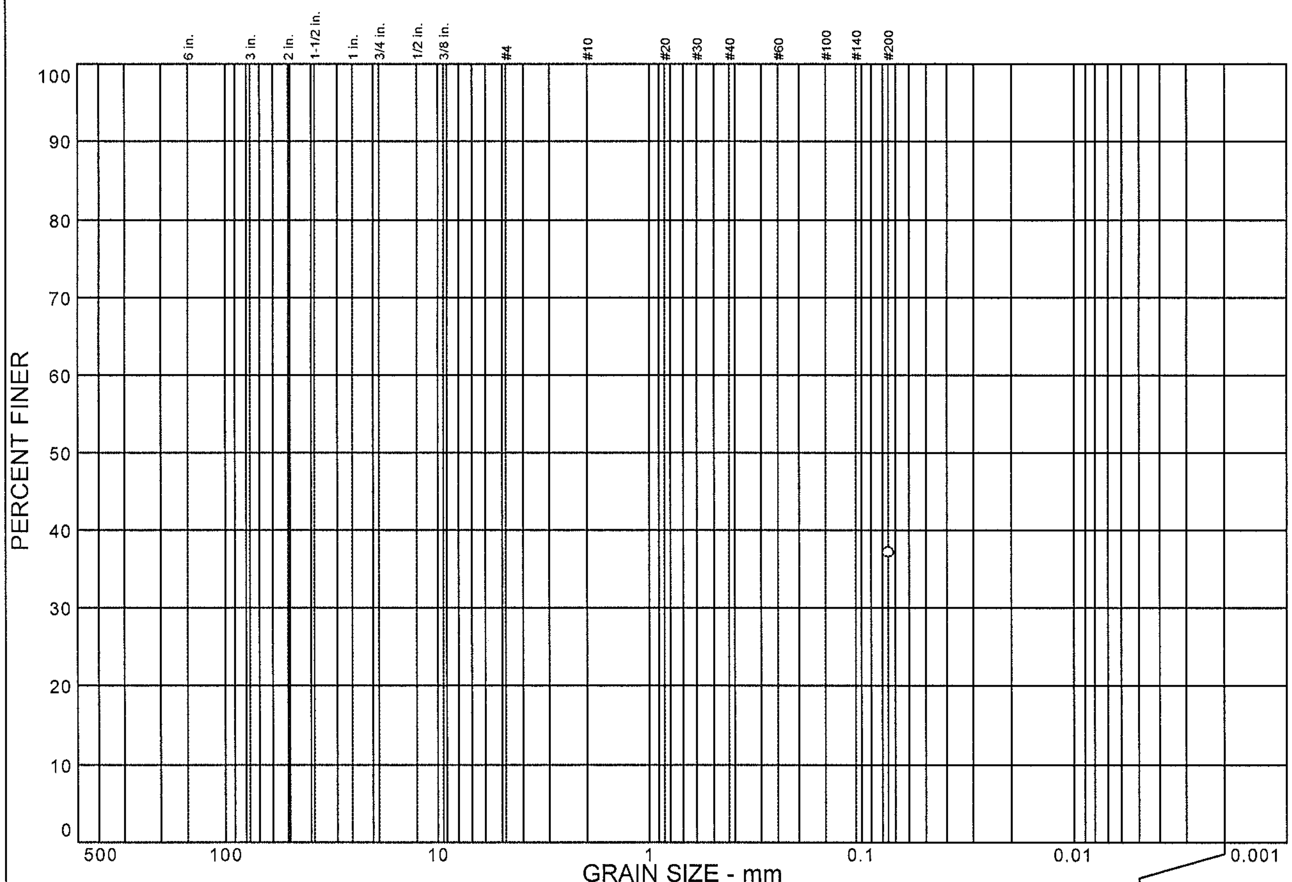
Remarks

Sample No.: 1-6-1 **Source of Sample:** %200 **Date:** 08-09-03
Location: **Elev./Depth:** 20 ft.

ENGEO INCORPORATED — GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, MATERIALS TESTING

Client:
Project: Lagoon Valley Preliminary. Vacaville, CA
Project No: 5489.2.003.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			37.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	37.1		

* (no specification provided)

Soil Description

Olive brown silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

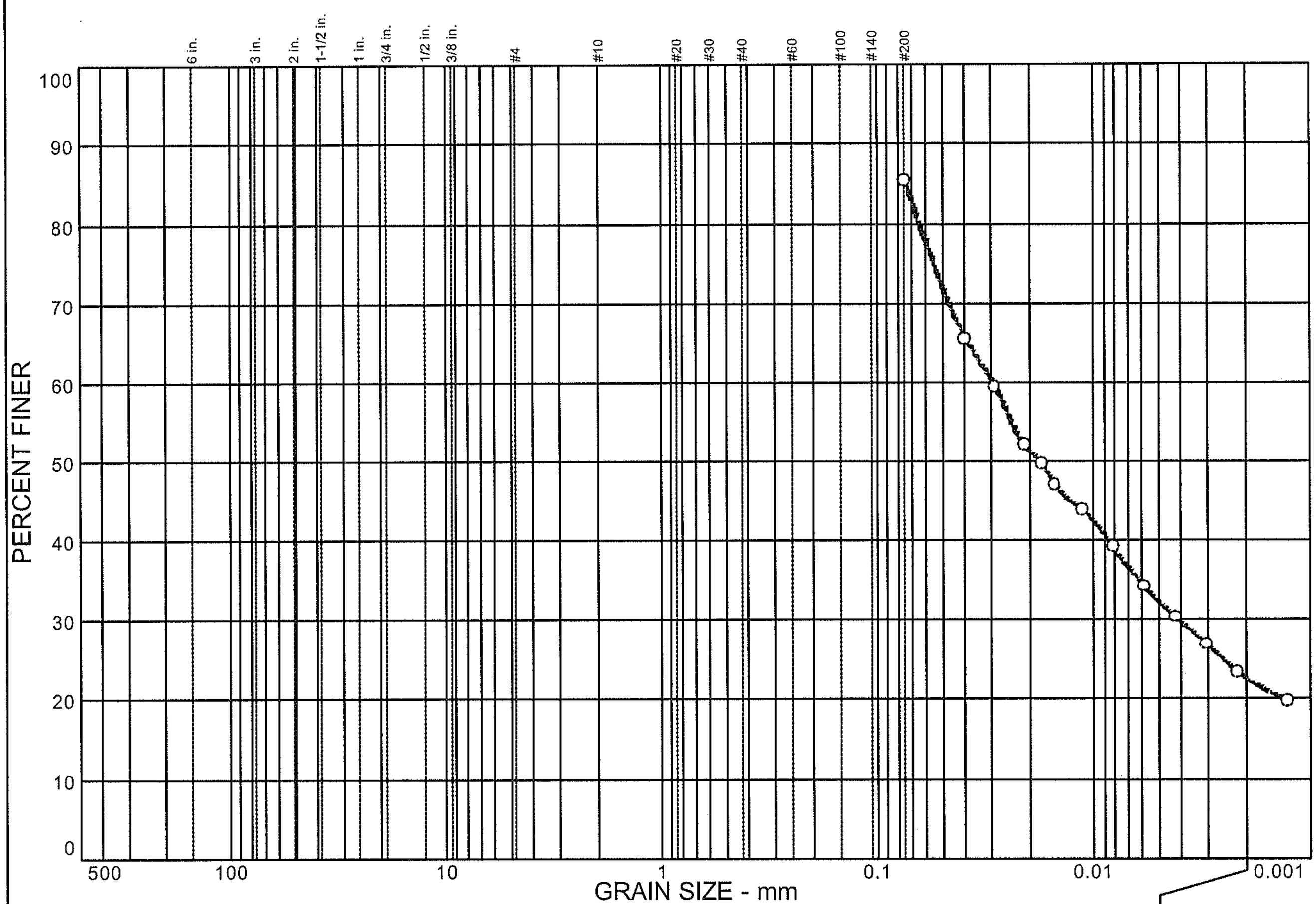
Sample No.: 3-6 **Source of Sample:** %200 **Date:** 08-09-03
Location: **Elev./Depth:** 20 ft.

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Client:
Project: Lagoon Valley Preliminary. Vacaville, CA

Project No: 5489.2.003.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			62.7	22.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	85.4		

* (no specification provided)

Soil Description

Light brown Silty Clay with sand

Atterberg Limits

PL= 19 LL= 35 PI= 16

Coefficients

D_{85}= 0.0742 D_{60}= 0.0296 D_{50}= 0.0178
D_{30}= 0.0041 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

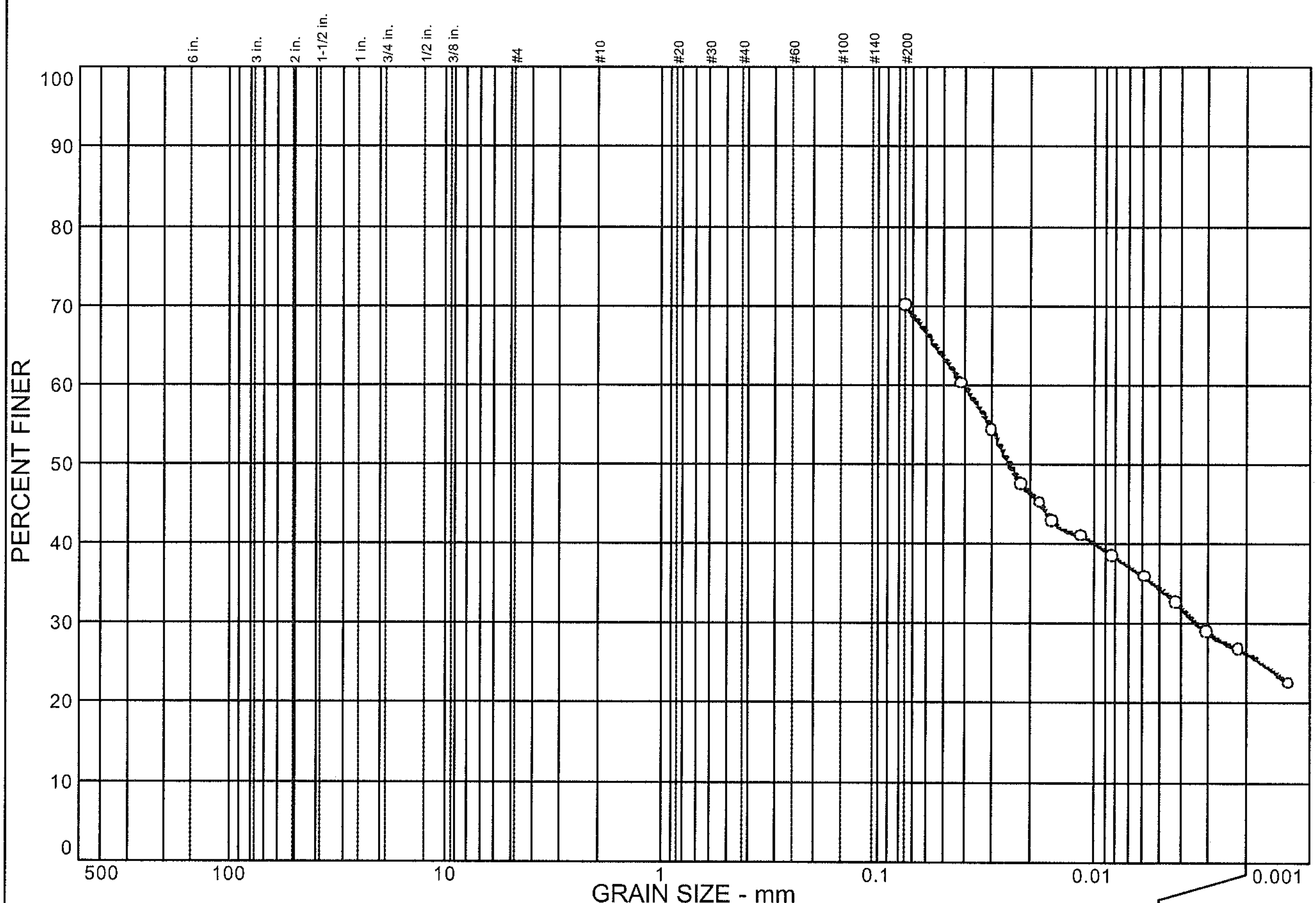
Remarks

Sample No.: 4-3-2 **Source of Sample:** PI/Hydro **Date:** 08/08/03
Location: **Elev./Depth:** 7.5 ft.

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Lagoon Valley Preliminary. Vacaville, CA
Project No: 5489.2.003.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			43.7	26.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	70.0		

* (no specification provided)

Soil Description

Yellowish brown silty Clay with some sand

Atterberg Limits

PL= 16 LL= 35 PI= 19

Coefficients

D_{85}= D_{60}= 0.0406 D_{50}= 0.0250
D_{30}= 0.0034 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

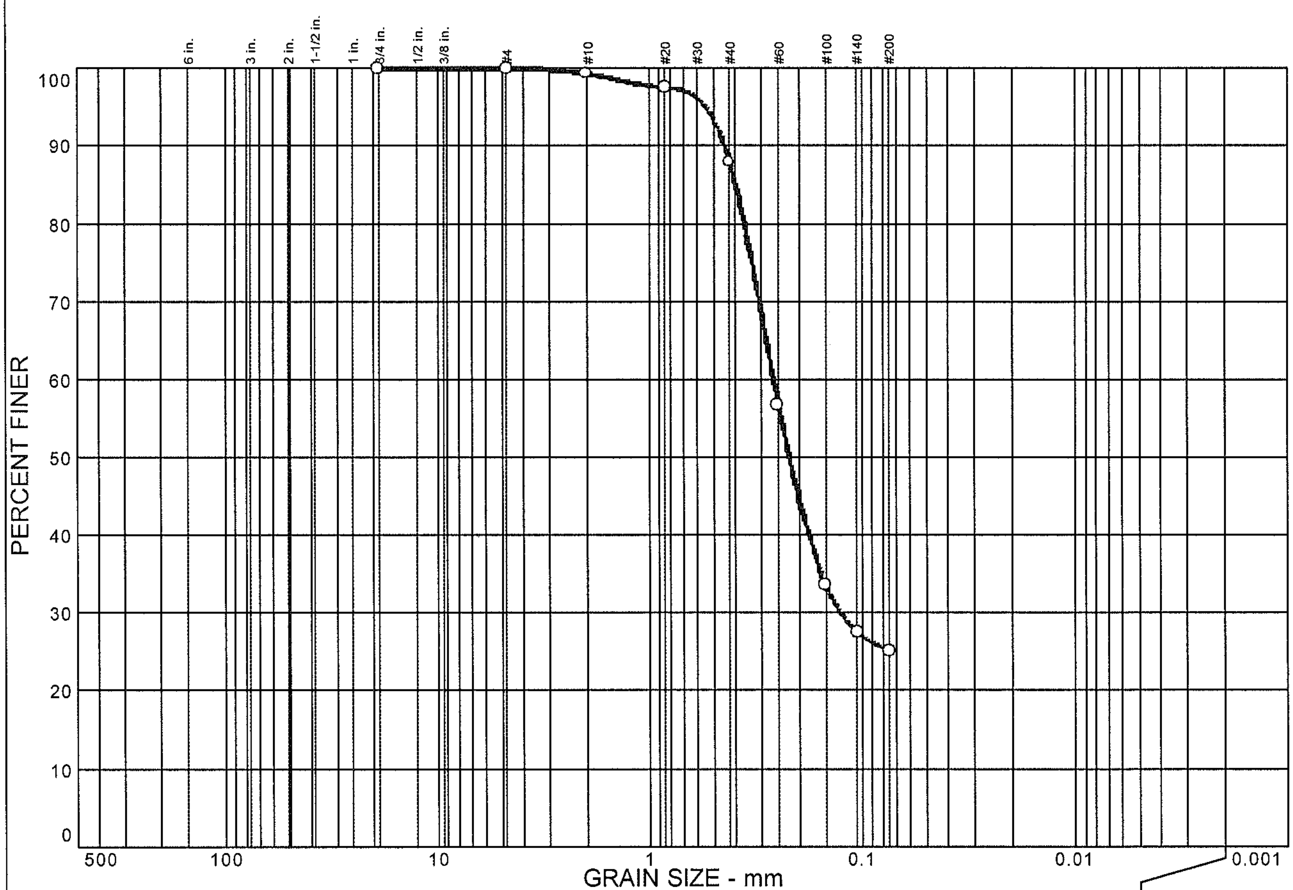
Remarks

Sample No.: 3-5-1 **Source of Sample:** PI/Hydro **Date:** 08/08/03
Location: **Elev./Depth:** 15 ft.

ENGEO INCORPORATED GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Client:
Project: Lagoon Valley Preliminary. Vacaville, CA
Project No: 5489.2.003.01

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	74.9	25.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
#4	100.0		
#10	99.3		
#20	97.5		
#40	87.9		
#60	56.7		
#100	33.5		
#140	27.5		
#200	25.1		

* (no specification provided)

Soil Description

Dark yellowish brown silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.399 D_{60}= 0.264 D_{50}= 0.223
D_{30}= 0.128 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

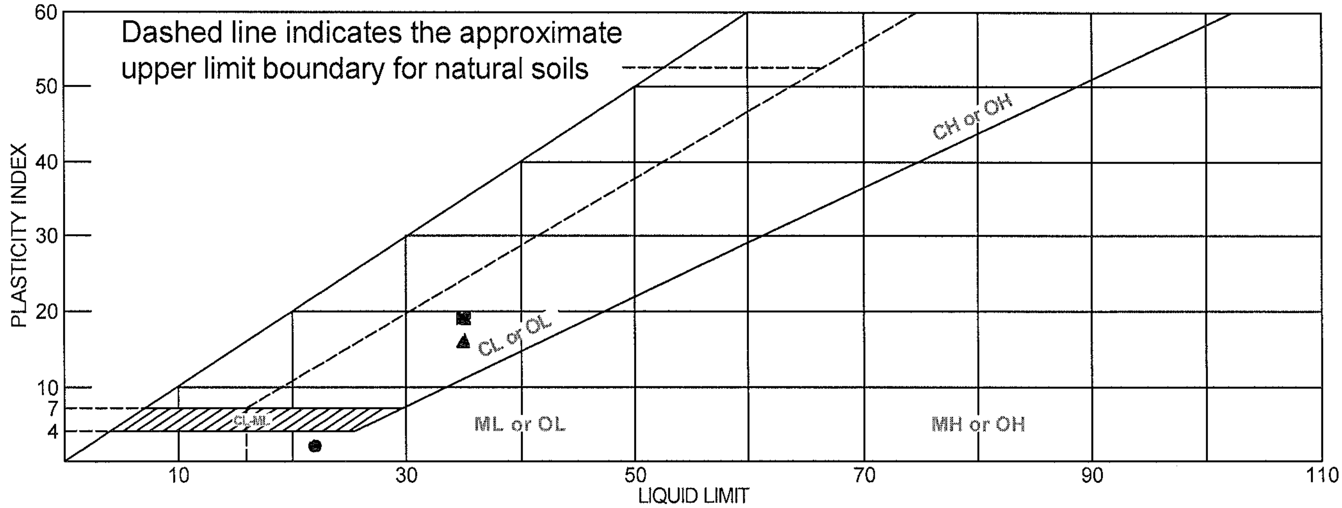
Sample No.: 2-7 **Source of Sample:** W.S. **Date:** 08-09-03
Location: **Elev./Depth:** 25 ft.

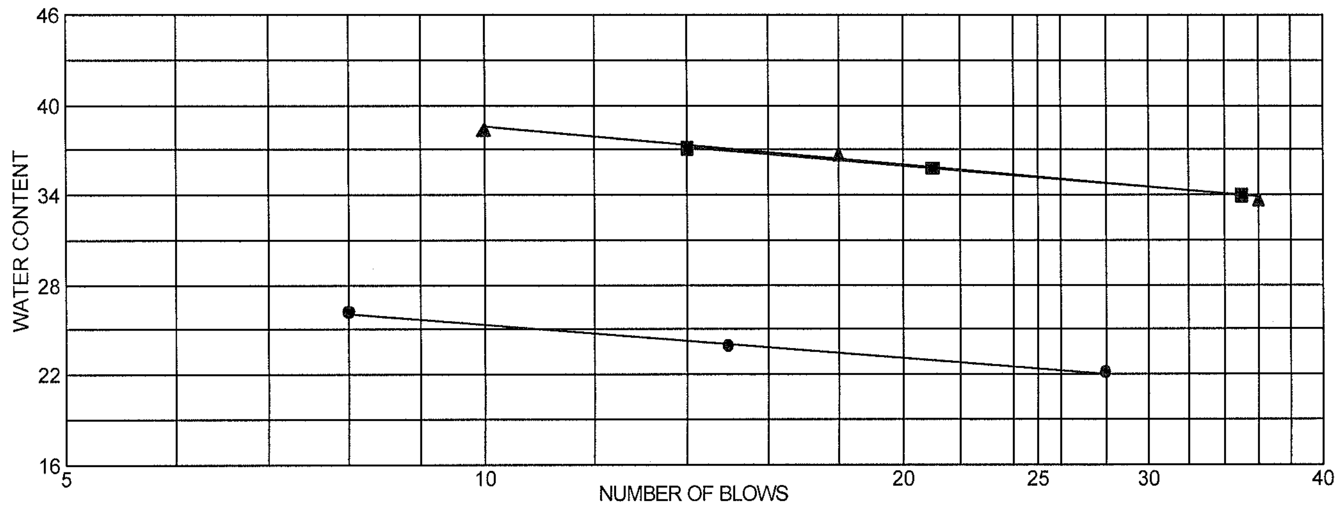
ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Lagoon Valley Preliminary. Vacaville, CA

Project No: 5489.2.003.01

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Yellowish brown silty clayey Sand	22	20	2		40.1	SM
■	Light olive brown sandy clayey Silt	35	16	19		70.0	CL
▲	Olive brown clayey Silt with sand	35	19	16		85.4	CL

Project No. **Client:**

Project: Lagoon Valley Preliminary. Vacaville, CA

● **Source:** %200 **Sample No.:** 1-4

■ **Source:** PI/Hydro **Sample No.:** 3-5-1

▲ **Source:** PI/Hydro **Sample No.:** 4-3-2

Remarks:
● 1-4 (10 ft.)
■ 3-5-1 (15 feet)
▲ 4-3-2 (7.5 feet)

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

APPENDIX C

Guide Contract Specifications

GUIDE CONTRACT SPECIFICATIONS

PART I - EARTHWORK

PREFACE

These specifications are intended as a guide for the earthwork performed at the subject development project. If there is a conflict between these specifications (including the recommendations of the geotechnical report) and agency or code requirements, it should be brought to the attention of ENGEO and Owner prior to contract bidding.

PART 1 - GENERAL

1.01 WORK COVERED

A. Grading, excavating, filling and backfilling, including trenching and backfilling for utilities as necessary to complete the Project as indicated on the Drawings.

B. Subsurface drainage as indicated on the Drawings.

1.02 CODES AND STANDARDS

A. Excavating, trenching, filling, backfilling, and grading work shall meet the applicable requirements of the Uniform Building Code and the standards and ordinances of state and local governing authorities.

1.03 SUBSURFACE SOIL CONDITIONS

A. The Owners' Geotechnical Exploration report is available for inspection by bidder or Contractor. The Contractor shall refer to the findings and recommendations of the Geotechnical Exploration report in planning and executing his work.

1.04 DEFINITIONS

A. Fill: All soil, rock, or soil-rock materials placed to raise the grades of the site or to backfill excavations.

B. Backfill: All soil, rock or soil-rock material used to fill excavations and trenches.

C. On-Site Material: Soil and/or rock material which is obtained from the site.

D. Imported Material: Soil and/or rock material which is brought to the site from off-site areas.

E. Select Material: On-site and/or imported material which is approved by ENGEO as a specific-purpose fill.

F. Engineered Fill: Fill upon which ENGEO has made sufficient observations and tests to confirm that the fill has been placed and compacted in accordance with specifications and requirements.

G. Degree of Compaction or Relative Compaction: The ratio, expressed as a percentage, of the in-place dry density of the fill and backfill material as compacted in the field to the maximum dry density of the same material as determined by ASTM D-1557 or California 216 compaction test method.

H. Optimum Moisture: Water content, percentage by dry weight, corresponding to the maximum dry density as determined by ASTM D-1557.

I. ENGEO: The project geotechnical engineering consulting firm, its employees or its designated representatives.

J. Drawings: All documents, approved for construction, which describe the Work.

1.05 OBSERVATION AND TESTING

A. All site preparation, cutting and shaping, excavating, filling, and backfilling shall be carried out under the observation of ENGEO, employed and paid for by the Owners. ENGEO will perform appropriate field and laboratory tests to evaluate the suitability of fill material, the proper moisture content for compaction, and the degree of compaction achieved. Any fill that does not meet the specification requirements shall be removed and/or reworked until the requirements are satisfied.

B. Cutting and shaping, excavating, conditioning, filling, and compacting procedures require approval of ENGEO as they are performed. Any work found unsatisfactory or any work disturbed by subsequent operations before approval is granted shall be corrected in an approved manner as recommended by ENGEO.

C. Tests for compaction will be made in accordance with test procedures outlined in ASTM D-1557, as applicable. Field testing of soils or compacted fill shall conform with the applicable requirements of ASTM D-2922.

D. All authorized observation and testing will be paid for by the Owners.

1.06 SITE CONDITIONS

A. Excavating, filling, backfilling, and grading work shall not be performed during unfavorable weather conditions. When the work is interrupted by rain, excavating, filling, backfilling, and grading work shall not be resumed until the site and soil conditions are suitable.

B. Contractor shall take the necessary measures to prevent erosion of freshly filled, backfilled, and graded areas until such time as permanent drainage and erosion control measures have been installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. Contractor shall furnish all materials, tools, equipment, facilities, and services as required for performing the required excavating, filling, backfilling, and grading work, and trenching and backfilling for utilities.

2.02 SOIL MATERIALS

A. Fill

1. Material to be used for engineered fill and backfill shall be free from organic matter and other deleterious substances, and of such quality that it will compact thoroughly without excessive voids when watered and rolled. Excavated on-site material will be considered suitable for engineered fill and backfill if it contains no more than 3 percent organic matter, is free of debris and other deleterious substances and conforms to the requirements specified above. Rocks of maximum dimension in excess of two-thirds of the lift thickness shall be removed from any fill material to the satisfaction of ENGEO.

2. Excavated earth material which is suitable for engineered fill or backfill, as determined by ENGEO, shall be conditioned for reuse and properly stockpiled as required for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed 8 inches and raking free of debris and rubble. Rocks and aggregate exceeding the allowed largest dimension, and deleterious material shall be removed from the site and disposed off site in a legal manner.

3. ENGEO shall be notified at least 48 hours prior to the start of filling and backfilling operations so that it may evaluate samples of the material intended for use as fill and backfill. All materials to be used for filling and backfilling require the approval of ENGEO.

B. Import Material: Where conditions require the importation of fill material, the material shall be an inert, nonexpansive soil or soil-rock material free of organic matter and meeting the following requirements unless otherwise approved by ENGEO.

Gradation (ASTM D-421):	Sieve Size	Percent Passing
	2-inch	100
	#200	15 - 70
Plasticity (ASTM D-4318):	Liquid Limit	Plasticity Index
	< 30	< 12
Swell Potential (ASTM D-4546B): (at optimum moisture)	Percent Heave	Swell Pressure
	< 2 percent	< 300 psf
Resistance Value (ASTM D-2844):	Minimum 25	
Organic Content (ASTM D-2974):	Less than 2 percent	

A sample of the proposed import material should be submitted to ENGEO for evaluation prior to delivery at the site.

2.03 SAND

A. Sand for sand cushion under slabs and for bedding of pipe in utility trenches shall be a clean and graded, washed sand, free from clay or organic material, suitable for the intended purpose with 90 to 100 percent passing a No. 4 U.S. Standard Sieve, not more than 5 percent passing a No. 200 U.S. Standard Sieve, and generally conforming to ASTM C33 for fine aggregate.

2.04 AGGREGATE DRAINAGE FILL

A. Aggregate drainage fill under concrete slabs and paving shall consist of broken stone, crushed or uncrushed gravel, clean quarry waste, or a combination thereof. The aggregate shall be free from fines, vegetable matter, loam, volcanic tuff, and other deleterious substances. It shall be of such quality that the absorption of water in a saturated surface dry condition does not exceed 3 percent of the oven dry weight of the samples.

B. Aggregate drainage fill shall be of such size that the percentage composition by dry weight as determined by laboratory sieves (U. S. Series) will conform to the following grading:

Sieve Size	Percentage Passing Sieve
1½-inches	100
1-inch	90 - 100
#4	0 - 5

2.05 SUBDRAINS

A. Perforated subdrain pipe of the required diameter shall be installed as shown on the drawings. The pipe(s) shall also conform to these specifications unless otherwise specified by ENGEO in the field.

Subdrain pipe shall be manufactured in accordance with one of the following requirements:

Design depths less than 30 feet

- Perforated ABS Solid Wall SDR 35 (ASTM D-2751)
- Perforated PVC Solid Wall SDR 35 (ASTM D-3034)
- Perforated PVC A-2000 (ASTM F949)
- Perforated Corrugated HDPE double-wall (AASHTO M-252 or M-294, Caltrans Type S, 50 psi minimum stiffness)

Design depths less than 50 feet

- Perforated PVC SDR 23.5 Solid Wall (ASTM D-3034)
- Perforated Sch. 40 PVC Solid Wall (ASTM-1785)
- Perforated ABS SDR 23.5 Solid Wall (ASTM D-2751)
- Perforated ABS DWV/Sch. 40 (ASTM D-2661 and D-1527)
- Perforated Corrugated HDPE double-wall (AASHTO M-252 or M-294, Caltrans Type S, 70 psi minimum stiffness)

Design depths less than 70 feet

- Perforated ABS Solid Wall SDR 15.3 (ASTM D-2751)
- Perforated Sch. 80 PVC (ASTM D-1785)
- Perforated Corrugated Aluminum (ASTM B-745)

B. Permeable Material (Class 2): Class 2 permeable material for filling trenches under, around, and over subdrains, behind building and retaining walls, and for pervious blankets shall consist of clean, coarse sand and gravel or crushed stone, conforming to the following grading requirements:

Sieve Size	Percentage Passing Sieve
1-inch	100
¾-inch	90 - 100
3/8-inch	40 - 100
#4	25 - 40
#8	18 - 33
#30	5 - 15
#50	0 - 7
#200	0 - 3

C. Filter Fabric: All filter fabric shall meet the following Minimum Average Roll Values unless otherwise specified by ENGEO.

Grab Strength (ASTM D-4632)..180 lbs
Mass Per Unit Area (ASTM D-4751)................................6 oz/yd^2
Apparent Opening Size (ASTM D-4751)...........................70-100 U.S. Std. Sieve
Flow Rate (ASTM D-4491)..80 gal/min/ft^2
Puncture Strength (ASTM D-4833) ....80 lbs

D. Vapor Retarder: Vapor Retarders shall consist of PVC, LDPE or HDPE impermeable sheeting at least 10 mils thick..

2.06 PERMEABLE MATERIAL (Class 1; Type A)

A. Class 1 permeable material to be used in conjunction with filter fabric for backfilling of subdrain excavations shall conform to the following grading requirements:

Sieve Size	Percentage Passing Sieve
¾-inch	100
½-inch	95 - 100
$^3/8$-inch	70 - 100
#4	0 - 55
#8	0 - 10
#200	0 - 3

PART 3 - EXECUTION

3.01 STAKING AND GRADES

A. Contractor shall lay out all his work, establish all necessary markers, bench marks, grading stakes, and other stakes as required to achieve design grades.

3.02 EXISTING UTILITIES

A. Contractor shall verify the location and depth (elevation) of all existing utilities and services before performing any excavation work.

3.03 EXCAVATION

A. Contractor shall perform excavating as indicated and required for concrete footings, drilled piers, foundations, floor slabs, concrete walks, and site leveling and grading, and provide shoring, bracing, underpinning, cribbing, pumping, and planking as required. The bottoms of excavations shall be firm undisturbed earth, clean and free from loose material, debris, and foreign matter.

B. Excavations shall be kept free from water at all times. Adequate dewatering equipment shall be maintained at the site to handle emergency situations until concrete or backfill is placed.

C. Unauthorized excavations for footings shall be filled with concrete to required elevations, unless other methods of filling are authorized by ENGEO.

D. Excavated earth material which is suitable for engineered fill or backfill, as determined by ENGEO, shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations as specified under Section 2.02, "Soil Materials."

E. Abandoned sewers, piping, and other utilities encountered during excavating shall be removed and the resulting excavations shall be backfilled with engineered fill as required by ENGEO.

F. Any active utility lines encountered shall be reported immediately to the Owner's Representative and authorities involved. The Owner and proper authorities shall be permitted free access to take the measures deemed necessary to repair, relocate, or remove the obstruction as determined by the responsible authority or Owner's Representative.

3.04 SUBGRADE PREPARATION

A. All brush and other rubbish, as well as trees and root systems not marked for saving, shall be removed from the site and legally disposed of.

B. Any existing structures, foundations, underground storage tanks, or debris must be removed from the site prior to any building, grading, or fill operations. Septic tanks, including all drain fields and other lines, if encountered, must be totally removed. The resulting depressions shall be properly prepared and filled to the satisfaction of ENGEO.

C. Vegetation and organic topsoil shall be removed from the surface upon which the fill is to be placed and either removed and legally disposed of or stockpiled for later use in approved landscape areas. The surface shall then be scarified to a depth of at least eight inches until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the equipment to be used.

D. After the foundation for the fill has been cleared and scarified, it shall be made uniform and free from large clods. The proper moisture content must be obtained by adding water or aerating. The foundation for the fill shall be compacted at the proper moisture content to a relative compaction as specified herein.

3.05 ENGINEERED FILL

A. Select Material: Fill material shall be "Select" or "Imported Material" as previously specified.

B. Placing and Compacting: Engineered fill shall be constructed by approved and accepted methods. Fill material shall be spread in uniform lifts not exceeding 8 inches in uncompacted thickness. Each layer shall be spread evenly, and thoroughly blade-mixed to obtain uniformity of material. Fill material which does not contain sufficient moisture as specified by ENGEO shall be sprinkled with water; if it contains excess moisture it shall be aerated or blended with drier material to achieve the proper water content. Select material and water shall then be thoroughly mixed before being compacted.

C. Unless otherwise specified in the Geotechnical Exploration report, each layer of spread select material shall be compacted to at least 90 percent relative compaction at a moisture content of at least three percent above the optimum moisture content. Minimum compaction in all keyways shall be a minimum of 95 percent with a minimum moisture content of at least 1 percentage point above optimum.

D. Unless otherwise specified in the Geotechnical Exploration report or otherwise required by the local authorities, the upper 6 inches of engineered fill in areas to receive pavement shall be compacted to at least 95 percent relative compaction with a minimum moisture content of at least 3 percentage points above optimum.

E. Testing and Observation of Fill: The work shall consist of field observation and testing to determine that each layer has been compacted to the required density and that the required moisture is being obtained. Any layer or portion of a layer that does not attain the compaction required shall be reworked until the required density is obtained.

F. Compaction: Compaction shall be by sheepsfoot rollers, multiple-wheel steel or pneumatic-tired rollers or other types of acceptable compaction equipment. Rollers shall be of such design that they will be able to compact the fill to the specified compaction. Rolling shall be accomplished while the fill material is within the specified moisture content range. Rolling of each layer must be continuous so that the required compaction may be obtained uniformly throughout each layer.

G. Fill slopes shall be constructed by overfilling the design slopes and later cutting back the slopes to the design grades. No loose soil will be permitted on the faces of the finished slopes.

H. Strippings and topsoil shall be stockpiled as approved by Owner, then placed in accordance with ENGEO's recommendations to a minimum thickness of 6 inches and a maximum thickness of 12 inches over exposed open space cut slopes which are 3:1 or flatter, and track walked to the satisfaction of ENGEO.

I. Final Prepared Subgrade: Finish blading and smoothing shall be performed as necessary to produce the required density, with a uniform surface, smooth and true to grade.

3.06 BACKFILLING

A. Backfill shall not be placed against footings, building walls, or other structures until approved by ENGEO.

B. Backfill material shall be Select Material as specified for engineered fill.

C. Backfill shall be placed in 6-inch layers, leveled, rammed, and tamped in place. Each layer shall be compacted with suitable compaction equipment to 90 percent relative compaction at a moisture content of at least 3 percent above optimum.

3.07 TRENCHING AND BACKFILLING FOR UTILITIES

A. Trenching:

1. Trenching shall include the removal of material and obstructions, the installation and removal of sheeting and bracing and the control of water as necessary to provide the required utilities and services.

2. Trenches shall be excavated to the lines, grades, and dimensions indicated on the Drawings. Maximum allowable trench width shall be the outside diameter of the pipe plus 24 inches, inclusive of any trench bracing.

3. When the trench bottom is a soft or unstable material as determined by ENGEO, it shall be made firm and solid by removing said unstable material to a sufficient depth and replacing it with on-site material compacted to 90 percent minimum relative compaction.

4. Where water is encountered in the trench, the contractor must provide materials necessary to drain the water and stabilize the bed.

B. Backfilling:

1. Trenches must be backfilled within 2 days of excavation to minimize desiccation.

2. Bedding material shall be sand and shall not extend more than 6 inches above any utility lines.

3. Backfill material shall be select material.

4. Trenches shall be backfilled as indicated or required and compacted with suitable equipment to 90 percent minimum relative compaction at the required moisture content.

3.08 SUBDRAINS

A. Trenches for subdrain pipe shall be excavated to a minimum width equal to the outside diameter of the pipe plus at least 12 inches and to a depth of approximately 2 inches below the grade established for the invert of the pipe, or as indicated on the Drawings.

B. The space below the pipe invert shall be filled with a layer of Class 2 permeable material, upon which the pipe shall be laid with perforations down. Sections shall be joined as recommended by the pipe manufacturer.

C. Rocks, bricks, broken concrete, or other hard material shall not be used to give intermediate support to pipes. Large stones or other hard objects shall not be left in contact with the pipes.

D. Excavations for subdrains shall be filled as required to fill voids and prevent settlement without damaging the subdrain pipe. Alternatively, excavations for subdrains may be filled with Class 1 permeable material (as defined in Section 2.06) wrapped in Filter Fabric (as defined in Section 2.05).

3.09 AGGREGATE DRAINAGE FILL

A. ENGEO shall approve finished subgrades before aggregate drainage fill is installed.

B. Pipes, drains, conduits, and any other mechanical or electrical installations shall be in place before any aggregate drainage fill is placed. Backfill at walls to elevation of drainage fill shall be in place and compacted.

C. Aggregate drainage fill under slabs and concrete paving shall be the minimum uniform thickness after compaction of dimensions indicated on Drawings. Where not indicated, minimum thickness after compaction shall be 4 inches.

D. Aggregate drainage fill shall be rolled to form a well-compacted bed.

E. The finished aggregate drainage fill must be observed and approved by ENGEO before proceeding with any subsequent construction over the compacted base or fill.

3.10 SAND CUSHION

A. A sand cushion shall be placed over the vapor retarder membrane under concrete slabs on grade. Sand cushion shall be placed in uniform thickness as indicated on the Drawings. Where not indicated, the thickness shall be 2 inches.

3.11 FINISH GRADING

A. All areas must be finish graded to elevations and grades indicated on the Drawings. In areas to receive topsoil and landscape planting, finish grading shall be performed to a uniform 6 inches below the grades and elevations indicated on the Drawings, and brought to final grade with topsoil.

3.12 DISPOSAL OF WASTE MATERIALS

A. Excess earth materials and debris shall be removed from the site and disposed of in a legal manner. Location of dump site and length of haul are the Contractor's responsibility.

PART II - GEOGRID SOIL REINFORCEMENT

1. DESCRIPTION:

Work shall consist of furnishing geogrid soil reinforcement for use in construction of reinforced soil slopes and retention systems.

2. GEOGRID MATERIAL:

2.1 The specific geogrid material shall be preapproved by ENGEO.

2.2 The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under construction stresses and shall have high resistance to damage during construction, to ultraviolet degradation, and to all forms of chemical and biological degradation encountered in the soil being reinforced.

2.3 The geogrids shall have an Allowable Strength (T_a) and Pullout Resistance, for the soil type(s) indicated, as listed in Table I.

2.4 Certifications: The Contractor shall submit a manufacturer's certification that the geogrids supplied meet the respective index criteria set when geogrid was approved by ENGEO, measured in full accordance with all test methods and standards specified. In case of dispute over validity of values, the Contractor will supply test data from an ENGEO-approved laboratory to support the certified values submitted.

3. CONSTRUCTION:

3.1 Delivery, Storage, and Handling: Contractor shall check the geogrid upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the geogrid shall be protected from temperatures greater than 140 °F, mud, dirt, dust, and debris. Manufacturer's recommendations in regard to protection from direct sunlight must also be followed. At the time of installation, the geogrid will be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be repaired by placing a patch over the damaged area. Any geogrid damaged during storage or installation shall be replaced by the Contractor at no additional cost to the owner.

3.2 On-Site Representative: Geogrid material suppliers shall provide a qualified and experienced representative on site at the initiation of the project, for a minimum of three days, to assist the Contractor and ENGEO personnel at the start of construction. If there is more than one slope on a project, this criterion will apply to construction of the initial slope only. The representative shall also be available on an as-needed basis, as requested by ENGEO, during construction of the remaining slope(s).

3.3 Geogrid reinforcement may be joined with mechanical connections or overlaps as recommended and approved by the Manufacturer. Joints shall not be placed within 6 feet of the slope face, within 4 feet below top of slope, nor horizontally or vertically adjacent to another joint.

3.4 Geogrid Placement: The geogrid reinforcement shall be installed in accordance with the manufacturer's recommendations. The geogrid reinforcement shall be placed within the layers of the compacted soil as shown on the plans or as directed.

The geogrid reinforcement shall be placed in continuous longitudinal strips in the direction of main reinforcement. However, if the Contractor is unable to complete a required length with a single continuous length of geogrid, a joint may be made with the Manufacturer's approval. Only one joint per length of geogrid shall be allowed. This joint shall be made for the full width of the strip by using a similar material with similar strength. Joints in geogrid reinforcement shall be pulled and held taut during fill placement.

Adjacent strips, in the case of 100 percent coverage in plan view, need not be overlapped. The minimum horizontal coverage is 50 percent, with horizontal spacings between reinforcement no greater than 40 inches. Horizontal coverage of less than 100 percent shall not be allowed unless specifically detailed in the construction drawings.

Adjacent rolls of geogrid reinforcement shall be overlapped or mechanically connected where exposed in a wrap around face system, as applicable.

The Contractor may place only that amount of geogrid reinforcement required for immediately pending work to prevent undue damage. After a layer of geogrid reinforcement has been placed, the next succeeding layer of soil shall be placed and compacted as appropriate. After the specified soil layer has been placed, the next geogrid reinforcement layer shall be installed. The process shall be repeated for each subsequent layer of geogrid reinforcement and soil.

Geogrid reinforcement shall be placed to lay flat and pulled tight prior to backfilling. After a layer of geogrid reinforcement has been placed, suitable means, such as pins or small piles of soil, shall be used to hold the geogrid reinforcement in position until the subsequent soil layer can be placed.

Under no circumstances shall a track-type vehicle be allowed on the geogrid reinforcement before at least six inches of soil have been placed. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and the geogrid reinforcement. If approved by the Manufacturer, rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds, less than 10 mph. Sudden braking and sharp turning shall be avoided.

During construction, the surface of the fill should be kept approximately horizontal. Geogrid reinforcement shall be placed directly on the compacted horizontal fill surface. Geogrid reinforcements are to be placed within three inches of the design elevations and extend the length as shown on the elevation view unless otherwise directed by ENGEO. Correct orientation of the geogrid reinforcement shall be verified by ENGEO.

Table I
Allowable Geogrid Strength
With Various Soil Types
For Geosynthetic Reinforcement In
Mechanically Stabilized Earth Slopes

(Geogrid Pullout Resistance and Allowable Strengths vary with reinforced backfill used due to soil anchorage and site damage factors. Guidelines are provided below.)

SOIL TYPE	MINIMUM ALLOWABLE STRENGTH, T_a (lb/ft)*		
	GEOGRID Type I	GEOGRID Type II	GEOGRID Type III
A. Gravels, sandy gravels, and gravel-sand-silt mixtures (GW, GP, GC, GM & SP)**	2400	4800	7200
B. Well graded sands, gravelly sands, and sand-silt mixtures (SW & SM)**	2000	4000	6000
C. Silts, very fine sands, clayey sands and clayey silts (SC & ML)**	1000	2000	3000
D. Gravelly clays, sandy clays, silty clays, and lean clays (CL)**	1600	3200	4800

* All partial Factors of Safety for reduction of design strength are included in listed values. Additional factors of safety may be required to further reduce these design strengths based on site conditions.

** Unified Soil Classifications.

PART III - GEOTEXTILE SOIL REINFORCEMENT

1. DESCRIPTION:

Work shall consist of furnishing geotextile soil reinforcement for use in construction of reinforced soil slopes.

2. GEOTEXTILE MATERIAL:

2.1 The specific geotextile material and supplier shall be preapproved by ENGEO.

2.2 The geotextile shall have a high tensile modulus and shall have high resistance to damage during construction, to ultraviolet degradation, and to all forms of chemical and biological degradation encountered in the soil being reinforced.

2.3 The geotextiles shall have an Allowable Strength (T_a) and Pullout Resistance, for the soil type(s) indicated as listed in Table II.

2.4 Certification: The Contractor shall submit a manufacturer's certification that the geotextiles supplied meet the respective index criteria set when geotextile was approved by ENGEO, measured in full accordance with all test methods and standards specified. In case of dispute over validity of values, the Contractor will supply the data from an ENGEO-approved laboratory to support the certified values submitted.

3. CONSTRUCTION:

3.1 Delivery, Storage and Handling: Contractor shall check the geotextile upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the geotextile shall be protected from temperatures greater than 140 °F, mud, dirt, dust, and debris. Manufacturer's recommendations in regard to protection from direct sunlight must also be followed. At the time of installation, the geotextile will be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be repaired by placing a patch over the damaged area. Any geotextile damaged during storage or installation shall be replaced by the Contractor at no additional cost to the owner.

3.2 On-Site Representative: Geotextile material suppliers shall provide a qualified and experienced representative on site at the initiation of the project, for a minimum of three days, to assist the Contractor and ENGEO personnel at the start of construction. If there is more than one slope on a project, this criterion will apply to construction of the initial slope only. The representative shall also be available on an as-needed basis, as requested by ENGEO, during construction of the remaining slope(s).

3.3 Geotextile Placement: The geotextile reinforcement shall be installed in accordance with the manufacturer's recommendations. The geotextile reinforcement shall be placed within the layers of the compacted soil as shown on the plans or as directed.

The geotextile reinforcement shall be placed in continuous longitudinal strips in the direction of main reinforcement. Joints shall not be used with geotextiles.

Adjacent strips, in the case of 100 percent coverage in plan view, need not be overlapped. The minimum horizontal coverage is 50 percent, with horizontal spacings between reinforcement no greater than 40 inches. Horizontal coverage of less than 100 percent shall not be allowed unless specifically detailed in the construction drawings.

Adjacent rolls of geotextile reinforcement shall be overlapped or mechanically connected where exposed in a wrap around face system, as applicable.

The Contractor may place only that amount of geotextile reinforcement required for immediately pending work to prevent undue damage. After a layer of geotextile reinforcement has been placed, the succeeding layer of soil shall be placed and compacted as appropriate. After the specified soil layer has been placed, the next geotextile reinforcement layer shall be installed. The process shall be repeated for each subsequent layer of geotextile reinforcement and soil.

Geosynthetic reinforcement shall be placed to lay flat and be pulled tight prior to backfilling. After a layer of geotextile reinforcement has been placed, suitable means, such as pins or small piles of soil, shall be used to hold the geotextile reinforcement in position until the subsequent soil layer can be placed.

Under no circumstances shall a track-type vehicle be allowed on the geotextile reinforcement before at least six inches of soil has been placed. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and the geotextile reinforcement. If approved by the Manufacturer, rubber-tired equipment may pass over the geotextile reinforcement as slow speeds, less than 10 mph. Sudden braking and sharp turning shall be avoided.

During construction, the surface of the fill should be kept approximately horizontal. Geotextile reinforcement shall be placed directly on the compacted horizontal fill surface. Geotextile reinforcements are to be placed within three inches of the design elevations and extend the length as shown on the elevation view unless otherwise directed by ENGEO. Correct orientation of the geotextile reinforcement shall be verified by ENGEO.

Table II
Allowable Geotextile Strength
With Various Soil Types
For Geosynthetic Reinforcement In
Mechanically Stabilized Earth Slopes

(Geotextile Pullout Resistance and Allowable Strengths vary with reinforced backfill used due to soil anchorage and site damage factors. Guidelines are provided below.)

SOIL TYPE	MINIMUM ALLOWABLE STRENGTH, T_a (lb/ft)*		
	GEOTEXTILE Type I	GEOTEXTILE Type II	GEOTEXTILE Type III
A. Gravels, sandy gravels, and gravel-sand-silt mixtures (GW, GP, GC, GM & SP)**	2400	4800	7200
B. Well graded sands, gravelly sands, and sand-silt mixtures (SW & SM)**	2000	4000	6000
C. Silts, very fine sands, clayey sands and clayey silts (SC & ML)**	1000	2000	3000
D. Gravelly clays, sandy clays, silty clays, and lean clays (CL)**	1600	3200	4800

* All partial Factors of Safety for reduction of design strength are included in listed values. Additional factors of safety may be required to further reduce these design strengths based on site conditions.

** Unified Soil Classifications.

PART IV - EROSION CONTROL MAT OR BLANKET

1. DESCRIPTION:

Work shall consist of furnishing and placing a synthetic erosion control mat and/or degradable erosion control blanket for slope face protection and lining of runoff channels.

2. EROSION CONTROL MATERIALS:

2.1 The specific erosion control material and supplier shall be pre-approved by ENGEO.

2.2 Certification: The Contractor shall submit a manufacturer's certification that the erosion mat/blanket supplied meets the criteria specified when the material was approved by ENGEO. The manufacturer's certification shall include a submittal package of documented test results that confirm the property values. In case of a dispute over validity of values, the Contractor will supply property test data from an ENGEO-approved laboratory, to support the certified values submitted. Minimum average roll values, per ASTM D 4759, shall be used for conformance determinations.

3. CONSTRUCTION:

3.1 Delivery, Storage, and Handling: Contractor shall check the erosion control material upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the erosion mat shall be protected from temperatures greater than 140 °F, mud, dirt, and debris. Manufacturer's recommendations in regard to protection from direct sunlight must also be followed. At the time of installation, the erosion mat/blanket shall be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be removed by cutting OUT a section of the mat. The remaining ends should be overlapped and secured with ground anchors. Any erosion mat/blanket damaged during storage or installation shall be replaced by the Contractor at no additional cost to the Owner.

3.2 On-Site Representative: Erosion control material suppliers shall provide a qualified and experienced representative on site, for a minimum of one day, to assist the Contractor and ENGEO personnel at the start of construction. If there is more than one slope on a project, this criteria will apply to construction of the initial slope only. The representative shall be available on an as-needed basis, as requested by ENGEO, during construction of the remaining slope(s).

3.3 Placement: The erosion control material shall be placed and anchored on a smooth graded, firm surface approved by the Engineer. Anchoring terminal ends of the erosion control material shall be accomplished through use of key trenches. The material in the trenches shall be anchored to the soil on maximum 1½ foot centers. Topsoil, if required by construction drawings, placed over final grade prior to installation of the erosion control material shall be limited to a depth not exceeding 3 inches.

3.4 Erosion control material shall be anchored, overlapped, and otherwise constructed to ensure performance until vegetation is well established. Anchors shall be as designated on the construction drawings, with a minimum of 12 inches length, and shall be spaced as designated on the construction drawings, with a maximum spacing of 4 feet.

3.5 Soil Filling: If noted on the construction drawings, the erosion control mat shall be filled with a fine grained topsoil, as recommended by the manufacturer. Soil shall be lightly raked or brushed on/into the mat to fill the mat voids or to a maximum depth of 1 inch.

PART V - GEOSYNTHETIC DRAINAGE COMPOSITE

1. DESCRIPTION:

Work shall consist of furnishing and placing a geosynthetic drainage system as a subsurface drainage medium for reinforced soil slopes.

2. DRAINAGE COMPOSITE MATERIALS:

2.1 The specific drainage composite material and supplier shall be preapproved by ENGEO.

2.2 The drain shall be of composite construction consisting of a supporting structure or drainage core material surrounded by a geotextile. The geotextile shall encapsulate the drainage core and prevent random soil intrusion into the drainage structure. The drainage core material shall consist of a three dimensional polymeric material with a structure that permits flow along the core laterally. The core structure shall also be constructed to permit flow regardless of the water inlet surface. The drainage core shall provide support to the geotextile. The fabric shall meet the minimum property requirements for filter fabric listed in Section 2.05C of the Guide Earthwork Specifications.

2.3 A geotextile flap shall be provided along all drainage core edges. This flap shall be of sufficient width for sealing the geotextile to the adjacent drainage structure edge to prevent soil intrusion into the structure during and after installation. The geotextile shall cover the full length of the core.

2.4 The geocomposite core shall be furnished with an approved method of constructing and connecting with outlet pipes or weepholes as shown on the plans. Any fittings shall allow entry of water from the core but prevent intrusion of backfill material into the core material.

2.5 Certification and Acceptance: The Contractor shall submit a manufacturer's certification that the geosynthetic drainage composite meets the design properties and respective index criteria measured in full accordance with all test methods and standards specified. The manufacturer's certification shall include a submittal package of documented test results that confirm the design values. In case of dispute over validity of design values, the Contractor will supply design property test data from an ENGEO-approved laboratory, to support the certified values submitted. Minimum average roll values, per ASTM D 4759, shall be used for determining conformance.

3. CONSTRUCTION:

3.1 Delivery, Storage, and Handling: Contractor shall check the geosynthetic drainage composite upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the geosynthetic drainage composite shall be protected from temperatures greater than 140 °F, mud, dirt, and debris. Manufacturer's recommendations in regards to protection from direct sunlight must also be followed. At the time of installation, the geosynthetic drainage composite shall be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be removed or repaired. Any geosynthetic drainage composite damaged during storage or installation shall be replaced by the Contractor at no additional cost to the Owner.

3.2 On-Site Representative: Geosynthetic drainage composite material suppliers shall provide a qualified and experienced representative on site, for a minimum of one half day, to assist the Contractor and ENGEO personnel at the start of construction with directions on the use of drainage composite. If there is more than one application on a project, this criterion will apply to construction of the initial application only. The representative shall also be available on an as-needed basis, as requested by ENGEO, during construction of the remaining applications.

3.3 Placement: The soil surface against which the geosynthetic drainage composite is to be placed shall be free of debris and inordinate irregularities that will prevent intimate contact between the soil surface and the drain.

3.4 Seams: Edge seams shall be formed by utilizing the flap of the geotextile extending from the geocomposite's edge and lapping over the top of the fabric of the adjacent course. The fabric flap shall be securely fastened to the adjacent fabric by means of plastic tape or non-water-soluble construction adhesive, as recommended by the supplier. Where vertical splices are necessary at the end of a geocomposite roll or panel, an 8-inch-wide continuous strip of geotextile may be placed, centering over the seam and continuously fastened on both sides with plastic tape or non-water-soluble construction adhesive. As an alternative, rolls of geocomposite drain material may be joined together by turning back the fabric at the roll edges and interlocking the cuspidations approximately 2 inches. For overlapping in this manner, the fabric shall be lapped and tightly taped beyond the seam with tape or adhesive. Interlocking of the core shall always be made with the upstream edge on top in the direction of water flow. To prevent soil intrusion, all exposed edges of the geocomposite drainage core edge must be covered. Alternatively, a 12-inch-wide strip of fabric may be utilized in the same manner, fastening it to the exposed fabric 8 inches in from the edge and folding the remaining flap over the core edge.

3.5 Soil Fill Placement: Structural backfill shall be placed immediately over the geocomposite drain. Care shall be taken during the backfill operation not to damage the geotextile surface of the drain. Care shall also be taken to avoid excessive settlement of the backfill material. The geocomposite drain, once installed, shall not be exposed for more than seven days prior to backfilling.

TECHNICAL APPENDIX K

Phase One Environmental Site Assessment
Lagoon Valley

Phase One Environmental Site Assessment
Lagoon Valley Commercial and Utility Corridors

IMPORTANT: PLEASE READ CAREFULLY

PHASE ONE ENVIRONMENTAL SITE ASSESSMENT

LAGOON VALLEY
APNs 128-050-070, 167-030-030, 167-030-050, 167-030-020, 167-030-080, 167-020-120, 167-020-110, 128-040-170, 128-040-150, 128-040-160, 128-040-180, 128-040-130, 128-040-080, 167-030-060, 167-020-100, 128-040-140, 128-040-110, 128-040-090, 128-040-120, 128-040-070, 128-040-100, 128-040-180, 167-030-040, AND 128-040-210

SOLANO COUNTY, CALIFORNIA

SUBMITTED

TO

EIP ASSOCIATES

SACRAMENTO, CALIFORNIA

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 5904.5.001.01

FEBRUARY 10, 2004

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