BOLINAS LAGOON
ECOSYSTEM RESTORATION PROJECT

GEOTECHNICAL ENGINEERING APPENDIX

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GEOTECHNICAL SECTION

1. SOILS

1.1 Soils Investigation

1.1.1 Drilling. Six (6) borings, BL-1, 2, 4, 6, 8, and 9 (BL-3, 5 and 7 were deleted due to access restrictions), were drilled at the locations shown in Appendix 1 from 20 September to 26 September 2000 at Bolinas Lagoon. The depth of the soil borings ranged from 13.0 feet to 70.5 feet below the existing surface. Bore holes were advanced to the final depths using rotary wash drilling with drilling mud recirculation. After completion of the sampling, each of the boreholes was grouted with cement-bentonite and the surface restored to its original condition.

1.1.2 Sampling. Both disturbed and undisturbed samples were obtained at 3 feet intervals for identification. Physical laboratory testing utilizing several types of samplers were used as follows:

SPT. The Standard Penetration Test (ASTM D-1586) sampler was used to obtain relatively disturbed samples for soil identification and classification with index tests, and to obtain penetration resistance data. A 140-lb safety-type hammer falling 30 inches was used to drive the samples. The penetration resistance values recorded on the boring logs adjacent to the sample depth is the number of blows required to drive the sampler for the final 12 inches of an 18 inch drive.

Dames & Moore U-Sampler. The U-Sampler was used in granular soils and cohesive soils to obtained relatively undisturbed soil samples. The ring-lined barrel sampler, with a nominal 2-1/2-inch inner diameter and 3-3/4-inch outer diameter is in compliance with ASTM D-3550. The same hammer used to drive the SPT sampler was used to drive the U-Sampler. Soil samples for laboratory testing were obtained with the U-Sampler lined with six 1-inch brass ring liners.

NQ-Rock Core Barrel. NQ split barrels with diamond core bits were used to obtain continuous cores of bedrock material at boring BL-9 where bedrock was encountered at a depth of 2.0 feet. The NQ barrel has a 2-inch-diameter diamond bit. Typical runs were 5 feet in length at the BL-9 location.

1.1.3 Laboratory Soil Testing. Soil samples were delivered to Signet Testing Labs, Hayward, California (AASHTO Materials Reference Library (AMRL) accredited) for classification and testing. Testing consisted of sieve and hydrometer tests (ASTM D-422), Atterberg limits tests (ASTM D-4318), unconsolidated undrained triaxial compression tests (ASTM D-2850), and consolidated, drained direct shear tests (ASTM D-3080). Results of the laboratory testing are shown on the Boring logs on Appendix 2.

1.1.4 Subsurface Soils. The subsurface soil in the North East and West side of Seadrift between Seadrift Lagoon and Bolinas Lagoon (See Appendix 1) consist of multiple alternating soil layers of Silty Sand (SM), Poorly-Graded Sand (SP), with the largest portion being a mixture of these two, Poorly-Graded Sand with Silt (SP-SM). Additional soil layers in smaller quantities found in this area are Well-Graded Sand (SW), Well-Graded Gravel (GW), and Silt (ML).

The soil found on the beach off the south end of Wharf Road (on the west side of the Bolinas Lagoon Entrance) is a 2 feet layer of Poorly-Graded Sand (SP) underlain by Dark Gray Siltstone with increasing Rock Quality Designation (RQD) of up to 80% at 12 feet below the surface.

The grain lithology analysis data in the 19 February 1999 Philip Williams and Associates draft report "Bolinas Lagoon Hydrographic Data Report", was converted for engineering grain size analysis for classification of soil type. The top layer of submerged soil in Bolinas Lagoon consists mostly of Silty Sand (SM) and Clayey Sand (SC). Smaller amounts of Poorly-Graded Sand (SP), Well-Graded Gravel (GW), Clayey Gravel (GC), Poorly-Graded Gravel (GP), and Silty Gravel (GM) were also found in and around localized areas in Bolinas Lagoon.

2. ANALYSES

2.1 Sheet Piles

2.1.1 Sheet Pile Embedment Length. The Corps computer program X0031, CSHTWAL, was used to determine the sheet pile embedment length for Seadrift Lagoon. Subsurface stratification and soil strength parameters were based on data obtained from borings BL-1, BL-2, BL-6, and BL-8. Cantilevered walls were analyzed and assumed saturated conditions behind the wall equal to high tide water elevation and water level elevation in Seadrift Lagoon equal to low tide water level.

2.1.2 North Seadrift Lagoon Sheet Pile. The overall length of the cantilever sheet pile required for the Northern location is thirty-two (32) feet with a twenty-one (21) feet embedment (See Appendix 4). The maximum bending moment is 53,823 LB-FT located at nine and a half (9.5) feet above the bottom of the sheet pile. If A690 marine steel is used, the section modulus required for the sheet pile is
$Sx \geq 8.70$ in / ft.

2.1.3 South Seadrift Lagoon Sheet Pile. The overall length of the cantilever sheet pile required for the Southern location is thirty (30) feet with a twenty-one (21) feet embedment (See Appendix 4). The maximum bending moment is 46,859 LB-FT located at ten (10) feet above the bottom of the sheet pile. If A690 marine steel is used, the section modulus required for the sheet pile is $Sx \geq 7.58$ in / ft.

2.2 Slope Stability Analyses

2.2.1 Slope Stability Cases. The Corps computer program, UTEXAS3, for slope stability analyses was used to determine the factor of safety for the Bolinas Lagoon channel for a 4H:1V and a 3H:1V design slope for (1) after construction case, (2) the pseudo static seismic case and (3) the rapid draw down case from tidal changes. Spencer's method of analysis with the search option was used to locate a series of slip surfaces from which the critical slip surface was determined. The converted grain size "Bolinas Lagoon Hydrographic Data Report" by Philip Williams and Associates was used to develop the soil profile for the sections (see Appendix 3). The result of the slope stability analyses are presented in the following paragraphs.

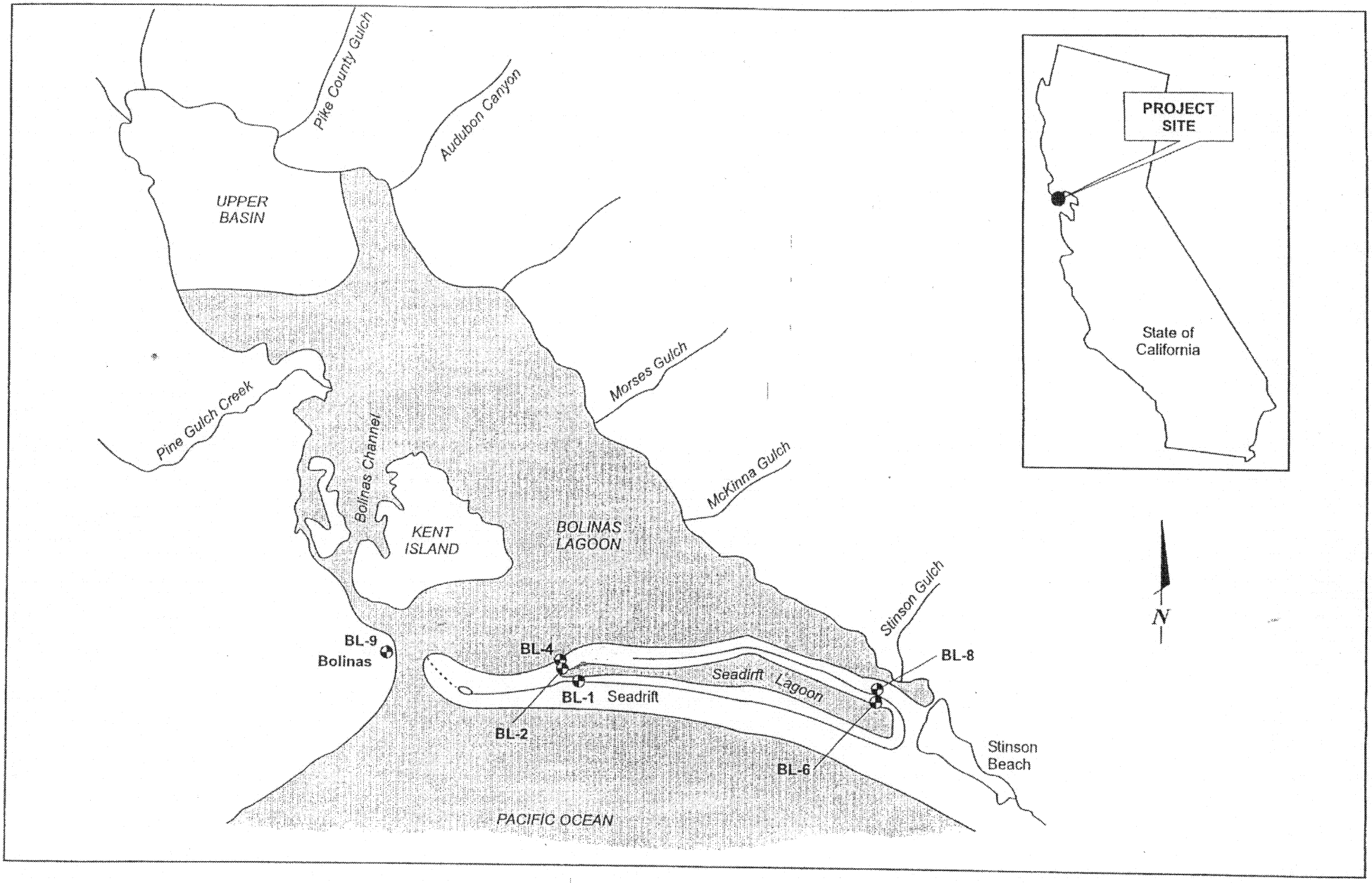
2.2.2 4H:1V Slope Stability Analyses. The after construction case safety factor is 2.48. The safety factor for the pseudo static seismic case is 1.01 using a seismic coefficient of 0.14G (See Sheet 1, Appendix 5). The safety factor for the rapid draw down case at low tide is 1.46 (See Sheet 2, Appendix 5).

2.2.3 3H:1V Slope Stability Analyses. The after construction case safety factor is 1.92. The safety factor for the pseudo static seismic case is 1.01 using a seismic coefficient of 0.11G (See Sheet 3, Appendix 5). The safety factor for the rapid draw down case at low tide is 0.91 which indicates a failure of the slope (See Sheet 4, Appendix 5).

2.2.4 Bolinas Lagoon Channel Design Slope of 4H:1V. Base on the result of the slope stability analyses for a 3H:1V and a 4H:1V slope, the slope of 4H:1V slope is proposed for the design slope as it is stable for each of the following cases: after construction, pseudo static seismic and rapid draw down. The 3H:1V slope will fail during rapid draw down which will occur during low tide.

APPENDIX 1

Sampling Locations



LEGEND

BL- Boring drilled for this investigation

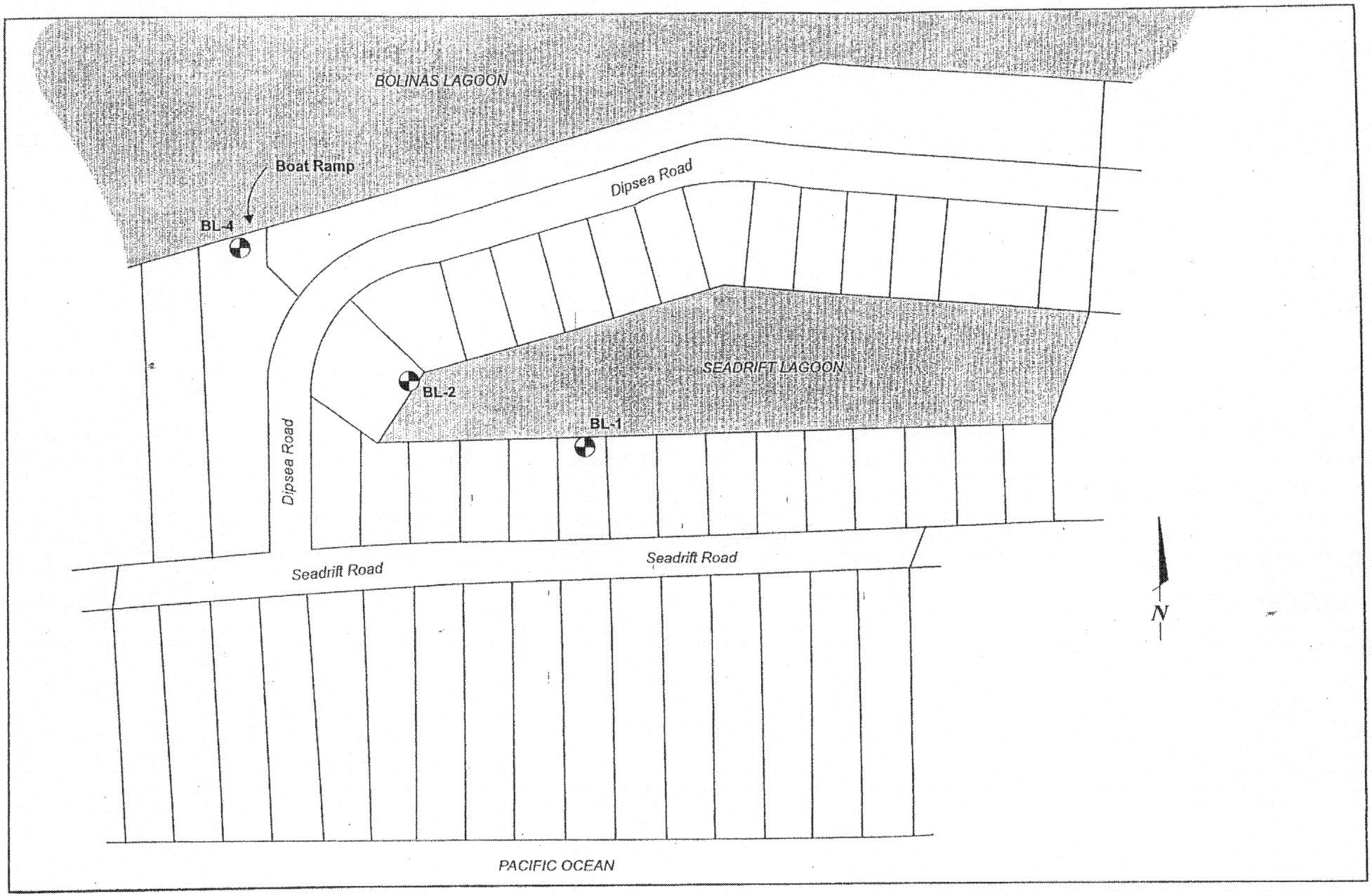
SITE VICINITY AND BORING LOCATION MAP

Bolinas Lagoon Environmental Restoration
November 2000 — US Army Corp of Engineers
47133-001-043 — Bolinas, California

URS
Dames & Moore

PLATE 1

11/16/00 sv ..\47133-001\svblm.cdr



LEGEND

◕ **BL-1** Boring drilled for this investigation

LOCATION OF BORINGS BL-1, BL-2 AND BL-4

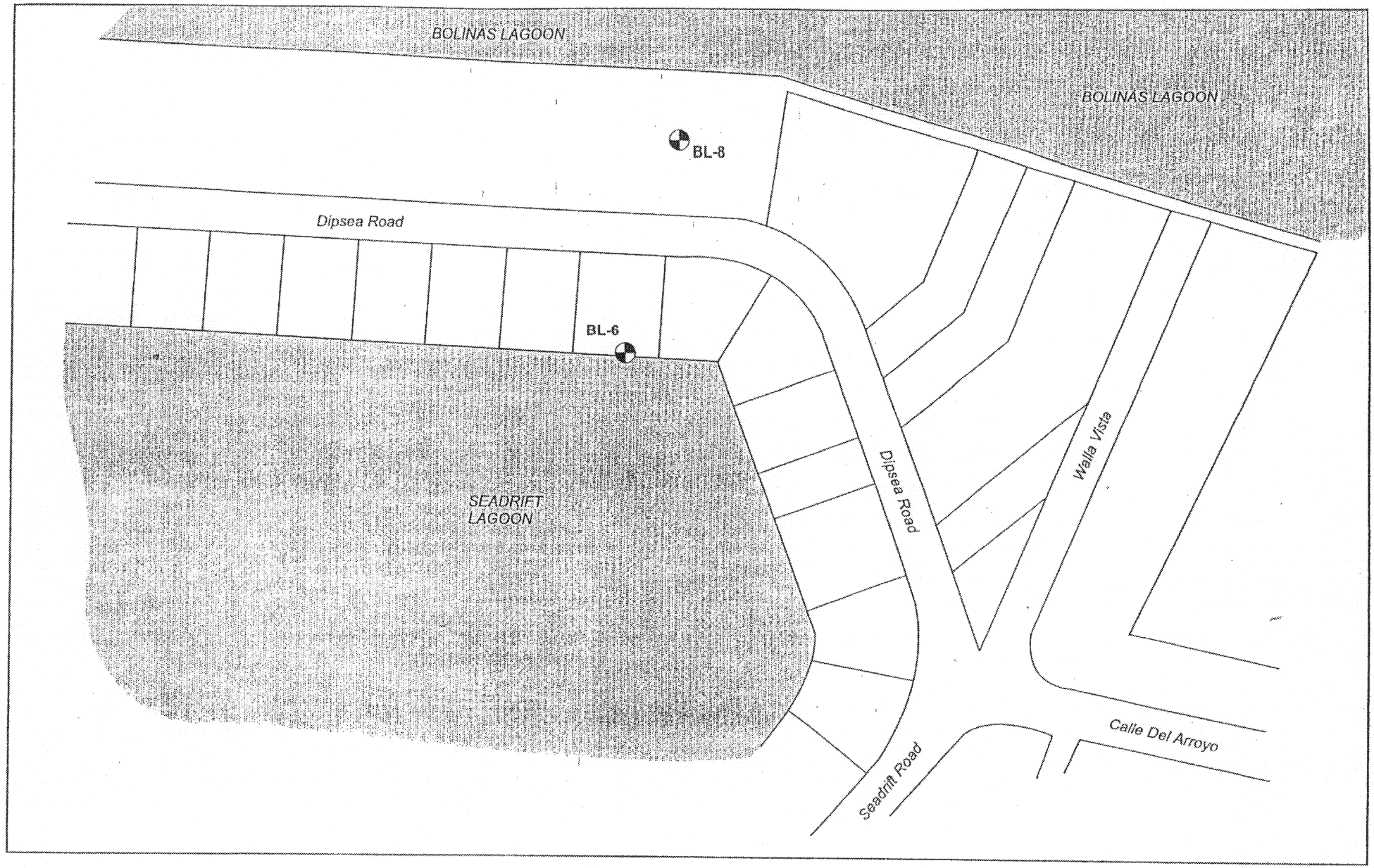
Bolinas Lagoon Environmental Restoration
US Army Corp of Engineers
Bolinas, California

November 2000
47133-001-043

URS
Dames & Moore

PLATE 2

11/16/00 sv ..\47133-001\LB bl1,bl2, bl4.cdr



LEGEND

BL-6 Boring drilled for this investigation

N

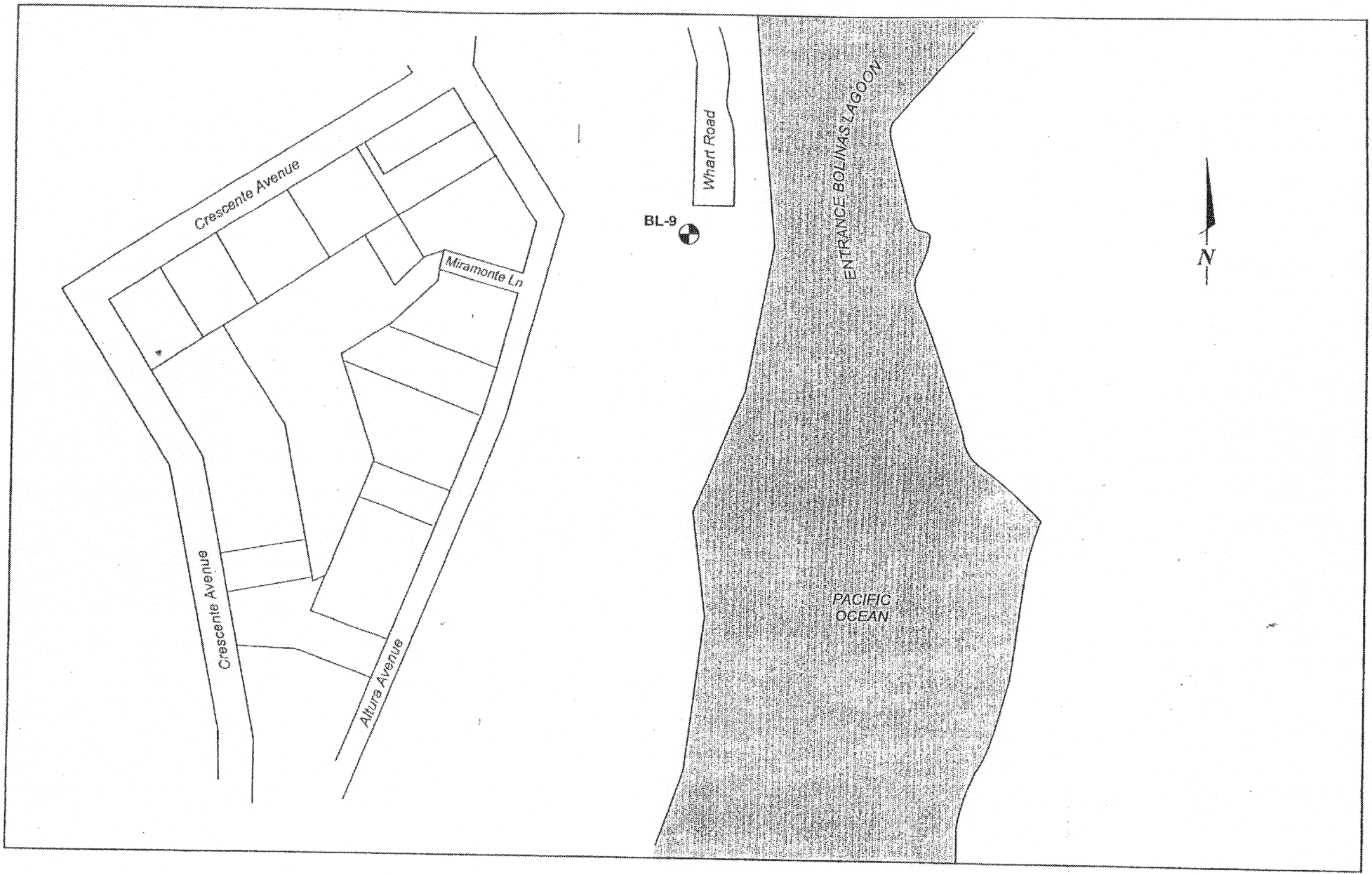
LOCATION OF BORINGS BL-6 AND BL-8

Bolinas Lagoon Environmental Restoration
November 2000 — US Army Corp of Engineers
47133-001-043 — Bolinas, California

URS
Dames & Moore

PLATE 3

11/16/00 sv ..\47133-001\LB bl6 bl8.cdr



LEGEND

◐ **BL-9** Boring drilled for this investigation

LOCATION OF BORINGS BL-6 AND BL-8

Bolinas Lagoon Environmental Restoration
November 2000 — US Army Corp of Engineers
47133-001-043 — Bolinas, California

URS
Dames & Moore

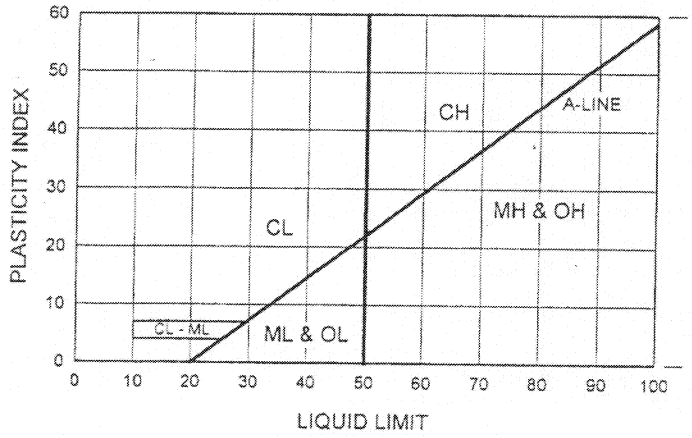
PLATE 4

11/16/00 sv ..\47133-001\LB bl9.cdr

INDEXED SOIL AND ROCK CLASSIFICATIONS

GRAPHIC	SYMBOL	DESCRIPTION	MAJOR DIVISIONS			
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	CLEAN GRAVELS (LITTLE OR NO FINES)	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO 4 SIEVE SIZE	FOR VISUAL CLASSIFICATION, THE 1/4" SIZE MAY BE USED AS EQUIVALENT TO THE NO 4 SIEVE SIZE	COARSE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO 200 SIEVE SIZE
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES				
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)			
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES				
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	CLEAN SANDS (LITTLE OR NO FINES)	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO 4 SIEVE SIZE		
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES				
	SM	SILTY SANDS, SAND-SILT MIXTURES	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES				
	ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	SILTS & CLAYS LIQUID LIMIT LESS THAN 50			FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO 200 SIEVE SIZE — THE NO 200 U.S. STANDARD SIEVE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS				
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY				
	MH	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF HIGH PLASTICITY	SILTS & CLAYS LIQUID LIMIT GREATER THAN 50			
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS				
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS				
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS			

PLASTICITY CHART



KEY TO TEST DATA

SA = SIEVE ANALYSIS

DS = DIRECT SHEAR TEST

TXUU = TRIAXIAL UNCONSOLIDATED UNDRAINED COMPRESSION TEST

KEY TO SAMPLER TYPE

U = DAMES & MOORE TYPE U SAMPLER

SPT = STANDARD PENETRATION TEST SAMPLER

NQ = NQ ROCK CORE

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

47133-001-043

Dames & Moore, Inc.

BORING BL-1

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0												SP	LIGHT GRAY TO BROWN POORLY-GRADED SAND with medium sand, loose, dry at surface, no fines, subrounded to rounded
									SPT	9			wet
5									SPT	9			medium gray, subrounded to subangular
									U	29			
10				DS	1100	893	24.4	118.4				SP SM	LIGHT GRAY TO BROWN POORLY GRADED SAND WITH SILT, medium dense, wet, little gravel
	SA (7.8)								SPT	15			
15									SPT	19			occasional pebbly layer
	SA (8.5)			DS	2200	2077	19.7	123.1	U	38		GW SW	MEDIUM GRAY GRAVELLY SAND TO SANDY GRAVEL, medium dense, wet. gravel clasts to at least 1-inch diameter
20									SPT	17			
25	SA (7.5)								SPT	20		SP SM	LIGHT GRAY POORLY GRADED SAND WITH SILT, medium dense, wet, medium to coarse sand, bedding 1/2 to 2 inch thick, subrounded to subangular
									U	15			
30	SA (1.1)								U	35		GP	POORLY GRADED GRAVEL, medium dense, wet, coarse gravel with abundant sand, cobbles to at least 3-inch diameter
									SPT	26		SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, medium dense, wet, fine to medium sand, subrounded, no discernible bedding
35													

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Job No: 47133-001-043 Pt. ID: BOLINAS.GPJ / BL-1	URS Dames & Moore		**Log of Boring**
Date Completed: 9/25/00 Boring Depth: 70.5 ft.	Surface Elev: Coordinates:		Location: Bolinas Lagoon

BORING BL-1

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
35				DS	4100	2539	23.9	123.5	U	53		SP SM	
40	SA (9.1)								SPT	20			
									SPT	44			thinly laminated bedding (<1/8 inch thick)
45									U	50/5"			
									U	63			abundant shell fragments
50									SPT	56			rare shell fragments
55									U	50/5"			
	SA (32.6)								SPT	50		SM	DARK GRAY SILTY SAND, dense, wet, fine to medium sand
												SW	DARK GRAY WELL GRADED SAND, dense to very dense, wet, fine to medium sand, little clay
60									SPT	82			
				DS	7600	6174	28.6	120.1	U	62			rare shell fragments
65									SPT	12			grades loose sand
70									SPT	63			

Continued Next Page

BORING BL-1

DEPTH IN FEET	LABORATORY TEST DATA								SAMPLING		SAMPLES	
	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS		STRENGTH DATA			MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	TYPE OF SAMPLER	SAMPLING RESISTANCE	SYMBOL	DESCRIPTION
		LIQUID LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	NORMAL OR CONFINING PRESSURE (PSF)	SHEAR STRENGTH (PSF)						
70												
75												
80												
85												
90												
95												
100												
105												

NOTES:
1. Boring was completed to 70.5 feet depth on September 25, 2000. Borehole advanced using rotary wash drilling techniques. Borehole was backfilled with cement bentonite grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for the "U" and SPT samplers are measured in blows per foot to drive the sampler 12 inches after an initial seating depth of 6 inches using a 140 lb hammer dropping 30 inches.
4. Groundwater not observed due to drilling method but estimated from the observed moisture change in samples.
5. See Plate A-7 for general log notes and explanation of symobols.

BORING BL-2

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SYMBOL	DESCRIPTION
0											SP SM	LIGHT GRAY TO BROWN POORLY GRADED SAND WITH SILT, loose, dry at surface, medium sand, subangular
									SPT	9		thinly laminated bedding
5												
									SPT	19		wet, rare shell fragments, no discernible bedding
				DS	1100	854	21.3	123.4	U	27		
10												
	SA (5.6)								SPT	12		medium gray, common shel fragments, few pebbles
15												
									SPT	17		
									U	43		
20												
	SA (6.3)								SPT	20	GW SW	MEDIUM GRAY GRAVELLY SAND TO SANDY GRAVEL, medium dense, wet
												grades more gravel
									SPT	18		
25												
				DS	3200	1924	53.7	103.9	U	5	SM	DARK GRAY SILTY SAND, loose to medium dense, wet, fine to very fine sand, subangular to subrounded, rare shell fragments
30	SA (16.9)								SPT	26		
									SPT	40	SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, dense, wet, interbedded medium to coarse sand, bedding 2 to 8 inch thick, common shell fragments
35												

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Job No: 47133-001-043 Pt. ID: BOLINAS.GPJ / BL-2	URS Dames & Moore		**Log of Boring**
Date Completed: 9/26/00 Boring Depth: 70.5 ft.	Surface Elev: Coordinates:		Location: Bolinas Lagoon

BORING BL-2

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SYMBOL	DESCRIPTION
35	SA (7.3)								U	50/5"	SP SM	no discernible bedding
40									SPT	34		
	SA (6.5)								SPT	68		
											GW	GRAY SANDY GRAVEL, dense, wet grades more pebbly
45									U	50/4"		grades more coarse gravel, less pebbly
											SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, very dense, wet, fine to medium sand
									SPT	63		
50									SPT	48		
55				DS	6500	6132	22.3	124.4	U	30		
	SA (33.5)								SPT	12	SM	grades more silt with slight organic odor
60									SPT	17	SP SM	GRAY TO DARK GRAY POORLY GRADED SAND WITH SILT medium dense to dense, wet, fine to medium sand
									U	52		
65									SPT	19		
70									SPT	65		

Continued Next Page

BORING BL-2

DEPTH IN FEET	LABORATORY TEST DATA								SAMPLING		SAMPLES	
	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS		STRENGTH DATA			MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	TYPE OF SAMPLER	SAMPLING RESISTANCE	SYMBOL	DESCRIPTION
		LIQUID LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	NORMAL OR CONFINING PRESSURE (PSF)	SHEAR STRENGTH (PSF)						
70												
75												
80												
85												
90												
95												
100												
105												

NOTES:
1. Boring was completed to 70.5 feet depth on September 26, 2000. Borehole advanced using rotary wash drilling techniques. Borehole backfilled with cement bentonite grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for the "U" and SPT samplers are measured in blows per foot to drive the sampler 12 inches after an initial seating depth of 6 inches using a 140 lb hammer dropping 30 inches.
4. Groundwater level not observed due to method of drilling but was estimated from the observed moisture change in samples.
5. See Plate A-7 for general log notes and explanation of symobols.

BORING BL-4

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0												SP	LIGHT BROWN POORLY-GRADED CLEAN SAND, very loose, dry, medium sand, no fines, subrounded [FILL?]
									SPT	2			
5													
									SPT	4		SP SM	BROWN TO LIGHT GRAY POORLY GRADED SAND WITH SILT, loose to medium dense, wet, medium to coarse sand, common shell fragments
				DS	1100	837	22.9	125.7	U	25			
10													
	SA (9.1)								SPT	24			finely lanminated sand, occasional pebbles
15									SPT	18			coarse clean sand to pebbles
									U	44			
20													
									SPT	38			grades finely laminated fine sand
													grades coarser to pebbles
									SPT	5		SM	DARK GRAY SILTY SAND, loose to medium dense, wet, fine to very fine sand, no shell fragments, no discernible bedding.
25													
	SA (22.0)			DS	3200	2450	39.7	112.7	U	21			
30													
									SPT	31			
									SPT	49		SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, dense to very dense, wet, medium to coarse sand, some gravel
35													

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Job No: 47133-001-043 Pt. ID: BOLINAS.GPJ / BL-4	URS Dames & Moore		Log of Boring
Date Completed: 9/21/00 Boring Depth: 40.5 ft.	Surface Elev: Coordinates:		Location: Bolinas Lagoon

BORING BL-4

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	LABORATORY TEST DATA: ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE
35				DS	4300	4539	22.6	125.3	U	50/6"
40	SA (11.3)								SPT	52
45										
50										
55										
60										
65										
70										

SAMPLES

SYMBOL DESCRIPTION

NOTES:
1. Boring was completed to 40.5 feet depth on September 21, 2000. Borehole was advanced using rotary wash drilling techniques. Borehole was backfilled with cement bentonite grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for the "U" and SPT samplers are measured in blows per foot to drive the sampler 12 inches after an initial seating depth of 6 inches using a 140 lb hammer dropping 30 inches.
4. Groundwater level not observed due to drilling method but estimated from the observed moisture change in samples.
5. See Plate A-7 for general log notes and explanation of symobols.

BORING BL-6

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES
0											
	SA (3.4)								SPT	6	
5											
									SPT	0	
				TXUU	1440	269	37.3	114.4	U	2	
10											
	SA (32.3)	NP	NP						SPT	5	
15											
									SPT	16	
									SPT	26	
20											
									U	59	
									SPT	28	
25											
				DS	3200	3529	16.2		U	74	
30	SA (6.6)								SPT	42	
									SPT	31	
35											

SYMBOL	DESCRIPTION
SP	LIGHT GRAY TO BROWN POORLY GRADED SAND, loose, dry at surface, medium to coarse sand with some gravel
SM	DARK GRAY SILTY SAND, very loose to medium dense, wet, fine to very fine sand with some black interbeds, occasional shell fragments
	grades clayey
	grades few pebbles
SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, medium to coarse sand, medium dense to dense, wet

Continued Next Page

Job No: 47133-001-043 Pt. ID: BOLINAS.GPJ / BL-6	URS Dames & Moore	Log of Boring
Date Completed: 9/20/00 Boring Depth: 70.5 ft.	Surface Elev: Coordinates:	Location: Bolinas Lagoon

BORING BL-6

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
35									U	50/5"		SP SM	
									SPT	8			
40													occasional to common shell fragments
									SPT	31			
45									U	58			
									SPT	65			
50													
									SPT	59			bedding 8-inch thick
				DS	6500	6764	26.1		U	50/4"			
55													
	SA (11.5)								SPT	37			few 1-inch thick dark gray silty clay interbeds
60									SPT	72			
									U	50/5"			
65													
									SPT	52			
									SPT	50/5"			
70													

Continued Next Page

BORING BL-6

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES
70											
75											
80											
85											
90											
95											
100											
105											

SYMBOL	DESCRIPTION

NOTES:

1. Boring was completed to 70.5 feet depth on September 21, 2000. Borehole drilled using rotary wash drilling techniques. Borehole was backfilled with cement bentonite grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for the "U" and SPT samplers are measured in blows per foot to drive the sampler 12 inches after an initial seating depth of 6 inches using a 140 lb hammer dropping 30 inches.
4. Groundwater level not observed due to drilling method but estimated from the observed moisture change in samples.
5. See Plate A-7 for general log notes and explanation of symobols.

BORING BL-8

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SYMBOL	DESCRIPTION
0											SP	LIGHT GRAY TO BROWN POORLY GRADED SAND, very loose, dry at surface, medium to coarse sand
	SA (1.7)								SPT	4		grades more brown, wet
5												grades more dark gray, common shell fragment, no discernible bedding
	SA (10.3)								SPT	3	SP SM	grades more silty
												grades loose
10	SA (50)	45	18	TXUU	2880	318	50.7	105.5	U	2	ML	BLACK TO DARK GRAY SANDY SILT, very soft, wet, very thin sand pockets of irregular shape, some organics
									SPT	3	SP	DARK GRAY SAND, very loose, wet, medium-grained sand, common shell fragments, no discernible bedding
15	SA (13.9)								SPT	8	SM	DARK BROWN SILTY SAND, loose, wet
									U	14		
20											ML	DARK BROWN CLAYEY SILT with brown mottling, soft, wet
	SA (56.4)								SPT	18	SP	DARK GRAY POORLY-GRADED SAND, medium dense, wet, medium grains, little fines
											GW	DARK GRAY SANDY GRAVEL, dense, wet, gravel to 1/2 inch diameter, well-rounded, 1/2 inch bedding
25	SA (6.7)								SPT	33	SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, dense, wet, medium to coarse sand, 4 inch thick bedding
									U	77		sand with common gravel, clasts to 3/4 inch diameter
30									SPT	30		4 inches thick gravel lens
											GW	DARK GRAY GRAVEL, wet, clasts to 1 inch diameter
35									SPT	35	SP SM	DARK GRAY POORLY GRADED SAND WITH SILT, dense, wet, fine to coarse sand, little to no gravel, subangular to subrounded

Continued Next Page

Job No: 47133-001-043 Pt. ID: BOLINAS.GPJ / BL-8	URS Dames & Moore		Log of Boring
Date Completed: 9/20/00 Boring Depth: 40.5 ft.	Surface Elev: Coordinates:		Location: Bolinas Lagoon

BORING BL-8

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
35				DS	4300	4517	22.1	125.3	U	50/6"		SP SM	6 inches thick gravel lens
40									SPT	35			
45													
50													
55													
60													
65													
70													

NOTES:
1. Boring was completed to 40.5 feet depth on September 20, 2000 and was backfilled with cement bentonite grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for the "U" and SPT samplers are measured in blows per foot to drive the sampler 12 inches after an initial seating depth of 6 inches using a 140 lb hammer dropping 30 inches.
4. Groundwater level was estimated from the observed moisture change in samples.
5. See Plate A-7 for general log notes and explanation of symobols.

BORING BL-9

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	LABORATORY TEST DATA: ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	TOTAL DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0									GRAB			SP	LIGHT GRAY POORLY GRADED FINE SAND, very loose, dry to wet, subangular, no fines
									SPT	45			DARK GRAY SILTSTONE, poorly consolidated, thinly bedded, moderately fractured, low hardness, weak, moderately weathered
5									HQ				switched to rock coring at depth of 5 ft
													RQD = 65%
									HQ				3 inches thin well cemented, hard siltstone layer
10													unfractured at the bottom of 3 ft of the core
													RQD = 80%
15													
20													
25													
30													
35													

NOTES:
1. Boring was completed to 13.0 feet depth on September 22, 2000 and was backfilled with cement bentonite grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for the SPT sampler is measured in blows per foot to drive the sampler 12 inches after an initial seating depth of 6 inches using a 140 lb hammer dropping 30 inches.
4. Groundwater level was estimated from the observed moisture change in samples.
5. See Plate A-7 for general log notes and explanation of symobols.

Job No: 47133-001-043 Pt. ID: BOLINAS.GPJ / BL-9	URS Dames & Moore	Log of Boring	
Date Completed: 9/22/00 Boring Depth: 13.0 ft.	Surface Elev: Coordinates:	Location: Bolinas Lagoon	

Log Template: 1A

November 22, 2000

APPENDIX 2

Boring Logs

BL-1 (25 SEPT. 2000)

DEPTH IN FEET	SYMBOL	SAMPLER	VISUAL-MANUAL DESCRIPION AND CLASSIFICATION (*LABORATORY)	N	GRAVEL,%	SAND,%	FINES,%	L.L.,	P.L.	P.I.	M.C.%	DENSITY,PCF	NORMAL PRESSURE PSF	SHEAR STRENGTH PSF
EL. 0			POORLY GRADED SAND (SP)-Light gray to brown with medium sand , loose, dry at surface, no fines subrounded to rounded.											
			Wet.	9										
-5			Medium gray, subrounded to subangular.	9										
-10				29							24.4	118.7	1100	893
			POORLY GRADED SAND with SILT (SP-SM)-Light gray to brown, medium dense, wet, little gravel.	15	0.0	92.2	7.8							
-15			Occasional pebbly layer.	19										
-20			Medium dense, gray, wet, gravel clasts to at least 1-inch diameter.	38	36.5	55.0	8.5				19.7	123.1	2200	2077
				17										
-25			Light gray, medium dense, wet,medium to coarse sand, bedding 1/2 to 2 inch thick, subrounded to subangular.	20	5.4	87.1	7.5							
				15										
-30			POORLY GRADED GRAVEL (GP)-Medium dense, wet, coarse gravel with abundant sand, cobbles to at least 3-inch diameter.	35	88.4	10.5	1.1							
			POORLY GRADED SAND with SILT (SP-SM)-Dark gray medium dense, wet, fine to medium sand, subrounded, no discernible bedding.	26										
-35				53							23.9	123.5	4100	2539
-40			Light gray.	20	0.0	90.9	9.1	NP		NP				
			Thinly laminated bedding (<1/8 inch thick)	44										
-45				50/5"										
			Abundant shell fragments.	63										
-50			Rare shell fragments.	56										
-55				50/5"										
				50	0.0	67.4	32.6							
			SILTY SAND (SM)-Dark gray silty sand, dense, wet, fine to medium sand.											
-60			WELL GRADED SAND (SW)-Dark gray well graded sand, dense to very dense, wet, fine to medium sand, little clay.	82										
			Rare shell fragments.	62							28.6	120.1	7600	6174
-65			Grades loose sand.	12										
-70				63										

BOTTOM OF BORING AT -70.5

BL-2 (26 SEPT. 2000)

DEPTH IN FEET	SYMBOL	SAMPLER	VISUAL-MANUAL DESCRIPION AND CLASSIFICATION (*LABORATORY)	N	GRAVEL,%	SAND,%	FINES,%	L.L.,	P.L.	P.I.	M.C.%	DENSITY,PCF	NORMAL PRESSURE PSF	SHEAR STRENGTH PSF
EL. 0			POORLY GRADED SAND with SILT (SP-SM)-Light gray to brown, loose, dry at surface, medium sand, subangular.											
			Thinly laminated bedding.	9										
-5			Wet, rare shell fragments, no discernible Bedding.	19										
-10				27							21.3	123.4	1100	854
			Light gray, common shell fragments, few pebbles.	12	1.9	92.5	5.6							
-15				17										
-20				43										
			Yellowish brown.	20	1.5	92.2	6.3							
			GRAVELLY SAND TO SANDY GRAVEL (GW-SW) Medium gray, dense, wet. Grades more to gravel.	18										
-25			SILTY SAND (SM)-Dark gray, loose to medium dense, wet, fine to very fine sand, subangular to subrounded, rare shell fragments.	5							53.7	103.9	3200	1924
-30				26	0.0	83.1	16.9							
				40										
-35			POORLY GRADED SAND with SILT (SP-SM)-Dark gray dense, wet, interbedded medium to coarse sand bedding 2 to 8 inch thick, common shell fragments, yellowish brown. No discernible bedding.	50/5"	0.0	92.7	7.3							
-40				34										
			Light brown.	68	3.5	90.0	6.5							
-45			SANDY GRAVEL (GW)-Gray, dense, wet, grades more pebbly. Grades more coarse gravel less pebbly.											
			POORLY GRADED SAND with SILT (SP-SM)-Dark gray very dense, wet fine to medium sand.	50/4"										
-50				63										
				48										
-55				30							22.3	124.4	6500	6123
			SILTY SAND (SM)-Grades more silt with slight organic odor, dark brown.	12	0.0	66.5	33.5							
-60			POORLY GRADED SAND with SILT (SP-SM)-Gray to dark, medium dense to dense, wet, fine to medium sand.	17										
-65				52										
				19										
-70				65										

BOTTOM OF BORING AT -70.5

NOTES: BL-3, BL-5 AND BL-7 WERE DELETED DUE TO ACCESS RESTRUCTIONS.

MARIN COUNTY CALIFORNIA

DRAWN BY: P H

CHECKED BY: S C

APPROVED:

SCALE:

SHEET: 1 OF 3

BOLINAS LAGOON ENVIRONMENTAL RESTORATION

BORING LOGS

BL-1 AND BL-2

U.S ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT

BL-4 (21 SEPT. 2000)

DEPTH IN FEET	SYMBOL	SAMPLER	VISUAL-MANUAL DESCRIPION AND CLASSIFICATION (*LABORATORY)	N	GRAVEL.%	SAND.%	FINES.%	L.L.	P.L.	P.I.	M.C.%	DENSITY.PCF	NORMAL PRESSURE PSF	SHEAR STRENGTH PSF
EL. 0			POORLY GRADED SAND (SP)-Light brown, very loose, dry, medium sand, no fines, subrounded Possible fill.	2										
-5			POORLY GRADED SAND with SILT (SP-SM)-Brown to light gray, loose to medium dense, wet, medium to coarse sand, common shell fragments.	4										
				25							22.9	125.7	1100	837
-10			Finely laminated sand, occasional pebbles.	24	6.0	84.9	9.1							
-15			Coarse clean sand to pebbles.	18										
				44										
-20			Grades finely laminated fine sand.	38										
			Grades coarser to pebbles.	5										
-25			SILTY SAND (SM)-Dark gray, loose to medium dense,wet, fine to very fine sand, no shell fragments, no discernible bedding.	21	2.4	75.6	22.0				39.7	112.7	3200	2450
-30				31										
				49										
-35			POORLY GRADED SAND with SILT (SP-SM)-Dark gray dense to very dense, wet, medium to coarse sand, some gravel.	50/6"							22.6	125.3	4300	4539
-40				52	1.5	87.2	11.3							

BOTTOM OF BORING AT -40.5

BL-6 (21 SEPT. 2000)

DEPTH IN FEET	SYMBOL	SAMPLER	VISUAL-MANUAL DESCRIPION AND CLASSIFICATION (*LABORATORY)	N	GRAVEL.%	SAND.%	FINES.%	L.L.	P.L.	P.I.	M.C.%	DENSITY.PCF	NORMAL PRESSURE PSF	SHEAR STRENGTH PSF
EL. 0			POORLY GRADED SAND (SP)-Light gray to brown, loose, dry at surface, medium to coarse sand with some gravel.	6	3.0	93.6	3.4							
-5				0										
			SILTY SAND (SM)-Dark gray, very loose to medium dense, wet, fine to very fine sand with some black interbeds,occasional shell fragments. Grades clayey.	2							37.3	114.4	1440	239
-10				5	0.0	67.7	32.3	NP	NP					
-15				16										
			Grades few pebbles.	26										
-20			POORLY GRADED SAND with SILT (SP-SM)-Dark gray, medium to coarse sand, medium dense to dense, wet.	59										
				28										
-25				74							16.2	131.3	3200	3592
-30				42	0.0	93.4	6.6							
				31										
-35				50/5"										
				8										
-40			Occasional to common shell fragments.											
				31										
-45				58										
				65										
-50			Bedding 8-inch thick.	59										
				50/4"							26.1	120.8	6500	6764
-55			Few 1-inch thick dark gray silty clay interbeds.	37	0.0	88.5	11.5							
-60				72										
				50/5"										
-65				52										
-70				50/5"										

BOTTOM OF BORING AT -70.5

MARIN COUNTY CALIFORNIA

DRAWN BY: P H

CHECKED BY: S C

APPROVED:

SCALE:

SHEET: 2 OF 3

BOLINAS LAGOON ENVIRONMENTAL RESTORATION

BORING LOGS

BL-4 AND BL-6

U.S ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT

BL-8 (20 SEPT. 2000)

DEPTH IN FEET	SYMBOL	SAMPLER	VISUAL-MANUAL DESCRIPION AND CLASSIFICATION (#LABORATORY)	N	GRAVEL.%	SAND.%	FINES.%	L.L.	P.L.	P.I.	M.C.%	DENSITY,PCF	NORMAL PRESSURE,PSF	SHEAR STRENGTH,PSF
EL. 0			POORLY GRADED SAND (SP)-Light Gray, very loose, dry at surface, medium to coarse sand.		0.0	98.3	1.7							
			Grades more brown, wet.	4										
-5			Grades more dark gray, common shell fragment, no discernible bedding.											
			POORLY GRADED SAND with SILT (SP-SM)-Dark gray, silty and loose.	3	9.4	80.3	10.3							
-10			SILT (ML)-Black to dark gray sandy silt, very soft, wet, very thin sand pockets of irregular shape, some organics.	2	12.3	37.7	50.0	45	27	18	50.7	105.5	2980	318
			POORLY GRADED SAND (SP)-Dark gray, very loose, wet, medium-grained sand, common shell fragments, no discernible bedding.	3										
-15			SILTY SAND (SM)-Dark brown, loose,wet.	8	0.0	86.1	13.9				39.7	112.7	3200	2450
				14										
-20			SILT (ML)-Dark brown sandy clayey silt with brown mottling, soft and wet.	18	0.0	43.6	56.4							
			POORLY GRADED SAND (SP)-Dark gray, medium dense, wet, medium grains, little fines.								22.6	125.3	4300	4539
			POORLY GRADED SAND with SILT (SP-SM)-Dark gray sandy gravel, dense, wet, gravel to 1/2 diameter, well-rounded, 1/2 inch bedding.											
-25			Medium to coarse sand, 4 inch thick bedding.	33	14.6	77.5	7.9							
			Light gray.	77	8.4	84.9	6.7				20.5	126.4	3200	2438
			Sand with common gravel, clasts to 3/4 inch diameter.											
-30			4 inches thick gravel lens.	30										
			WELL GRADED GRAVEL (GW)-Dark gray, wet, clasts to 1 inch diameter.											
			POORLY GRADED SAND with SILT (SP-SM)-Dark gray, dense, wet, fine to coarse sand, little to no gravel, subangular to subrounded.	35										
-35			6 inches thick gravel lens.	50/6"							22.1	125.3	4300	4517
-40				35	0.0	94.9	5.1							

BOTTOM OF BORING AT -40.5

BL-9 (22 SEPT. 2000)

DEPTH IN FEET	SYMBOL	SAMPLER	VISUAL-MANUAL DESCRIPION AND CLASSIFICATION (#LABORATORY)	N	GRAVEL.%	SAND.%	FINES.%	L.L.	P.L.	P.I.	M.C.%	DENSITY,PCF	NORMAL PRESSURE,PSF	SHEAR STRENGTH,PSF
EL. 0			POORLY GRADED SAND (SP)-Light gray, fine sand, very loose, dry to wet, subangular, no fines.											
	X X		DARK GRAY SILTSTONE, poorly consolidated, thinly bedded, moderately fractured low hardness, weak moderately weathered.	45										
-5	X X		Switched to rock coring at depth of 5 feet.											
	X X		RQD=65%											
	X X		3 inches thin well cemented, hard siltstone layer.											
-10	X X		Unfractured at the bottom of 3 ft of the core.											
	X X		RQD=80%											
-13	X													

BOTTOM OF BORING AT -13.0

MARIN COUNTY CALIFORNIA

DRAWN BY: P H

CHECKED BY: S C

APPROVED:

SCALE:

SHEET: 3 OF 3

BOLINAS LAGOON ENVIRONMENTAL RESTORATION

BORING LOGS

BL-8 AND BL-9

U.S ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT

APPENDIX 3

Grain Size Analysis

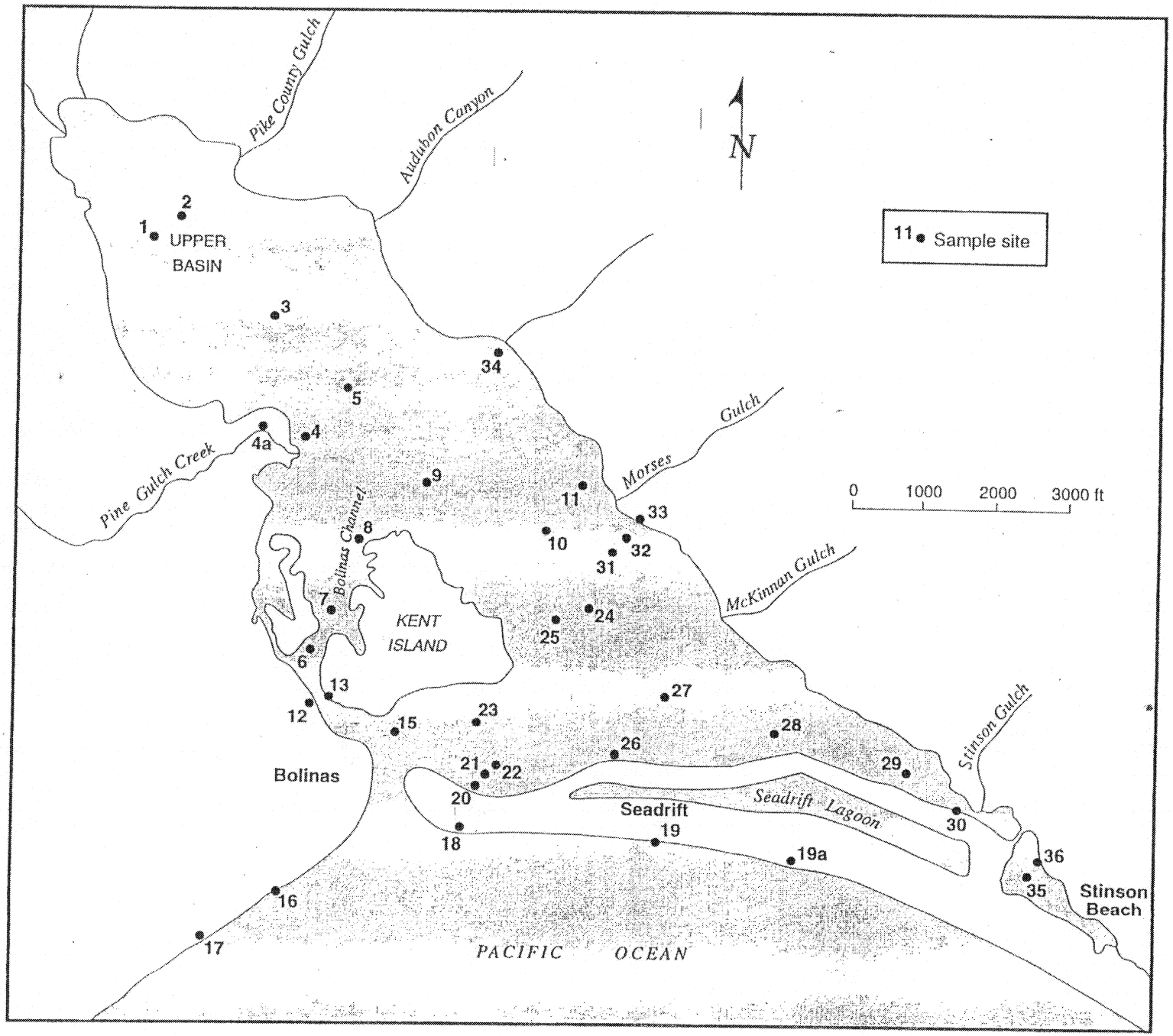


Figure 2. Bed material sampling sites, Bolinas Lagoon, 1998.

COMPUTATION SHEET

PROJECT Bolinas Lagoon

ITEM Bolinas Grain Size Samples

COMPUTED BY S.Y.C. CHECKED BY

SHEET NO. 1 OF 1 SHEETS

DATE 3/9 ~~19~~ 2000

FILE

REF. DRWG. NO.

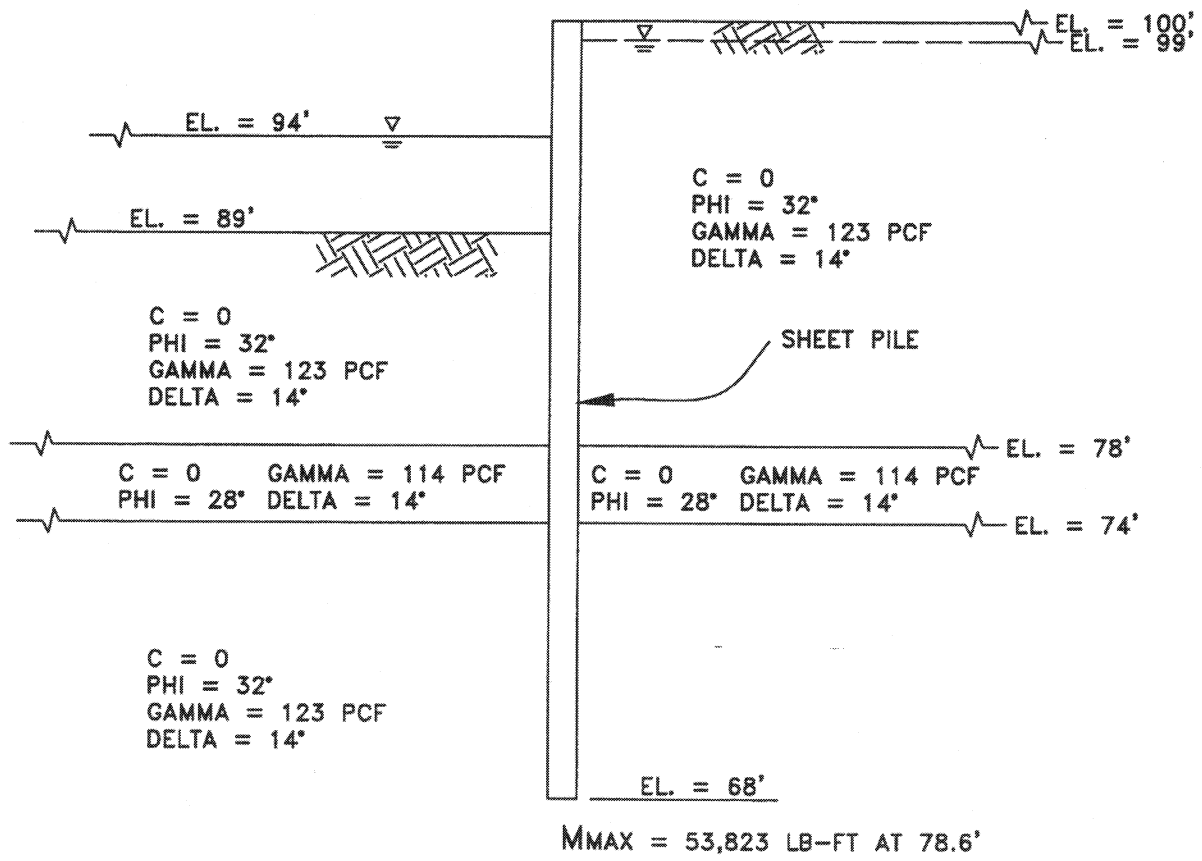
Sample	Percent Passing No.4 (4.76mm)	No.40 (0.420mm)	No. 200 (0.074mm)	(Gravel/Sand/Fines)	Classificati
1	100	100	51	0/49/51	SM, SC
2	100	100	51	0/49/51	SM, SC
3	100	100	60	0/40/60	SM, SC
4	49*	47	28	49/23/28*	GM, GC
4a	12*	8	3	88/9/3*	GW, GP
5	10	99	59	0/41/59	SM, SC
6	90*	89	31	10/59/31*	SM, SC
7	100	100	21	0/79/21	SM, SC
8	100	84	21	0/79/21	SM, SC
9	89*	86	12	11/77/12*	Sand
10	100	99	19	0/81/19	SM, SC
11	100	100	42	0/58/42	SM, SC
12	100	99	8	0/92/8	Sand
13	100	99	7	0/93/7	Sand
15	70*	11	11	30/59/11*	Sand
16	14*	3	1	85/13/1*	GW, GP
17	100	98	6	0/94/6	Sand
18	11*	4	1	89/10/1*	GW, GP
19	100	99	15	0/85/15	SM, SC
19a	100	98	3	0/97/3	SW, SP
20	12*	10	1	88/11/1*	GW, GP
21	71*	70	9	29/62/9	Sand
22	100	95	16	0/84/16	SM, SC
23	100	96	13	0/87/13	SM, SC
24	100	98	22	0/78/22	SM, SC
25	75*	74	12	25/63/12*	Sand
26	70*	57	5	30/65/15*	SW, SP
27	100	99	29	0/71/29	SM, SC
28	100	100	55	0/45/55	SM, SC
29	100	100	85	0/15/85	SM, SC
30	100	99	78	0/22/78	SM, SC
34	77	45	5	23/72/5	SW, SP
35	36	33	10	64/18/18	GM, GC
36	100	100	97	0/3/97	SM, SC

* Extrapolated

☆ U.S. GOVERNMENT PRINTING OFFICE: 1991—586-139

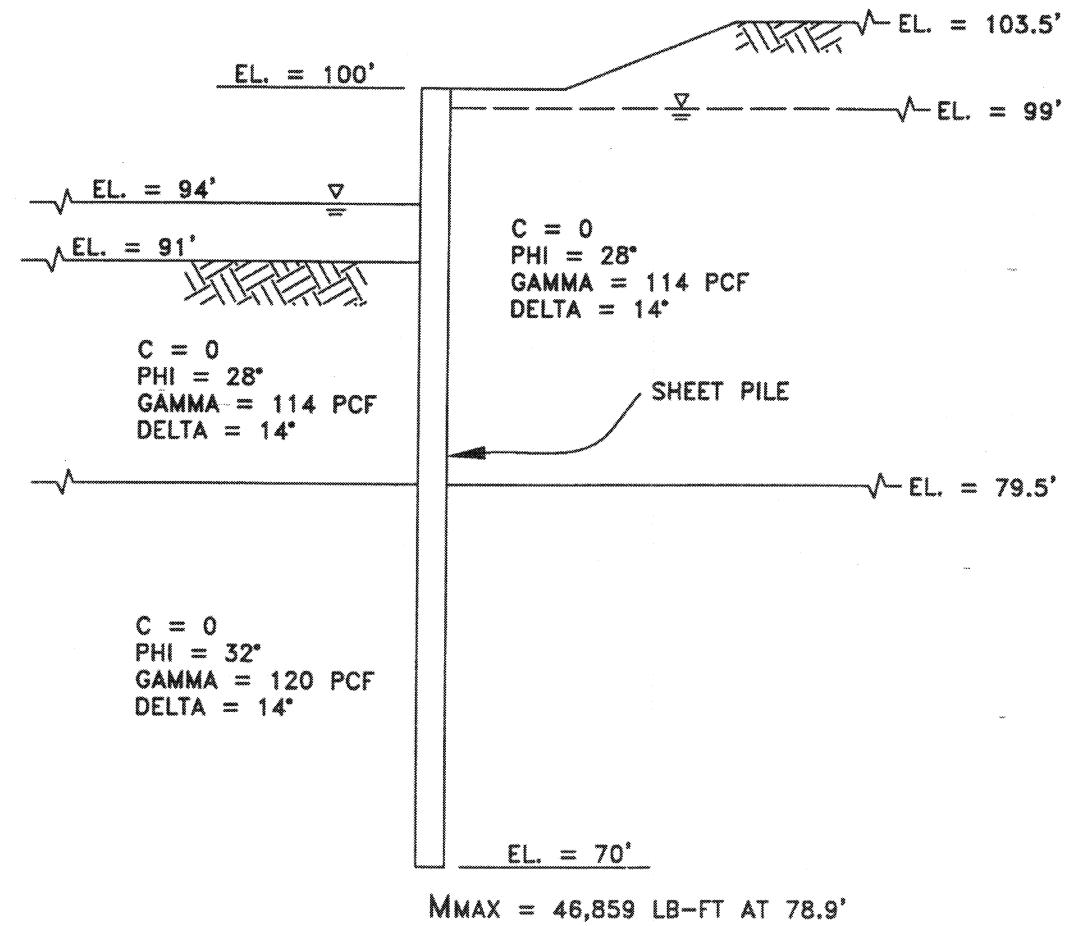
APPENDIX 4

Seadrift Lagoon Sheet Pile Analyses



BL2 TYPICAL SECTION - NORTH SEA DRIFT LAGOON SHEET PILE

SCALE : 1" = 10'



BL6 TYPICAL SECTION - SOUTH SEA DRIFT LAGOON SHEET PILE

SCALE : 1" = 10'

US Army Corps of Engineers
San Francisco District
333 Market Street
San Francisco, CA 94105

Mark	Description	Date	Appr.

DESIGNED BY: S. CHEN | CHECKED BY: | DRAWN BY:
DATE: 5-30-01 | SHEET NO. 1 OF 1 | DRAWING NO.
PREPARED UNDER THE DIRECTION OF TIMOTHY S. O'ROURKE LT. COLONEL, C.E., DISTRICT ENGINEER

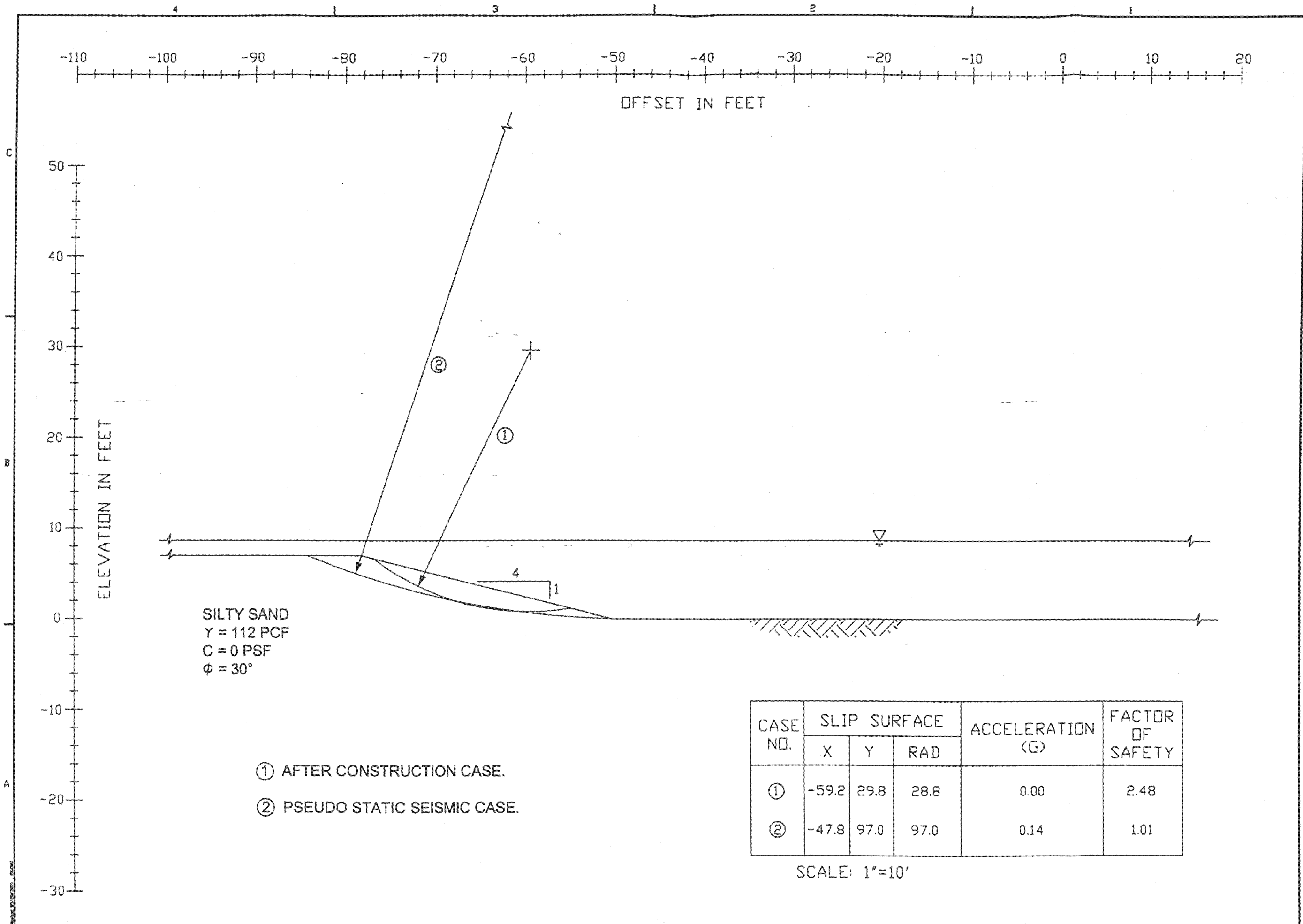
SUBMITTED: Chief, Civil Design Section
APPROVAL:
Chief, Engineering Division
APPROVAL RECOMMENDED: Chief, Engineering Technical Services Division

MARIN COUNTY CALIFORNIA
BOLINAS LAGOON ENVIRONMENTAL RESTORATION
TYPICAL SEA DRIFT LAGOON
SHEET PILE SECTIONS AT
BL-2 AND BL-6

Sheet reference number
1

APPENDIX 5

Bolinas Lagoon Channel Slope Stability Analyses



① AFTER CONSTRUCTION CASE.

② PSEUDO STATIC SEISMIC CASE.

CASE NO.	SLIP SURFACE			ACCELERATION (G)	FACTOR OF SAFETY
	X	Y	RAD		
①	-59.2	29.8	28.8	0.00	2.48
②	-47.8	97.0	97.0	0.14	1.01

SCALE: 1"=10'

US Army Corps of Engineers
San Francisco District

Mark	Description	Date	App.

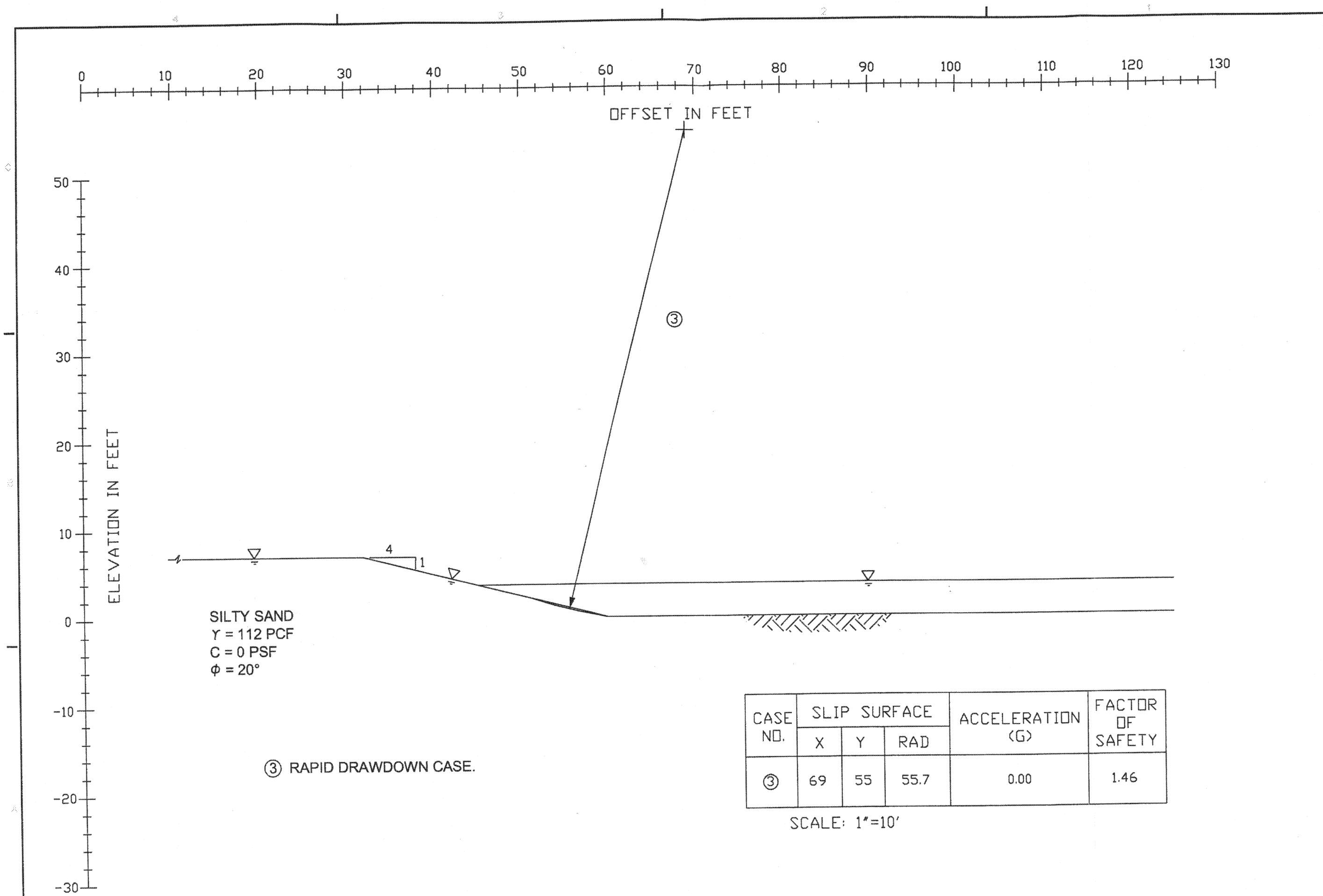
DESIGNED BY: S. CHEN
DATE: 05/30/2001
CHECKED BY:
SHEET NO. 1 OF 4
DRAWING NO. XX XX XX
DRAWN BY: P. HO

PREPARED UNDER THE DIRECTION OF
TIMOTHY S. O'ROURKE
LT. COLONEL, C.E., DISTRICT ENGINEER

SUBMITTED:
Department Director
APPROVED:
Chief, Engineering Division
APPROVED, RECOMMENDED:
Chief, Engineering Technical Services Division

CALIFORNIA
MARIN COUNTY
BOLINAS LAGOON ENVIRONMENTAL RESTORATION
TYPICAL CHANNEL SECTION
AFTER CONSTRUCTION AND PSEUDO STATIC
SEISMIC CASE. SLOPE=4H:1V

Sheet reference number
1



③ RAPID DRAWDOWN CASE.

CASE NO.	SLIP SURFACE			ACCELERATION (G)	FACTOR OF SAFETY
	X	Y	RAD		
③	69	55	55.7	0.00	1.46

SCALE: 1"=10'

US Army Corps of Engineers
San Francisco District
333 Market Street
San Francisco, CA 94105

Mark	Description	Date	Appr.

SUBMITTED:
Geotechnical Section
APPROVED:
Chief, Engineering Branch
APPROVAL RECOMMENDED:
Chief, Engineering Technical Services Division

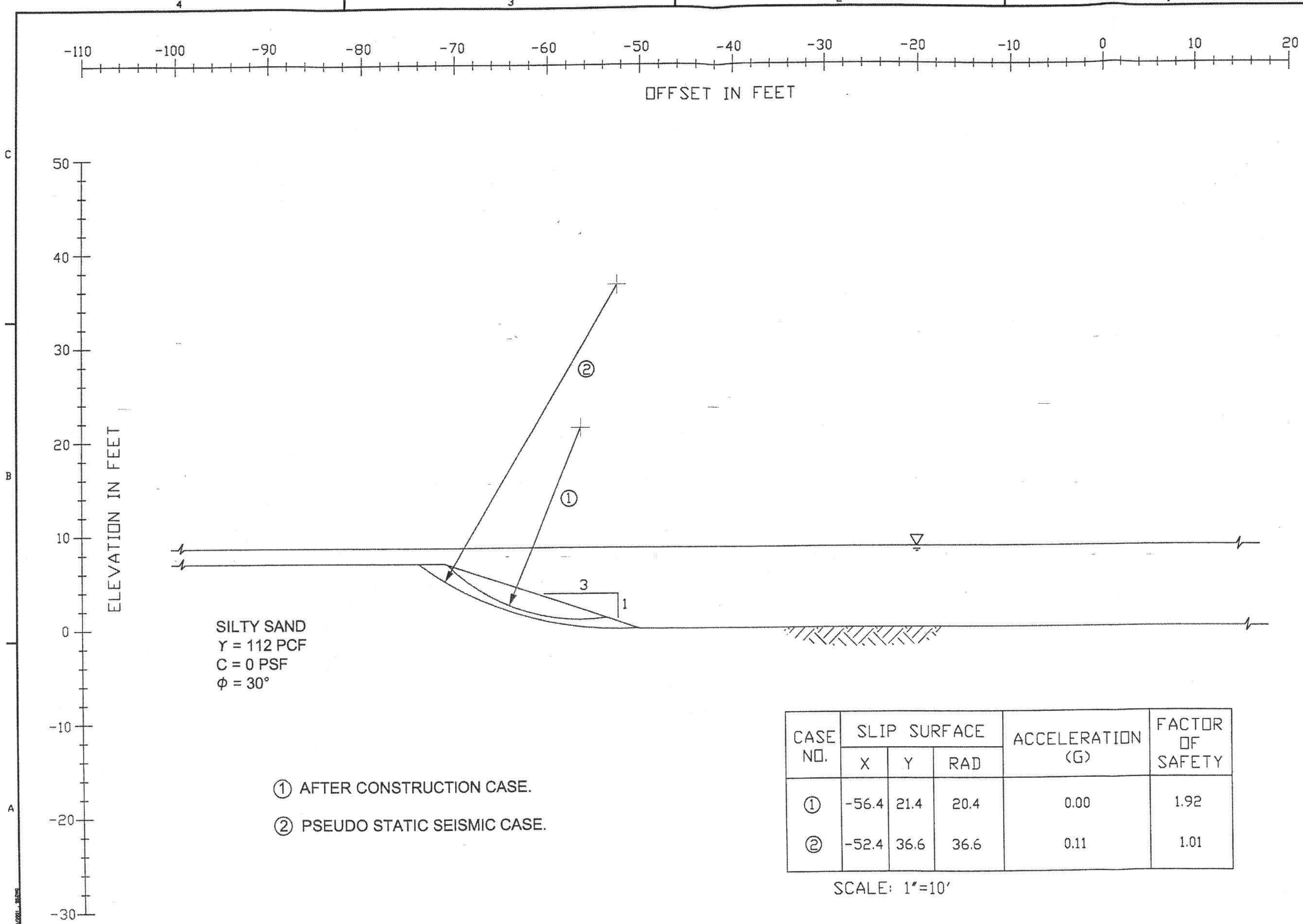
DESIGNED BY: S. CHEN/M. GOODHUE
CHECKED BY:
DRAWN BY: M. GOODHUE
DATE: 5/30/2001
SHEET NO. 2 OF 4
DRAWING NO.

PREPARED UNDER THE DIRECTION OF
TIMOTHY S. O'ROURKE
LT. COLONEL, C.E., DISTRICT ENGINEER

MARIN COUNTY CALIFORNIA

BOLINAS LAGOON ENVIRONMENTAL RESTORATION
TYPICAL CHANNEL SECTION
RAPID DRAWDOWN CASE, SLOPE=4H:1V

Sheet reference number:
2



① AFTER CONSTRUCTION CASE.

② PSEUDO STATIC SEISMIC CASE.

CASE NO.	SLIP SURFACE			ACCELERATION (G)	FACTOR OF SAFETY
	X	Y	RAD		
①	-56.4	21.4	20.4	0.00	1.92
②	-52.4	36.6	36.6	0.11	1.01

SCALE: 1"=10'

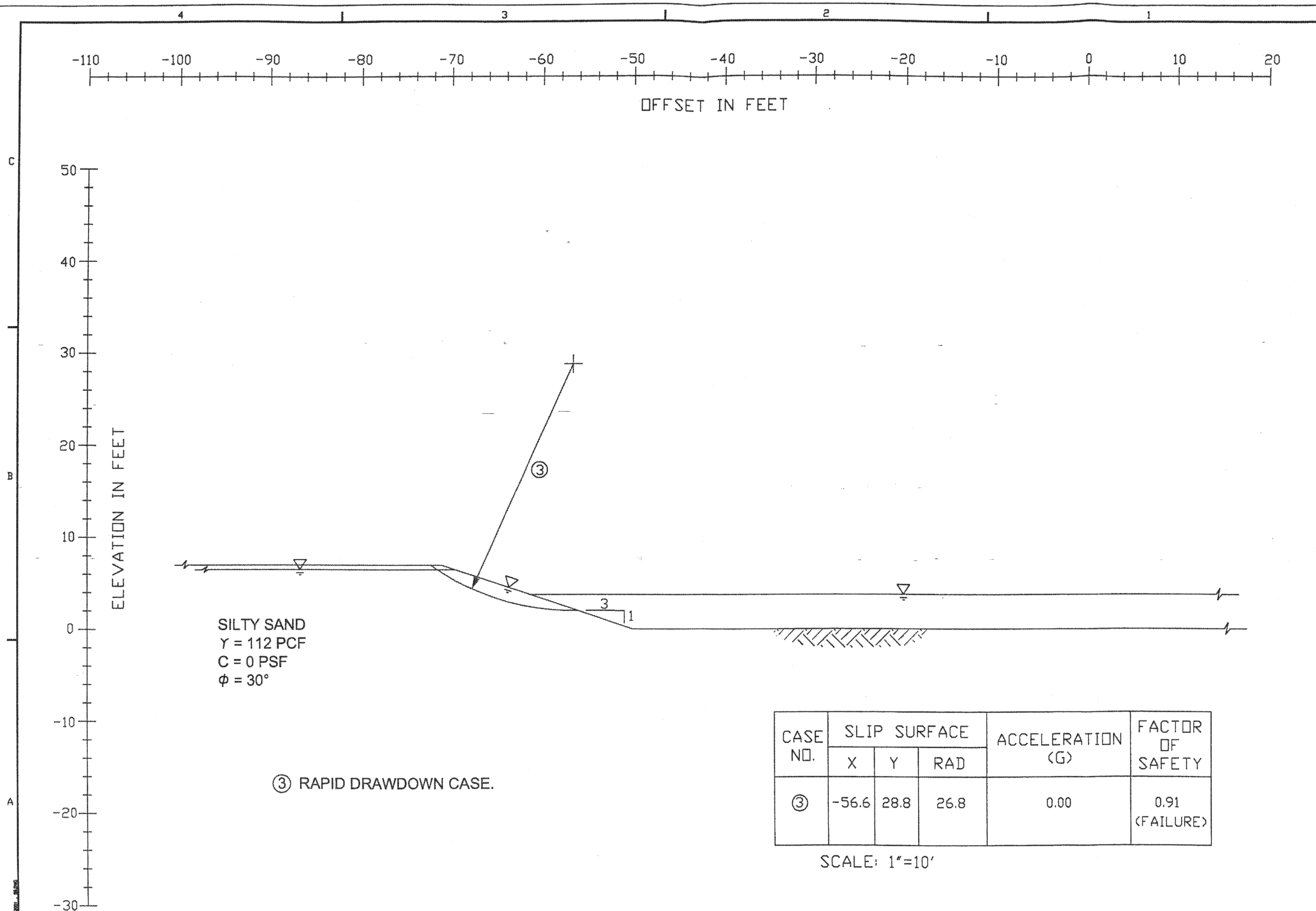
US Army Corps of Engineers San Francisco District

Mark	Description	Date	Appr.

DESIGNED BY: S. CHEN
CHECKED BY:
DATE: 05/30/2001
SHEET NO. 3 OF 4
DRAWING NO. XX XX XX
DRAWN BY: P. HO
PREPARED UNDER THE DIRECTION OF TIMOTHY S. O'ROURKE LT. COLONEL, CE., DISTRICT ENGINEER

CALIFORNIA
MARIN COUNTY
BOLINAS LAGOON ENVIRONMENTAL RESTORATION
TYPICAL CHANNEL SECTION
AFTER CONSTRUCTION AND PSEUDO STATIC SEISMIC CASE, SLOPE=3H:1V

Sheet reference number
3



③ RAPID DRAWDOWN CASE.

CASE NO.	SLIP SURFACE			ACCELERATION (G)	FACTOR OF SAFETY
	X	Y	RAD		
③	-56.6	28.8	26.8	0.00	0.91 (FAILURE)

SCALE: 1"=10'

US Army Corps of Engineers San Francisco District

Mark	Description	Date	Appr.

DESIGNED BY: S. CHEN
DATE: 05/30/2001
CHECKED BY:
SHEET NO. 4 OF 4
DRAWING NO. XX XX XX
DRAWN BY: P. HO

PREPARED UNDER THE DIRECTION OF
TIMOTHY S. O'ROURKE
LT. COLONEL, C.E., DISTRICT ENGINEER

SUBMITTED:
Geotechnical Section
APPROVAL:
Chief, Engineering Division
APPROVAL RECOMMENDED:
Chief, Engineering Technical Branches Division

CALIFORNIA
MARIN COUNTY
BOLINAS LAGOON ENVIRONMENTAL RESTORATION
TYPICAL CHANNEL SECTION
RAPID DRAWDOWN CASE. SLOPE=3H:1V

Sheet reference number
4