

CITY OF EUREKA
WATERFRONT MAINTENANCE DREDGING



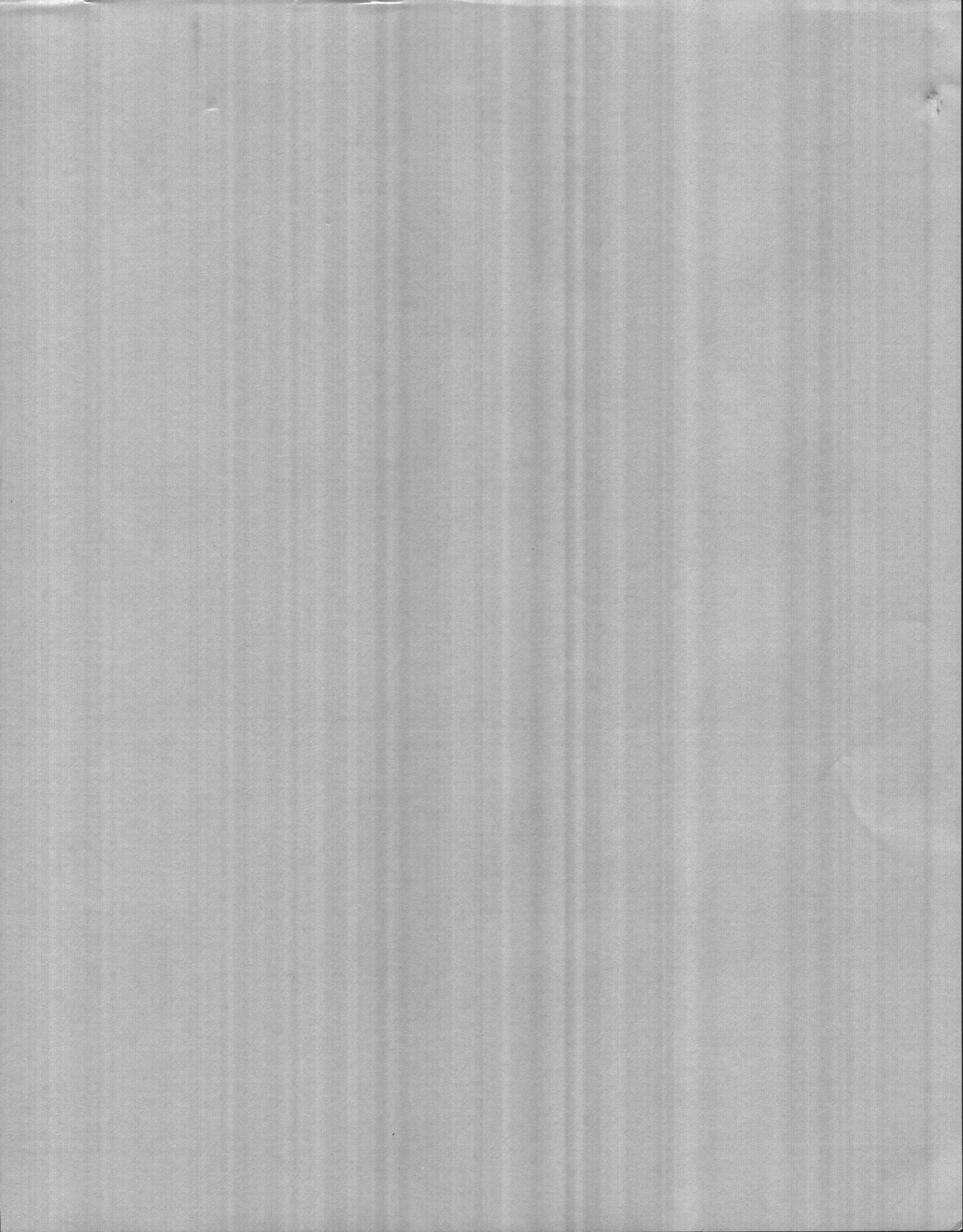
North Coast Regional Water Quality Control Board
Water Quality Certification and/or
Waste Discharge Requirements (Dredge) Application
Permit Application Attachment



U.S. Army Corps of Engineers
Chemical Analysis, Toxicity Evaluation and
Bioaccumulation Testing of Sediments from
Humboldt Bay

prepared by

Toxscan, Inc. and Kinnetic Laboratories, Inc.
(1993 – 2001)



CHEMICAL ANALYSIS, TOXICITY EVALUATION
AND BIOACCUMULATION TESTING
OF SEDIMENTS FROM
HUMBOLDT BAY:

BASELINE SURVEY I

Fiscal Year 1993

FINAL REPORT

Prepared for:

U.S. ARMY ENGINEERING DISTRICT
SAN FRANCISCO CORPS OF ENGINEERS
San Francisco, California

Prepared by:

TOXSCAN INC. and KINETIC LABORATORIES, INC.
Watsonville, California

SEPTEMBER 1993
Final Revision 9/94

C:\WP51\BIOASSAYS\FCOE\HUMBOLT2\HUMBOLT2.RP2:09/23/94:1344

Table 1. Analyses performed, Humboldt Bay Baseline Survey I (FY 1993). Shaded samples composited; SPP = Suspended Particulate Phase.

SAMPLE	ANALYSES			
	Initial Grain Size	Sediment Chemistry	Solid Phase Bioassay	SPP Bioassay
North Bay Channel:				
NB1	YES	NO	NO	NO
NB2	YES	NO	NO	NO
NB3	YES	NO	NO	NO
NB4	YES	NO	NO	NO
NB5	YES	NO	NO	NO
NB6	YES	NO	NO	NO
NB7	YES	NO	NO	NO
NB8	YES	NO	NO	NO
NB9	YES	NO	NO	NO
NB10	YES	NO	NO	NO
Samoa Turning Basin:				
SAM1	YES	YES	NO	NO
SAM2	YES	YES	NO	NO
SAM3	YES	YES	NO	NO
SAM4	YES	YES	NO	NO
SAM5	YES	YES	NO	NO
Comp SAMTB:	YES	YES	YES	YES
SAM6-A	YES	YES	NO	NO
SAM6-B	YES	YES	NO	NO
SAM6-C	YES	YES	NO	NO
SAM7	YES	YES	NO	NO
Eureka Upper Channel:				
EK1	YES	YES	NO	NO
Comp EKUP:	YES	YES	YES	YES
EK2	YES	YES	NO	NO
EK3	YES	YES	NO	NO
EK4	YES	YES	NO	NO
Fields Landing Lower Channel and Turning Basin:				
Comp FLTB:	YES	YES	YES	YES
FL1	YES	YES	NO	NO
FL2	YES	YES	NO	NO
FL3	YES	YES	NO	NO
FL4	YES	YES	NO	NO
FL5	YES	YES	NO	NO
FL6	YES	YES	NO	NO
FL7	YES	YES	NO	NO
FL8	YES	YES	NO	NO
Entrance Channel, Bar, Reference Site and Control:				
ENT1	YES	NO	NO	NO
ENT2	YES	NO	NO	NO
BAR1	YES	NO	NO	NO
REF	YES	YES	YES	YES
CONTROL	YES	YES	YES	YES

Table 2. Sediment samples collected, Humboldt Bay Baseline Survey I (FY 1993). Samples collected by vibracore or Smith-Macintyre grab; shaded samples composited.

SAMPLE	DATE	TIME	Core Penetration (Feet)		California State Plane Coordinates ¹	
			ACHIEVED	SAMPLED	NORTH	EAST
North Bay Channel:						
NB1	10/30/92	10:05		GRAB ²	525031	1384394
NB2	10/30/92	09:59		GRAB	526030	1384057
NB3	10/30/92	09:44		GRAB	528797	1386523
NB4	10/30/92	09:35		GRAB	530599	1387800
NB5	10/30/92	09:14		GRAB	531749	1389435
NB6	10/29/92	15:54		GRAB	533758	1391370
NB7a	10/29/92	16:22		GRAB	535830	1392466
NB7b	10/29/92	16:35		GRAB	535752	1392243
NB8	10/29/92	08:38		GRAB	537273	1393224
NB9	10/31/92	08:00		GRAB	538721	1393809
NB10	10/31/92	08:12		GRAB	540443	1394440
Samoa Turning Basin (SAMTB):						
SAM1	10/31/92	08:22		GRAB	541705	1394795
SAM2	10/31/92	08:30		GRAB	542592	1395004
SAM3	10/31/92	08:42		GRAB	544002	1395528
SAM4	10/31/92	08:52		GRAB	545288	1395694
SAM5	10/31/92	09:01		GRAB	547195	1397435
SAM6 A	10/31/92	10:05		GRAB	547717	1397065
SAM6 B	10/31/92	11:15	2.8	2.8	547415	1397729
SAM6 C	10/31/92	12:10	3.5	3.5	548045	1397400
SAM7	10/31/92	09:22		GRAB	548062	1399100
Eureka Upper Channel (EKUP):						
EK1	10/31/92	14:50	1.6	1.6	541616	1394926
EK2	11/01/92	09:00	1.5	1.5	543229	1396864
EK3	11/01/92	10:30	5.2	5.2	543538	1397512
EK4	11/01/92	11:45		GRAB	543931	1394440
Fields Landing Lower Channel and Turning Basin (FLTBT):						
FL1	10/30/92	13:50		GRAB	513761	1383887
FL2	10/30/92	14:51		GRAB	514038	1384234
FL3	10/30/92	15:16		GRAB	514435	1383990
FL4	10/30/92	12:08		GRAB	515405	1384560
FL5	10/30/92	10:56		GRAB	517266	1385306
FL6	10/30/92	10:45		GRAB	519218	1384729
FL7	10/30/92	10:32		GRAB	521153	1383800
FL8	10/30/92	10:19		GRAB	523119	1384683
Entrance Channel, Bar and Reference Site:						
ENT1	11/02/92	11:45		GRAB	526029	1382439
ENT2	11/02/92	12:00		GRAB	529168	1380331
BAR1	11/02/92	12:10		GRAB	530790	1377603
REF1	11/02/92	13:15		GRAB	524696	1351329

¹ Field measurements of station locations were made in latitude x longitude (see Field Logs, Appendix A), and converted here to California State Plane Coordinates.

² Grab samples (except Entrance and Bar) were taken only where depth from bottom to project depth was less than 1.5 ft; Entrance and Bar stations were grab sampled due to wind and sea conditions.

Table 3. Biological assessments, Humboldt Bay Baseline Survey I (FY 1993).

Test Species:	SP	SPP	BA
<i>R. abronius</i>	X	-	-
<i>M. edulis</i>	-	X	-
<i>H. costata</i>	X	X	-
<i>C. stigmaeus</i>	-	X	-
<i>N. caecoides</i>	X	-	X
<i>M. nasuta</i>	-	-	X

X = test performed

SP = Solid Phase Bioassay; SPP = Suspended Particulate Phase Bioassay; BA = Bioaccumulation

Table 4. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections					Detection Limit
	EKUP	SAMTB	FLT B	REF	Control	
METALS (ppm, dry wt)						
Arsenic	5.3	5.2	6.0	5.5	3.5	0.1
Cadmium	ND	ND	0.11	ND	ND	0.1
Chromium	120	140	160	150	46	0.1
Copper	16	13	20	15	3	0.1
Lead	5.6	4.4	5.3	4.9	2.2	0.1
Mercury	0.02	0.03	0.03	0.03	0.02	0.02
Nickel	65	60	76	78	20	0.1
Selenium	0.13	0.12	0.17	0.10	ND	0.1
Silver	ND	ND	ND	ND	ND	0.1
Zinc	49	43	54	50	18	1.0
ORGANOTINS (ppb, dry weight)						
Monobutyltin	ND	ND	ND	ND	ND	1.0
Dibutyltin	ND	1	ND	ND	ND	1.0
Tributyltin	1	1	1	ND	ND	1.0
Tetrabutyltin	ND	ND	ND	ND	ND	1.0
PAHs (ppb, dry wt)						
2-Methyl naphthalene	ND	ND	ND	ND	ND	8
Naphthalene	ND	ND	ND	ND	ND	20
Acenaphthylene	ND	ND	ND	ND	ND	6
Acenaphthene	ND	ND	ND	ND	ND	8
Fluorene	ND	ND	ND	ND	ND	20
Phenanthrene	ND	ND	ND	ND	ND	20
Anthracene	ND	ND	ND	ND	ND	20
Fluoranthene	ND	ND	ND	ND	ND	20
Pyrene	ND	ND	ND	ND	ND	40
Chrysene	ND	ND	ND	ND	ND	30
Benzo(a)anthracene	ND	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	20
Benzo(a)pyrene	ND	ND	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	ND	40
total PAHs	ND	ND	ND	ND	ND	
PHENOLS (ppb, dry wt)						
Phenol	ND	ND	ND	ND	ND	10
2,4-Dimethylphenol	ND	ND	ND	ND	ND	10
2,4-Dichlorophenol	ND	ND	ND	ND	ND	40
Pentachlorophenol	ND	ND	ND	ND	ND	40
Total Chlorinated phenol	ND	ND	ND	ND	ND	4-60
total phenols	ND	ND	ND	ND	ND	
DIOXINS (pptr, dry wt)						
2,3,7,8-TCDD	ND	ND	ND	ND	ND	0.24
2,3,7,8-TCDF	ND	ND	ND	ND	ND	0.39

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections					Detection Limit
	EKUP	SAMTB	FLTB	Ref Comp	Control	
MISCELLANEOUS CHEMISTRIES						
Total sulfides (ppm, dry)	160	48	11	ND	53	0.1
Water soluble sulfides (ppm, dry)	0.1	ND	ND	ND	ND	0.1
Oil & Grease (ppm, dry)	ND	22	ND	ND	ND	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	ND	ND	ND	20
% Solids (%)	75	77	68	77	77	0.1
TOC (%)	0.1	0.1	0.3	ND	ND	0.1
CHLORINATED PESTICIDES (ppb, dry weight)						
Aldrin	ND	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	ND	0.5-1.0
beta-BHC	ND	ND	ND	ND	ND	0.5-1.0
delta-BHC	ND	ND	ND	ND	ND	0.5-1.0
gamma-BHC (lindane)	ND	ND	ND	ND	ND	0.5-1.0
alpha-Chlordane	ND	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	ND	5.0
2,4'-DDD	ND	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	ND	1.0
2,4'-DDE	ND	ND	ND	ND	ND	0.5
4,4'-DDE	ND	ND	ND	ND	ND	0.5
2,4'-DDT	ND	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	ND	ND	1.0
Dieldrin	ND	ND	ND	ND	ND	0.5
Endosulfan I	ND	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	ND	0.5
Endosulfan sulfate	ND	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	ND	0.5
Heptachlor epoxide	ND	ND	ND	ND	ND	10
Methoxychlor	ND	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	ND	30
PCBs (ppb, dry weight)						
PCB 1242	ND	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	EK1	EK2	EK3	EK4	
METALS (ppm, dry wt)					
Arsenic	5.7	5.2	5.1	6.2	0.1
Cadmium	ND	ND	ND	0.11	0.1
Chromium	86	110	130	160	0.1
Copper	8	11	15	25	0.1
Lead	3.2	4.4	5.2	7.3	0.1
Mercury	0.02	0.02	0.02	0.03	0.02
Nickel	39	56	62	85	0.1
Selenium	ND	ND	0.10	0.18	0.1
Silver	ND	ND	ND	ND	0.1
Zinc	32	40	ND	67	1.0
ORGANOTINS (ppb, dry weight)					
Monobutyltin	ND	ND	ND	ND	1.0
Dibutyltin	ND	ND	ND	ND	1.0
Tributyltin	ND	ND	ND	2	1.0
Tetrabutyltin	ND	ND	ND	ND	1.0
PAHs (ppb, dry wt)					
2-Methyl naphthalene	ND	ND	ND	ND	8
Naphthalene	ND	ND	ND	ND	20
Acenaphthylene	ND	ND	ND	ND	6
Acenaphthene	ND	ND	ND	ND	8
Fluorene	ND	ND	ND	ND	20
Phenanthrene	ND	ND	ND	ND	20
Anthracene	ND	ND	ND	ND	20
Fluoranthene	ND	ND	ND	ND	20
Pyrene	ND	ND	ND	ND	40
Chrysene	ND	ND	ND	ND	30
Benzo(a)anthracene	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	20
Benzo(a)pyrene	ND	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	40
total PAHs	ND	ND	ND	ND	
PHENOLS (ppb, dry wt)					
Phenol	ND	ND	ND	ND	10
2,4-Dimethylphenol	ND	ND	ND	ND	10
2,4-Dichlorophenol	ND	ND	ND	ND	40
Pentachlorophenol	ND	ND	ND	ND	40
Total Chlorinated phenol	ND	ND	ND	ND	4-60
total phenols	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	EK1	EK2	EK3	EK4	
MISCELLANEOUS CHEMISTRIES					
Total sulfides (ppm, dry)	ND	16	15	420	0.1
Water soluble sulfides (ppm, dry)	ND	ND	ND	ND	0.1
Oil & Grease (ppm, dry)	160	ND	ND	36	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	ND	21	20
% Solids (%)	85	82	79	62	0.1
TOC (%)	0.1	0.1	0.3	0.5	0.1
CHLORINATED PESTICIDES (ppb, dry weight)					
Aldrin	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	0.5-1.0
beta-BHC	ND	ND	ND	ND	0.5-1.0
delta-BHC	ND	ND	ND	ND	0.5-1.0
gamma-BHC (lindane)	ND	ND	ND	ND	0.5-1.0
alpha-Chlordane	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	5.0
2,4'-DDD	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	1.0
2,4'-DDE	ND	ND	ND	ND	0.5
4,4'-DDE	ND	ND	ND	ND	0.5
2,4'-DDT	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	ND	1.0
Dieldrin	ND	ND	ND	ND	0.5
Endosulfan I	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	0.5
Endosulfan sulfate	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	0.5
Heptachlor epoxide	ND	ND	ND	ND	10
Methoxychlor	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	30
PCBs (ppb, dry weight)					
PCB 1242	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	SAM1	SAM2	SAM3	SAM4	
METALS (ppm, dry wt)					
Arsenic	4.9	4.9	4.7	6.0	0.1
Cadmium	ND	ND	ND	ND	0.1
Chromium	100	110	88	110	0.1
Copper	8	6	6	7	0.1
Lead	3.8	4.0	3.4	4.1	0.1
Mercury	0.05	0.02	0.03	0.03	0.02
Nickel	41	44	42	42	0.1
Selenium	ND	ND	ND	ND	0.1
Silver	ND	ND	ND	ND	0.1
Zinc	29	31	29	32	1.0
ORGANOTINS (ppb, dry weight)					
Monobutyltin	ND	ND	ND	ND	1.0
Dibutyltin	ND	ND	ND	ND	1.0
Tributyltin	ND	1	ND	ND	1.0
Tetrabutyltin	ND	ND	ND	ND	1.0
PAHs (ppb, dry wt)					
2-Methyl naphthalene	ND	ND	ND	ND	8
Naphthalene	ND	ND	ND	ND	20
Acenaphthylene	ND	ND	ND	ND	6
Acenaphthene	ND	ND	ND	ND	8
Fluorene	ND	ND	ND	ND	20
Phenanthrene	ND	ND	ND	ND	20
Anthracene	ND	ND	ND	ND	20
Fluoranthene	ND	ND	ND	ND	20
Pyrene	ND	ND	ND	ND	40
Chrysene	ND	ND	ND	ND	30
Benzo(a)anthracene	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	20
Benzo(a)pyrene	ND	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	40
total PAHs	ND	ND	ND	ND	
PHENOLS (ppb, dry wt)					
Phenol	ND	ND	ND	ND	10
2,4-Dimethylphenol	ND	ND	ND	ND	10
2,4-Dichlorophenol	ND	ND	ND	ND	40
Pentachlorophenol	ND	ND	ND	ND	40
Total Chlorinated phenol	ND	ND	ND	ND	4-60
total phenols	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	SAM1	SAM2	SAM3	SAM4	
MISCELLANEOUS CHEMISTRIES					
Total sulfides (ppm, dry)	ND	ND	ND	2.4	0.1
Water soluble sulfides (ppm, dry)	ND	ND	ND	ND	0.1
Oil & Grease (ppm, dry)	ND	56	ND	ND	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	ND	ND	20
% Solids (%)	80	80	78	79	0.1
TOC (%)	ND	ND	ND	0.1	0.1
CHLORINATED PESTICIDES (ppb, dry weight)					
Aldrin	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	0.5-1.0
beta-BHC	ND	ND	ND	ND	0.5-1.0
delta-BHC	ND	ND	ND	ND	0.5-1.0
gamma-BHC (lindane)	ND	ND	ND	ND	0.5-1.0
alpha-Chlordane	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	5.0
2,4'-DDD	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	1.0
2,4'-DDE	ND	ND	ND	ND	0.5
4,4'-DDE	ND	ND	3.3	ND	0.5
2,4'-DDT	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	ND	1.0
Dieldrin	ND	ND	ND	ND	0.5
Endosulfan I	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	0.5
Endosulfan sulfate	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	0.5
Heptachlor epoxide	ND	ND	ND	ND	10
Methoxychlor	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	30
PCBs (ppb, dry weight)					
PCB 1242	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections					Detection Limit
	SAM5	SAM6-A	SAM6-B	SAM6-C	SAM7	
METALS (ppm, dry wt)						
Arsenic	6.0	5.3	5.7	5.9	5.4	0.1
Cadmium	ND	ND	ND	ND	ND	0.1
Chromium	120	150	160	160	120	0.1
Copper	7	15	18	14	7	0.1
Lead	4.5	4.9	5.7	5.4	4.6	0.1
Mercury	0.06	0.03	0.05	0.05	0.04	0.02
Nickel	48	66	73	68	46	0.1
Selenium	ND	0.11	0.12	0.10	ND	0.1
Silver	ND	ND	ND	ND	ND	0.1
Zinc	34	48	54	49	35	1.0
ORGANOTINS (ppb, dry weight)						
Monobutyltin	ND	ND	ND	ND	ND	1.0
Dibutyltin	ND	ND	ND	ND	ND	1.0
Tributyltin	1	1	1	1	ND	1.0
Tetrabutyltin	ND	ND	ND	ND	ND	1.0
PAHs (ppb, dry wt)						
2-Methyl naphthalene	ND	ND	ND	ND	ND	8
Naphthalene	ND	ND	ND	ND	ND	20
Acenaphthylene	ND	ND	ND	ND	ND	6
Acenaphthene	ND	ND	ND	ND	ND	8
Fluorene	ND	ND	ND	ND	ND	20
Phenanthrene	ND	ND	ND	ND	ND	20
Anthracene	ND	ND	ND	ND	ND	20
Fluoranthene	ND	ND	ND	ND	ND	20
Pyrene	ND	ND	ND	ND	ND	40
Chrysene	ND	ND	ND	ND	ND	30
Benzo(a)anthracene	ND	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	20
Benzo(a)pyrene	ND	ND	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	ND	40
total PAHs	ND	ND	ND	ND	ND	
PHENOLS (ppb, dry wt)						
Phenol	ND	ND	ND	ND	ND	10
2,4-Dimethylphenol	ND	ND	ND	ND	ND	10
2,4-Dichlorophenol	ND	ND	ND	ND	ND	40
Pentachlorophenol	ND	ND	ND	ND	ND	40
Total Chlorinated phenol	ND	ND	ND	ND	ND	4-60
total phenols	ND	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections					Detection Limit
	SAM5	SAM6-A	SAM6-B	SAM6-C	SAM7	
MISCELLANEOUS CHEMISTRIES						
Total sulfides (ppm, dry)	2.5	41	42	49	ND	0.1
Water soluble sulfides (ppm, dry)	ND	ND	ND	0.2	ND	0.1
Oil & Grease (ppm, dry)	ND	ND	ND	ND	ND	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	ND	ND	ND	20
% Solids (%)	76	71	69	75	78	0.1
TOC (%)	0.1	0.3	0.3	0.3	0.1	0.1
CHLORINATED PESTICIDES (ppb, dry weight)						
Aldrin	ND	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	ND	0.5-1.0
beta-BHC	ND	ND	ND	ND	ND	0.5-1.0
delta-BHC	ND	ND	ND	ND	ND	0.5-1.0
gamma-BHC (lindane)	ND	ND	ND	ND	ND	0.5-1.0
alpha-Chlordane	ND	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	ND	5.0
2,4'-DDD	ND	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	ND	1.0
2,4'-DDE	ND	ND	ND	ND	ND	0.5
4,4'-DDE	ND	ND	ND	ND	ND	0.5
2,4'-DDT	ND	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	ND	ND	1.0
Dieldrin	ND	ND	ND	ND	ND	0.5
Endosulfan I	ND	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	ND	0.5
Endosulfan sulfate	ND	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	ND	0.5
Heptachlor epoxide	ND	ND	ND	ND	ND	10
Methoxychlor	ND	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	ND	30
PCBs (ppb, dry weight)						
PCB 1242	ND	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	FL1	FL2	FL3	FL4	
METALS (ppm, dry wt)					
Arsenic	5.1	6.6	5.3	4.9	0.1
Cadmium	ND	0.16	ND	ND	0.1
Chromium	140	150	150	150	0.1
Copper	9	35	18	15	0.1
Lead	3.3	7.1	5.0	4.1	0.1
Mercury	0.04	0.07	0.04	0.02	0.02
Nickel	55	85	77	69	0.1
Selenium	ND	0.22	0.15	0.11	0.1
Silver	ND	ND	ND	ND	0.1
Zinc	39	73	51	46	1.0
ORGANOTINS (ppb, dry weight)					
Monobutyltin	ND	ND	ND	ND	1.0
Dibutyltin	ND	1	ND	ND	1.0
Tributyltin	1	4	ND	ND	1.0
Tetrabutyltin	ND	ND	ND	ND	1.0
PAHs (ppb, dry wt)					
2-Methyl naphthalene	ND	23	ND	ND	8
Naphthalene	ND	ND	ND	ND	20
Acenaphthylene	ND	ND	ND	ND	6
Acenaphthene	ND	ND	ND	ND	8
Fluorene	ND	ND	ND	ND	20
Phenanthrene	ND	ND	ND	ND	20
Anthracene	ND	ND	ND	ND	20
Fluoranthene	ND	ND	ND	ND	20
Pyrene	ND	13	ND	ND	40
Chrysene	ND	ND	ND	ND	30
Benzo(a)anthracene	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	20
Benzo(a)pyrene	ND	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	40
total PAHs	ND	37	ND	ND	
PHENOLS (ppb, dry wt)					
Phenol	ND	ND	ND	ND	10
2,4-Dimethylphenol	ND	ND	ND	ND	10
2,4-Dichlorophenol	ND	ND	ND	ND	40
Pentachlorophenol	ND	ND	ND	ND	40
Total Chlorinated phenol	ND	ND	ND	ND	4-60
total phenols	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	FL1	FL2	FL3	FL4	
MISCELLANEOUS CHEMISTRIES					
Total sulfides (ppm, dry)	21	290	49	7.1	0.1
Water soluble sulfides (ppm, dry)	ND	ND	ND	ND	0.1
Oil & Grease (ppm, dry)	ND	31	ND	ND	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	ND	ND	20
% Solids (%)	78	57	71	78	0.1
TOC (%)	0.3	0.7	0.4	0.4	0.1
CHLORINATED PESTICIDES (ppb, dry weight)					
Aldrin	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	0.5-1.0
beta-BHC	ND	ND	ND	ND	0.5-1.0
delta-BHC	ND	ND	ND	ND	0.5-1.0
gamma-BHC (lindane)	ND	ND	ND	ND	0.5-1.0
alpha-Chlordane	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	5.0
2,4'-DDD	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	1.0
2,4'-DDE	ND	ND	ND	ND	0.5
4,4'-DDE	ND	ND	ND	ND	0.5
2,4'-DDT	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	42	1.0
Dieldrin	ND	ND	ND	ND	0.5
Endosulfan I	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	0.5
Endosulfan sulfate	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	0.5
Heptachlor epoxide	ND	ND	ND	ND	10
Methoxychlor	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	30
PCBs (ppb, dry weight)					
PCB 1242	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	FL5	FL6	FL7	FL8	
METALS (ppm, dry wt)					
Arsenic	5.0	3.1	5.2	4.9	0.1
Cadmium	ND	ND	ND	ND	0.1
Chromium	130	140	140	120	0.1
Copper	7	7	6	8	0.1
Lead	3.0	3.3	3.6	3.9	0.1
Mercury	0.05	0.03	0.05	0.04	0.02
Nickel	49	45	47	59	0.1
Selenium	ND	ND	ND	ND	0.1
Silver	ND	ND	ND	ND	0.1
Zinc	34	34	34	39	1.0
ORGANOTINS (ppb, dry weight)					
Monobutyltin	ND	ND	ND	ND	1.0
Dibutyltin	ND	ND	ND	ND	1.0
Tributyltin	ND	ND	ND	ND	1.0
Tetrabutyltin	ND	ND	ND	ND	1.0
PAHs (ppb, dry wt)					
2-Methyl naphthalene	ND	4.0	ND	ND	8
Naphthalene	ND	ND	ND	ND	20
Acenaphthylene	ND	ND	ND	ND	6
Acenaphthene	ND	ND	ND	ND	8
Fluorene	ND	ND	ND	ND	20
Phenanthrene	ND	ND	ND	ND	20
Anthracene	ND	ND	ND	ND	20
Fluoranthene	ND	ND	ND	ND	20
Pyrene	ND	ND	ND	ND	40
Chrysene	ND	ND	ND	ND	30
Benzo(a)anthracene	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	20
Benzo(a)pyrene	ND	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	40
total PAHs	ND	4.0	ND	ND	
PHENOLS (ppb, dry wt)					
Phenol	ND	ND	ND	ND	10
2,4-Dimethylphenol	ND	ND	ND	ND	10
2,4-Dichlorophenol	ND	ND	ND	ND	40
Pentachlorophenol	ND	ND	ND	ND	40
Total Chlorinated phenol	ND	ND	ND	ND	4-60
total phenols	ND	ND	ND	ND	

Table 4, continued. Sediment chemistry summary, Humboldt Bay Baseline Survey I (FY 1993).

Analyte	Sampling Sections				Detection Limit
	FL5	FL6	FL7	FL8	
MISCELLANEOUS CHEMISTRIES					
Total sulfides (ppm, dry)	12	2.3	ND	0.3	0.1
Water soluble sulfides (ppm, dry)	ND	ND	ND	ND	0.1
Oil & Grease (ppm, dry)	ND	ND	81	ND	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	73	ND	20
% Solids (%)	76	80	78	75	0.1
TOC (%)	0.1	ND	ND	0.1	0.1
CHLORINATED PESTICIDES (ppb, dry weight)					
Aldrin	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	0.5-1.0
beta-BHC	ND	ND	ND	ND	0.5-1.0
delta-BHC	ND	ND	ND	ND	0.5-1.0
gamma-BHC (lindane)	ND	ND	ND	ND	0.5-1.0
alpha-Chlordane	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	5.0
2,4'-DDD	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	1.0
2,4'-DDE	ND	ND	ND	ND	0.5
4,4'-DDE	ND	ND	ND	ND	0.5
2,4'-DDT	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	44	1.0
Dieldrin	ND	ND	ND	ND	0.5
Endosulfan I	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	0.5
Endosulfan sulfate	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	0.5
Heptachlor epoxide	ND	ND	ND	ND	10
Methoxychlor	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	30
PCBs (ppb, dry weight)					
PCB 1242	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	

Table 5. Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent				
	EK1	EK2	EK3	EK4	Comp EKUP
<-5	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0
-2	7.6	0.0	0.0	0.0	0.0
-1	19.0	0.0	0.0	0.0	0.0
0	28.6	0.5	0.7	0.0	0.1
1	40.3	1.5	1.7	0.7	0.9
2	64.0	27.0	17.5	4.6	19.2
3	94.9	84.8	80.6	20.7	68.6
4	96.8	88.3	84.6	41.3	76.3
5	97.5	90.5	87.5	56.3	81.8
6	98.0	92.6	90.3	68.7	87.5
7	98.5	94.5	92.9	78.2	90.8
8	98.8	95.8	94.2	83.2	93.2
9	99.0	97.0	96.0	87.5	95.0
>9	100.0	100.0	100.0	100.0	100.0
Total weight:	34.7	33.0	32.0	22.8	30.7
Coarse weight:	33.6	29.1	27.0	9.4	23.4
Fine weight:	1.1	3.9	4.9	13.4	7.3

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent					
	SAM1	SAM2	SAM3	SAM4	SAM5	SAM7
<-5	0.0	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0	0.0
-2	0.0	6.7	0.0	0.0	0.0	0.0
-1	5.0	13.0	1.5	0.0	0.0	0.7
0	11.0	15.5	4.8	2.8	0.8	0.7
1	25.0	20.0	14.1	15.1	4.9	3.4
2	88.7	70.8	71.7	69.4	50.1	65.0
3	99.3	98.8	98.8	97.9	97.8	98.4
4	99.4	99.2	99.0	98.4	98.2	98.7
5	99.5	99.3	99.2	98.8	98.3	98.7
6	99.5	99.3	99.3	98.9	98.7	98.7
7	99.6	99.4	99.4	99.2	99.0	99.1
8	99.6	99.5	99.5	99.3	99.1	99.2
9	100.0	100.0	99.5	99.4	99.1	99.3
>9	100.0	100.0	100.0	100.0	100.0	100.0
Total weight:	51.6	41.0	35.7	42.4	40.4	31.1
Coarse weight:	51.3	40.7	35.4	41.7	39.6	30.7
Fine weight:	0.3	0.3	0.3	0.7	0.7	0.4

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent			
	SAM6-A	SAM6-B	SAM6-C	Comp SAMTB
<-5	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0
-2	0.0	0.0	0.0	0.0
-1	0.0	0.0	0.4	0.2
0	0.3	0.3	1.1	0.6
1	1.1	0.9	2.9	1.5
2	6.1	6.2	6.9	5.5
3	65.9	72.0	75.3	73.9
4	76.4	77.3	82.1	81.2
5	81.8	83.3	86.9	85.6
6	86.6	86.5	90.0	89.1
7	89.8	89.9	92.2	92.0
8	92.2	92.3	94.0	93.7
9	94.0	94.3	95.7	95.2
>9	100.0	100.0	100.0	100.0
Total weight:	29.7	31.6	30.4	31.8
Coarse weight:	22.7	24.4	25.0	25.8
Fine weight:	7.0	7.2	5.5	6.0

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent				Comp FLTB
	FL1	FL2	FL3	FL4	
<-5	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0
-2	0.0	0.0	0.0	0.0	0.0
-1	0.0	0.0	0.0	0.0	0.0
0	0.3	0.2	0.1	0.4	0.1
1	1.2	0.4	0.4	1.3	0.6
2	16.3	1.6	2.1	12.9	6.6
3	83.4	7.1	36.2	43.5	37.1
4	87.7	34.2	62.8	63.9	58.5
5	91.2	51.5	76.4	79.0	69.9
6	93.4	63.9	84.1	86.4	79.4
7	94.9	74.0	88.3	90.4	85.5
8	96.1	81.8	91.4	92.7	88.8
9	97.2	87.1	93.5	94.7	91.4
>9	100.0	100.0	100.0	100.0	100.0
Total weight:	32.9	28.1	28.7	32.1	28.6
Coarse weight:	28.9	9.6	18.0	20.5	16.7
Fine weight:	4.1	18.5	10.7	11.6	11.9

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent					
	FL5	FL6	FL7	FL8	Ref Comp	Control
<-5	0.0	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0	0.0
-2	0.0	6.6	0.0	0.0	0.0	0.0
-1	0.0	10.7	0.4	0.0	0.0	0.0
0	0.1	12.8	1.1	0.2	0.2	0.0
1	0.5	17.0	4.9	1.0	0.3	0.7
2	13.2	54.8	60.8	28.9	0.6	37.7
3	96.7	96.0	97.8	97.6	9.0	93.5
4	98.8	97.4	98.6	99.1	77.0	96.4
5	99.2	98.1	98.8	99.2	93.7	97.4
6	99.3	98.4	99.0	99.3	95.8	97.9
7	99.4	99.0	99.3	99.5	97.2	98.3
8	99.4	99.2	99.4	99.5	97.8	98.5
9	99.5	99.3	99.4	100.0	97.8	98.5
>9	100.0	100.0	100.0	100.0	100.0	100.0
Total weight:	34.5	37.5	33.6	38.3	30.2	31.7
Coarse weight:	34.1	36.5	33.1	38.0	23.3	30.5
Fine weight:	0.4	1.0	0.5	0.3	7.0	1.1

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent				
	NB1	NB2	NB3	NB4	NB5
<-5	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0
-2	0.2	0.0	0.3	0.0	0.0
-1	0.3	0.0	0.9	2.0	0.8
0	0.8	0.1	2.4	7.0	2.1
1	5.3	0.3	19.0	20.5	9.8
2	60.9	46.0	85.0	80.4	73.9
3	98.9	99.3	99.4	99.2	99.2
4	99.5	99.5	99.6	99.5	99.5
5	99.6	99.5	99.7	99.5	99.5
6	99.6	99.5	99.7	99.5	99.5
7	99.6	99.5	99.7	99.5	99.5
8	99.7	99.6	99.7	99.5	99.5
9	99.7	99.6	99.7	99.5	99.5
>9	100.0	100.0	100.0	100.0	100.0
Total weight:	46.1	42.6	44.5	41.5	42.2
Coarse weight:	45.9	42.4	44.3	41.3	42.0
Fine weight:	0.2	0.2	0.2	0.2	0.2

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent				
	NB6	NB7	NB8	NB9	NB10
<-5	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0
-2	14.7	12.0	9.5	6.7	14.2
-1	30.7	25.8	23.9	24.9	34.4
0	37.6	33.6	32.8	39.2	46.1
1	44.6	45.5	43.0	57.4	59.0
2	75.9	85.3	79.2	90.5	87.7
3	98.4	99.1	94.1	98.2	96.8
4	99.1	99.3	95.0	98.6	97.4
5	99.1	99.4	96.1	99.0	98.5
6	99.4	99.5	96.9	99.2	98.6
7	99.4	99.5	97.8	99.3	98.8
8	99.4	99.5	98.3	99.5	99.1
9	99.5	99.6	98.9	99.6	99.5
>9	100.0	100.0	100.0	100.0	100.0
Total weight:	43.9	41.5	37.0	51.5	45.0
Coarse weight:	43.5	41.2	35.2	50.7	43.9
Fine weight:	0.4	0.3	1.9	0.7	1.2

Table 5, continued.

Particle Size Distributions (PSD), Humboldt Bay Baseline Survey I (FY 1993). Cumulative percent particle size intervals; weight (g): Coarse $\leq 4\phi$; Fine $\geq 5\phi$.

Size Interval (Phi)	Sampling Stations: Cumulative Percent		
	ENT1	ENT2	BAR1
<-5	0.0	0.0	0.0
-4	0.0	0.0	0.0
-3	0.0	0.0	0.0
-2	0.0	0.0	0.0
-1	0.0	0.0	0.0
0	0.3	0.2	0.0
1	1.9	0.8	0.2
2	41.9	69.9	47.4
3	96.3	99.0	99.0
4	99.0	99.4	99.4
5	99.6	99.4	99.4
6	99.6	99.4	99.4
7	99.6	99.4	99.5
8	99.6	99.5	99.5
9	99.7	99.5	99.5
>9	100.0	100.0	100.0
Total weight:	41.5	39.5	42.3
Coarse weight:	41.0	39.2	42.1
Fine weight:	0.4	0.2	0.2

Table 6. Bivalve larvae (*M. edulis*) suspended particulate phase bioassays, Humboldt Harbor Baseline Survey I (FY 1993). See text for explanation of calculations (Mean initial recovery = 4354).

Sample ID	Rep	Number		Total Recovered per 1 mL	Resuspended Volume	Total # Normal Larvae Recovered	% Survival	Mean % Survival + S.D.	% Normal Development	Mean % Normal Development + S.D.	Survival		Normal Development	
		Normal	Abnormal								Abbotts Corrected Value	Mean Corrected Value	Abbotts Corrected Value	Mean Corrected Value
Control	1	118	2	120	38	4484	103.0	98.4	98.3	96.3				
	2	98	5	103	43	4214	96.8	98.4	95.1	96.3				
	3	127	4	131	32	4064	93.3	+	96.9	+				
	4	131	6	137	35	4565	105.3	4.86	95.6	1.21				
	5	122	6	128	35	4270	98.1		95.3					
	6	136	5	141	30	4080	93.7		96.5					
Humboldt Reference Sediment 100%	1	63	31	94	36	2268	52.1	71.4	67.0	77.6	53.0	72.6	69.6	80.6
	2	97	34	131	37	3589	82.4	+	74.0	+	83.8	+	76.9	+
	3	78	17	95	43	3354	77.0	12.36	82.1	6.94	78.3	12.56	85.3	7.20
	4	111	22	133	31	3441	79.0		83.5		80.3		86.7	
	5	78	18	96	37	2886	66.3		81.3		67.4		84.4	
EKUP 100%	1	85	1	86	45	3825	87.9	81.2	98.8	94.6	89.3	82.6	102.6	98.3
	2	106	7	113	31	3286	75.5	+	93.8	+	76.7	+	97.4	+
	3	102	9	111	41	4182	96.0	10.61	91.9	2.55	97.6	10.79	95.4	2.65
	4	84	5	89	36	3024	69.5		94.4		70.6		98.0	
	5	99	6	105	34	3366	77.3		94.3		78.6		97.9	
SAMTB 100%	1	122	5	127	34	4148	95.3	87.2	96.1	93.2	96.9	88.6	99.8	96.7
	2	96	9	105	37	3552	81.6	+	91.4	+	82.9	+	94.9	+
	3	87	7	94	41	3567	81.9	6.29	92.6	1.98	83.3	6.40	96.1	2.06
	4	115	7	122	35	4025	92.4		94.3		94.0		97.9	
	5	97	9	106	38	3686	84.7		91.5		86.1		95.0	
FLTB 100%	1	143	9	152	29	4147	95.2	89.5	94.1	92.7	96.8	91.0	97.7	96.3
	2	99	13	112	40	3960	91.0	+	88.4	+	92.5	+	91.8	+
	3	86	7	93	45	3870	88.9	4.11	92.5	2.93	90.4	4.17	96.0	3.04
	4	107	4	111	36	3852	88.5		96.4		89.9		100.1	
	5	85	7	92	43	3655	83.9		92.4		85.3		95.9	

Point Estimates:

EKUP: LC₅₀ >100%; EC₅₀ >100%
SAMTB: LC₅₀ >100%; EC₅₀ >100%
FLTB: LC₅₀ >100%; EC₅₀ >100%

Table 7. Mysid (*H. costata*) suspended particulate phase bioassays, Humboldt Bay Baseline Survey I (FY 1993).

<i>Holmesimysis costata</i> Suspended Particulate Phase Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 10)					
Replicate No.	Home Sediment	Disposal Reference	EKUP	SAMTB	FLT B
1	10	10	10	9	10
2	10	9	10	10	10
3	10	10	10	10	10
4	10	10	10	10	10
5	10	10	10	10	10
Mean	10.0	9.8	10.0	9.8	10.0
SD	0.0	0.45	0.0	0.45	0.0

1. Data **fail** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W=0.603$

$D = 1.600$

Critical $W_{(20, 0.01)} = 0.868$

2. Data **fail** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$: At least one group has zero variance.

3. Steel's Many-One Rank test shows **no significant difference** among sample data and disposal site reference:

Critical F value = 17 (0.05, k=3)

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLT B</u>
Rank Sum:	30	27.5	30

Table 8. Fish (*C. stigmae...us*) suspended particulate phase bioassays, Humboldt Bay Baseline Survey I (FY 1993).

<i>Citharichthys stigmaeus</i> Suspended Particulate Phase Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 10)					
Replicate No.	Home Sediment	Disposal Reference	EKUP	SAMTB	FLTB
1	10	10	10	9	10
2	10	10	10	10	10
3	10	10	10	10	10
4	10	10	9	10	10
5	10	10	10	10	10
Mean	10.0	10.0	9.8	9.8	10.0
SD	0.0	0.0	0.45	0.45	0.0

1. Data fail SHAPIRO-WILKS TEST for normality at P=0.01:
W=0.588 D = 2.400 Critical $W_{(20, 0.01)} = 0.868$
2. Data fail BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$: At least one group has zero variance.
3. Steel's Many-One Rank test shows no significant difference among sample data and disposal site reference:
Critical value = 17 (0.05, k=3)

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTB</u>
Rank Sum:	27.5	27.5	30

Table 9. Amphipod (*R. abronius*) solid phase static bioassays, Humboldt Bay Baseline Survey I (FY 1993).

<i>Rhepoxynius abronius</i> Solid Phase Static Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 20)					
Replicate No.	Home Sediment	Disposal Reference	EKUP	SAMTB	FLTB
1	19	19	19	17	20
2	19	17	18	20	20
3	20	18	20	17	17
4	18	19	16	15	18
5	17	19	20	18	17
Mean	18.6	18.8	18.6	17.4	18.4
SD	1.14	0.45	1.67	1.81	1.52
Mean % Reburial	98.9	98.8	93.3	90.2	92.6
SD	2.37	2.64	6.20	7.43	8.56

1. Data **pass** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W=0.964$

$D = 36.800$

Critical $W_{(20, 0.01)} = 0.868$

2. Data **pass** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$:

Calculated B statistic = 1.81

Table Chi-square value = 11.34

3. ANOVA test shows **no significant difference** among sample means and disposal site reference:

Critical F value = 3.24 (0.05, 3, 16)

Calculated F value = 0.638

Calculated F > Critical F; \therefore **Fail to Reject H_0** : all groups equal

4. DUNNETT'S TEST (Mean Comparison Test) shows **no Humboldt Harbor sample composite with lower survival** than the Humboldt reference composite at $P = 0.05$:

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTB</u>
Dunnett's t:	-0.209	1.043	0.000
(1-tailed, $P=0.05$, d.f.=16,3)			

Dunnett table value = 2.23

Table 10. Mysid (*H. costata*) solid phase flow-through bioassays, Humboldt Bay Baseline Survey I (FY 1993).

<i>Holmesimysis costata</i> Solid Phase Flow-Through Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 20)					
Replicate No.	Home Sediment	Disposal Reference	EKUP	SAMTB	FLTB
1	19	18	19	20	20
2	19	20	20	19	19
3	20	19	18	20	19
4	19	18	19	18	19
5	20	20	19	19	19
Mean	19.4	19.0	19.0	19.2	19.2
SD	0.55	1.0	0.71	0.71	0.45

1. Data **pass** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W=0.888$

$D = 9.600$

Critical $W_{(20, 0.01)} = 0.868$

2. Data **pass** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$:

Calculated B statistic = 2.23

Table Chi-square value = 11.34

3. ANOVA test shows **no significant difference** among sample means and disposal site reference:

Critical F value = 3.24 (0.05, 3, 16)

Calculated F value = 0.111

Calculated $F > \text{Critical } F$; \therefore **Fail to Reject H_0** ; all groups equal

4. DUNNETT'S TEST (Mean Comparison Test) shows **no Humboldt Harbor sample composite with lower survival** than the Humboldt reference composite at $P = 0.05$:

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTB</u>
Dunnett's t:	0.000	-0.200	-0.2000
(1-tailed, $P=0.05$, $d.f.=16,3$)			
	Dunnett table value = 2.23		

Table 11. Polychaete worm (*N. caecoides*) solid phase flow-through bioassays, Humboldt Bay
Baseline Survey I (FY 1993).

<i>Nephtys caecoides</i> Solid Phase Flow-Through Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 20)					
Replicate No.	Home Sediment	Disposal Reference	EKUP	SAMTB	FLT B
1	20	19	18	20	18
2	20	20	19	18	18
3	20	20	18	19	19
4	20	120	20	20	17
5	20	20	18	20	18
Mean	20.0	19.8	18.6	19.4	18.0
SD	0.0	0.45	0.89	0.89	0.71

1. Data **pass** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W=0.978$

$D = 9.200$

Critical $W_{(20, 0.01)} = 0.868$

2. Data **pass** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$:

Calculated B statistic = 1.94

Table Chi-square value = 11.34

3. ANOVA test shows **significant difference** among sample means and disposal site reference:

Critical F value = 3.24 (0.05, 3, 16)

Calculated F value = 5.652

Calculated $F > \text{Critical } F$; \therefore **Reject** H_0 : all groups equal

4. DUNNETT'S TEST (Mean Comparison Test) shows **sample composites** **Comp EKUP** and **Comp FLT B** produce **lower** survival than the Humboldt reference composite at $P = 0.05$:

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLT B</u>
Dunnett's t:	2.502	0.834	3.753

(1-tailed, $P=0.05$, d.f.=16,3)

Dunnett table value = 2.23

Table 12. Mean metals concentrations (mg/kg) in tissues of *M. nasuta* and *N. caecoides* exposed to Humboldt Bay sediments, Baseline Survey I (FY 1993). Non-detected analytes calculated at 0.5 x D.L.; n = 5 for all means; Baseline values are from a single tissue composite.

Macoma nasuta

Sediment Treatment	As	Cd	Cr	Cu	Pb	Hg	Ni	Se	Ag	Zn
Baseline	34	0.70	19	81	3.1	0.53	9.5	2.4	0.70	200
Control	43.4	0.50	6.48	64.0	2.72	0.30	6.08	2.38	0.55	192
EKUP	37.8	0.49	22.2	69.4	5.00	0.18	20.8	2.04	0.60	198
SAMTB	41.8	0.87	20.8	60.4	3.94	0.16	22.2	1.96	0.43	180
FLTB	41.2	0.54	25.8	78.2	5.24	0.19	24.8	2.04	0.55	210
Reference	42.8	0.59	12.3	48.4	2.86	0.24	5.18	2.46	0.40	174

Nephtys caecoides

Sediment Treatment	As	Cd	Cr	Cu	Pb	Hg	Ni	Se	Ag ¹	Zn
Baseline	27	1.5	7.0	22	1.2	0.19	9.7	3.9	0.05	300
Control	24.4	0.77	1.62	26.8	0.62	0.13	4.82	3.16	0.05	182
EKUP	28.0	0.77	1.40	23.8	0.94	0.14	5.56	3.18	0.06	170
SAMTB	26.0	0.73	1.62	24.4	0.88	0.14	5.40	3.20	0.05	168
FLTB	28.0	0.70	3.04	25.8	0.80	0.14	5.68	2.94	0.05	172
Reference	25.0	0.89	1.68	25.0	0.68	0.14	5.70	3.18	0.05	180

¹ Ag means calculations contain ND values (calculated as 0.05 mg/kg).

Detection Limits: Hg = 0.02 mg/kg (parts per million)
All others = 0.1 mg/kg.

Shaded values are statistically elevated compared to reference treatments (see Table 13 and Table 14 for statistical summaries).

Table 13. Statistical analyses: *Macoma nasuta* bioaccumulation, Humboldt Bay Baseline Survey I (FY 1993).

CONSTITUENT	PARAMETRIC TESTS			NON-PARAMETRIC TESTS	
	Bartlett's B-Value	ANOVA F-Value	Significant Stations by Dunn's Test	Kruskal- Wallace H-Value	Significant Stations by Dunn's Test
Arsenic	2.109	0.630	none	---	---
Cadmium	37.437	---	---	3.789	none
Chromium	4.216	9.628	EKUP+SAMTB+FLTB	---	---
Copper	6.459	5.203	EKUP+FLTB	---	---
Lead	3.363	11.037	EKUP+SAMTB+FLTB	---	---
Mercury	6.458	4.080	none	---	---
Nickel	6.550	7.006	EKUP+SAMTB+FLTB	---	---
Selenium	10.727	---	---	4.771	none
Silver	4.866	2.115	none	---	---
Zinc	2.838	1.538	none	---	---

--- not determined

Table 14. Statistical analyses: *Nephtys caecoides* bioaccumulation, Humboldt Bay Baseline Survey I (FY 1993).

CONSTITUENT	PARAMETRIC TESTS			NON-PARAMETRIC TESTS		
	Bartlett's B-Value	ANOVA F-Value	Significant Stations by Dunnnett's Test	Kruskal- Wallace H-Value	Significant Stations by Dunn's Test	
Arsenic	4.362	2.647	EKUP+FLTB	---	---	---
Cadmium	4.772	3.280	none	---	---	---
Chromium	13.724	---	---	4.079	none	none
Copper	8.221	---	---	4.377	none	none
Lead	5.311	3.771	EKUP+SAMTB	---	---	---
Mercury	1.160	0.043	none	---	---	---
Nickel	7.839	---	---	2.293	none	none
Selenium	6.938	0.646	none	---	---	---
Silver	3.087	1.083	none	---	---	---
Zinc	2.258	0.622	none	---	---	---

--- not determined

FIGURES

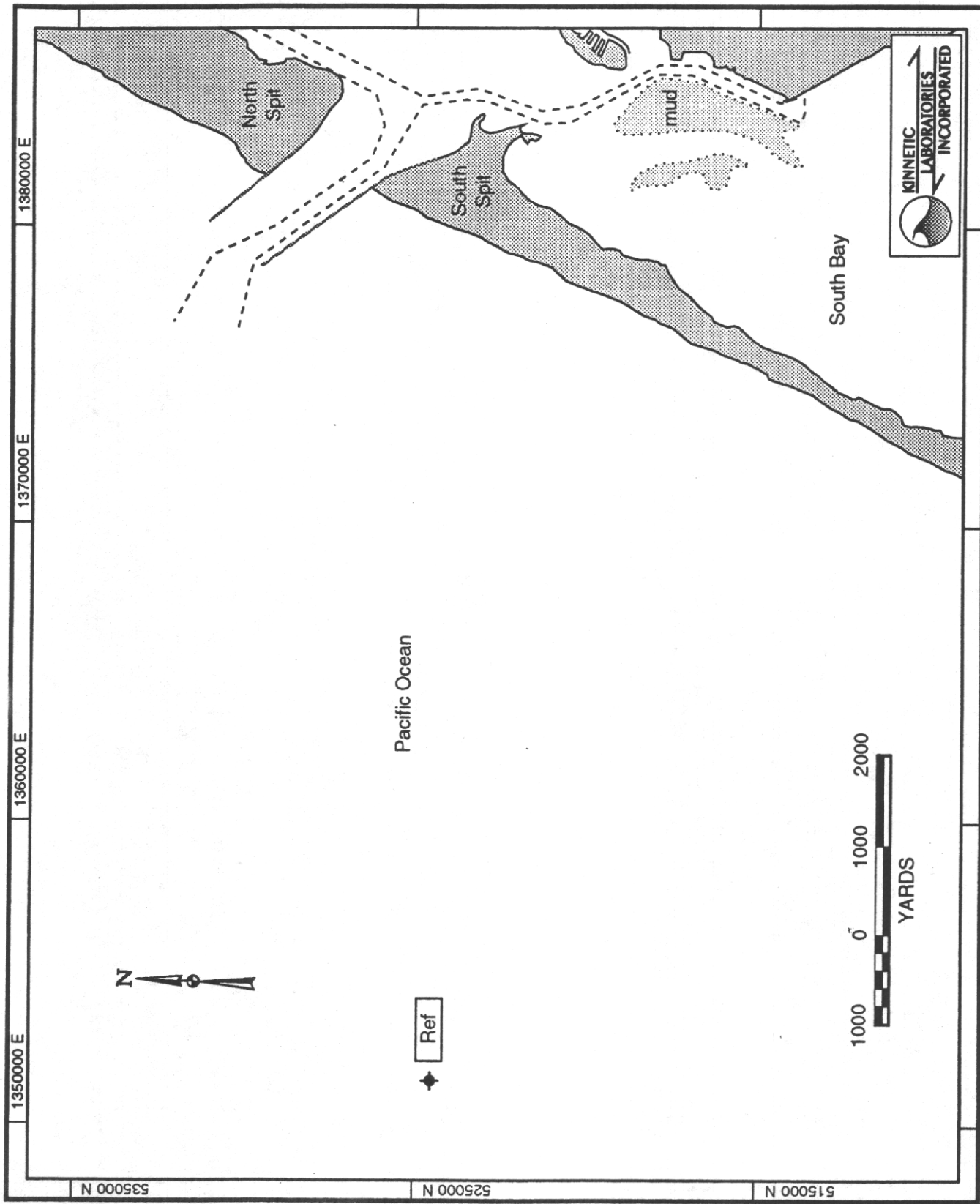


Figure 1. Humboldt Bay FY 1993 sampling locations. Reference station (solid) composite of six grab samples.

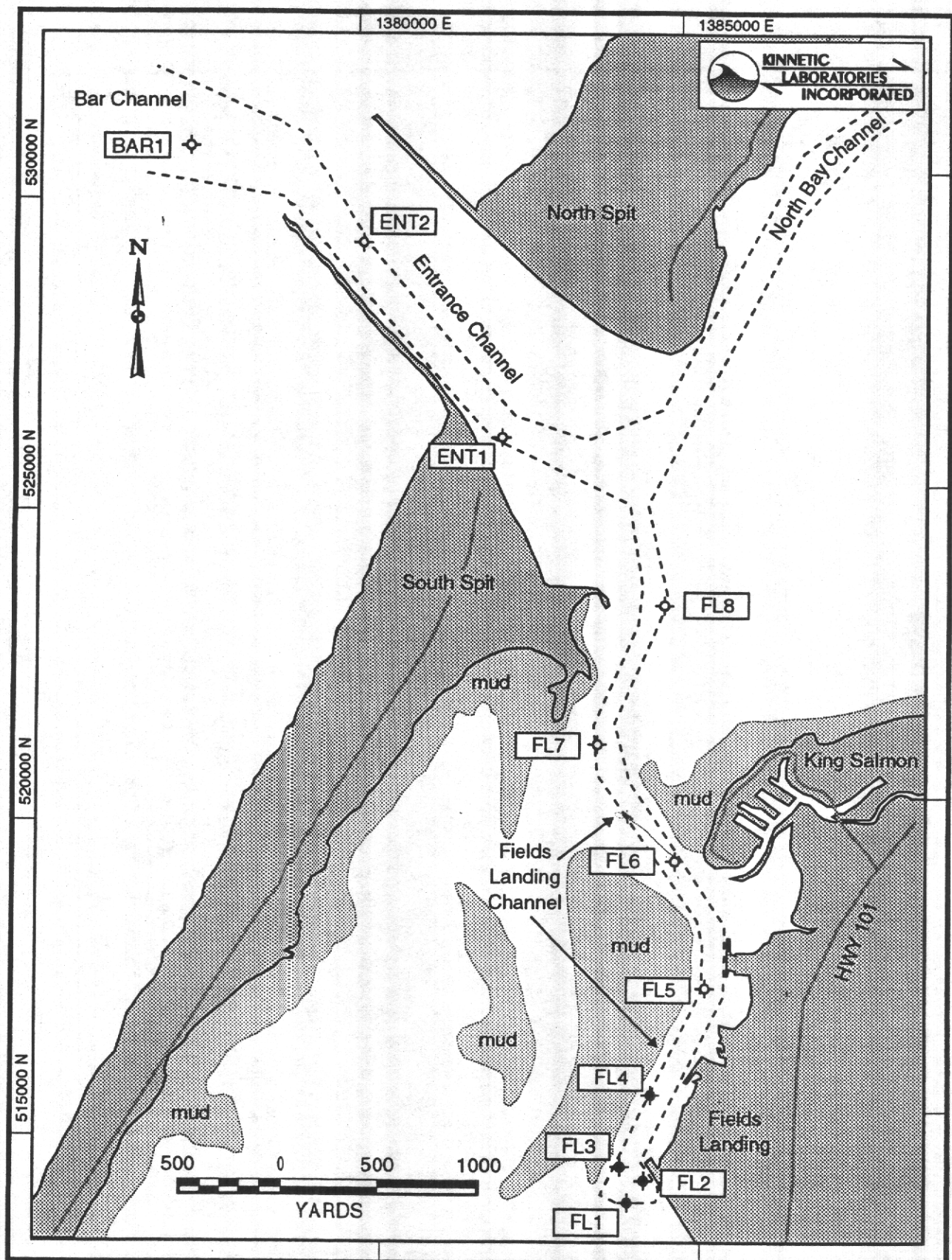


Figure 2. Humboldt Bay FY1993 sampling locations. Stations FL1 through FL8, ENT1, ENT2, and BAR1. Solid stations indicate those used in Fields Landing Lower Channel and Turning Basin (FLTBC) composite.

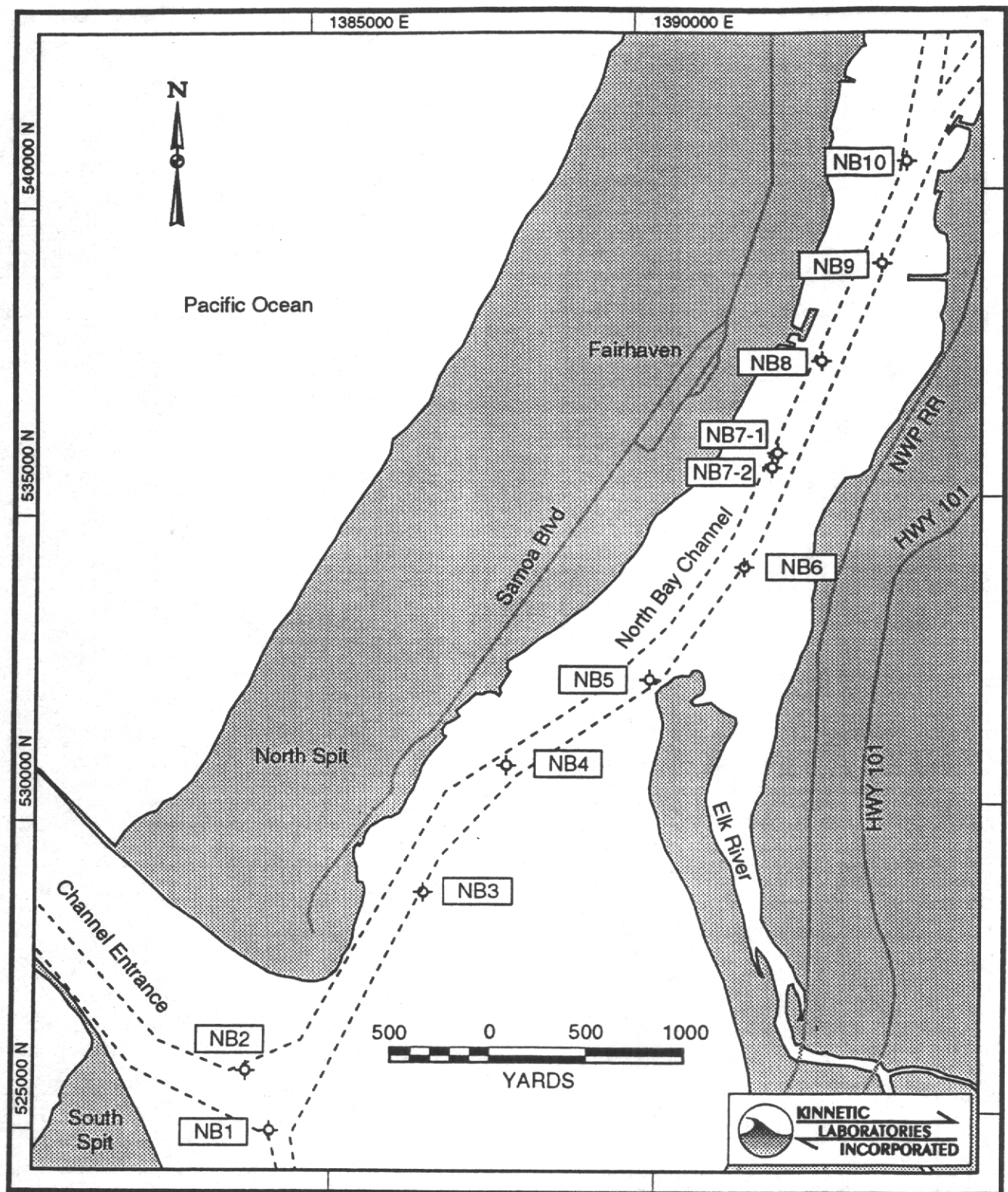


Figure 3. Humboldt Bay FY1993 sampling locations. Stations NB1 through NB10.

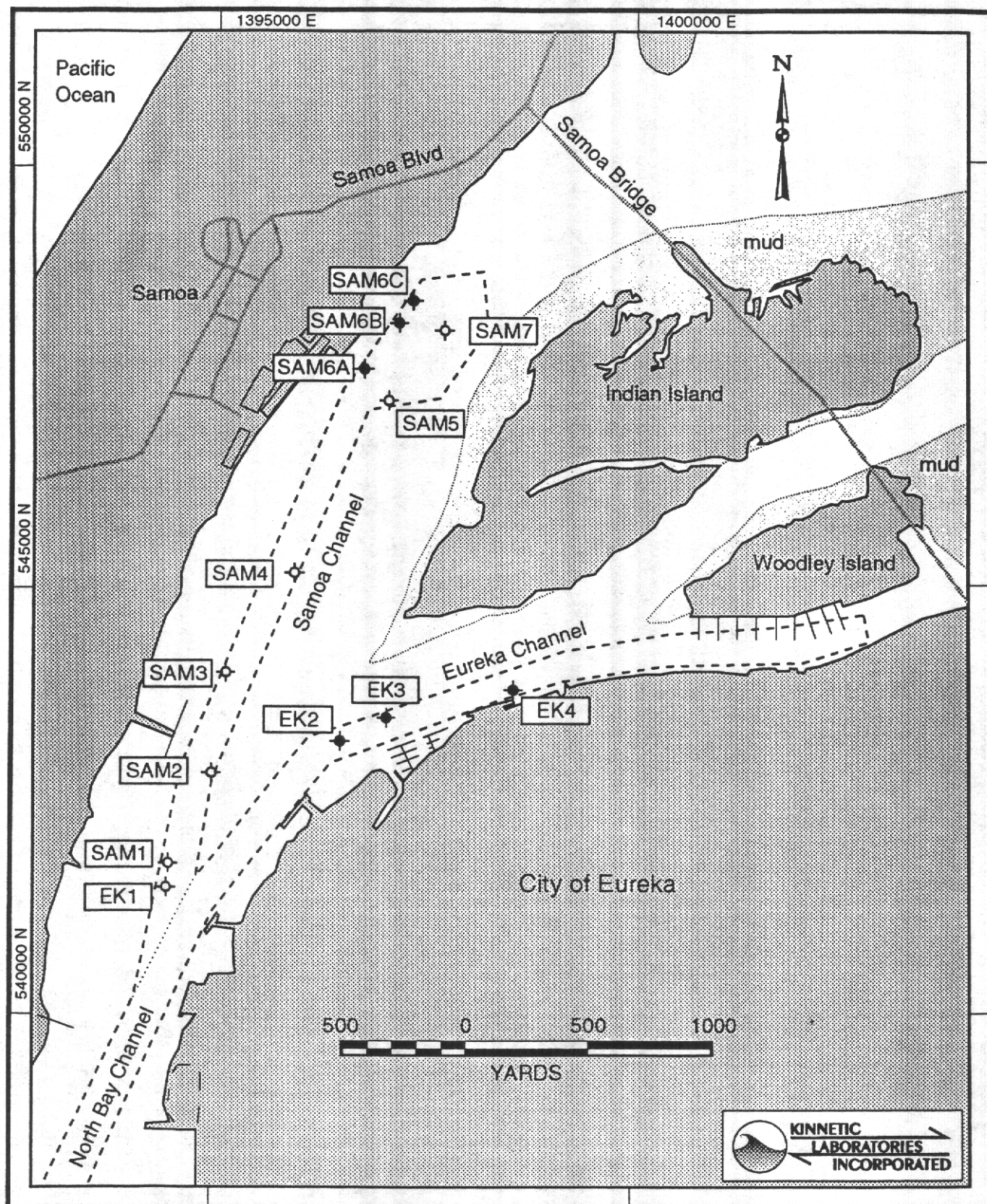


Figure 4. Humboldt Bay FY1993 sampling locations. Stations EK1 through EK4 and SAM1 through SAM7. Solid stations indicate those used in Eureka Upper Channel (EKUP) and Samoa Turning Basin (SAMTB) composites.

CHEMICAL ANALYSIS, TOXICITY EVALUATION
AND BIOACCUMULATION EXPOSURE
OF SEDIMENTS FROM
HUMBOLDT BAY:

BASELINE SURVEY II

Fiscal Year 1994

FINAL REPORT

Prepared for:

U.S. ARMY ENGINEERING DISTRICT
SAN FRANCISCO CORPS OF ENGINEERS
San Francisco, California

Prepared by:

TOXSCAN INC. and KINNETIC LABORATORIES, INC.
Watsonville, California

NOVEMBER 1994

C:\WP51\BIOASSAY\SFCOE\HUMBOLT4\HUMBOLT4.RPT:11/09/94:1722

Table 1. Analyses Performed, Humboldt Bay Baseline Survey II (FY 1994). Shaded samples composited; SP = Suspended Phase; SPP = Suspended Particulate Phase.

SAMPLE	Initial Grain Size	Sediment Chemistry	SP + SPP Bioassay	Bioaccumulation ¹
North Bay Channel:				
NB1	YES	NO	NO	NO
NB2	YES	NO	NO	NO
NB3	YES	NO	NO	NO
NB4 Rep 1	YES	YES	NO	NO
NB4 Rep 2	YES	NO	NO	NO
NB5	YES	NO	NO	NO
NB6	YES	NO	NO	NO
NB7	YES	NO	NO	NO
NB8	YES	NO	NO	NO
NB9	YES	NO	NO	NO
NB10	YES	NO	NO	NO
Samoa Turning Basin:				
SAM1	YES	YES	NO	NO
SAM2	YES	YES	NO	NO
SAM3	YES	YES	NO	NO
SAM4	YES	YES	NO	NO
SAM5	YES	YES	NO	NO
Comp SAMTB:	YES	YES	YES	YES
SAM6-A	YES	YES	NO	NO
SAM6-B	YES	YES	NO	NO
SAM6-C	YES	YES	NO	NO
SAM7	YES	YES	NO	NO
Eureka Upper Channel:				
EK1	YES	YES	NO	NO
Comp EKUP:	YES	YES	YES	YES
EK2	YES	YES	NO	NO
EK3	YES	YES	NO	NO
EK4	YES	YES	NO	NO
Fields Landing Lower Channel and Turning Basin:				
Comp FLTB:	YES	YES	YES	YES
FL1	YES	YES	NO	NO
FL2	YES	YES	NO	NO
FL3	YES	YES	NO	NO
FL4	YES	YES	NO	NO
FL5	YES	YES	NO	NO
FL6	YES	YES	NO	NO
FL7	YES	YES	NO	NO
FL8	YES	YES	NO	NO
Entrance Channel, Bar, Reference Site and Control:				
ENT1	YES	NO	NO	NO
ENT2	YES	NO	NO	NO
BAR1	YES	NO	NO	NO
REF	YES	YES	YES	YES
CONTROL	YES	YES	YES	YES

¹ Exposures only; no tissue analyses performed.

Table 2. Sediments Collected, Humboldt Bay Baseline Survey II (FY 1994). Samples collected by vibracore or Smith-Macintyre grab; shaded samples composited.

SAMPLE	DATE	TIME	MUDLINE	Core Penetration (Feet)		California State Plane Coordinates ¹	
				ACHIEVED	SAMPLED	NORTH	EAST
North Bay Channel:							
NB 1	4/1/94	16:47	36.0	GRAB ²	0.5	525040	1384353
NB 2	4/4/94	14:10	37.5	GRAB	0.5	526977	1380256
NB 3	4/1/94	16:20	34.5	GRAB	0.5	528632	1386625
NB 4 Rep1	4/1/94	15:55	36.5	GRAB	0.5	530690	1387641
NB 4 Rep2	4/1/94	17:23	36.5	GRAB	0.5	530690	1387641
NB 5	4/1/94	15:23	37.0	GRAB	0.8	531747	1389429
NB 6	4/1/94	15:02	35.7	GRAB	0.4	533775	1391711
NB 7	4/1/94	14:31	34.4	GRAB	0.4	535684	1392296
NB 8	4/1/94	14:10	36.5	GRAB	0.5	536655	1392972
NB 9	4/1/94	13:52	35.4	GRAB	0.7	540438	1394733
NB 10	4/1/94	13:33	35.5	GRAB	0.3	552578	1395037
Samoa Turning Basin (SAMTB):							
SAM 1	3/31/94	10:56	34.6	GRAB	0.4	541657	1394834
SAM 2	3/31/94	10:27	36.1	GRAB	0.5	542636	1395296
SAM 3	3/31/94	10:03	33.0	GRAB	0.5	544222	1395985
SAM 4	3/31/94	09:30	35.5	GRAB	0.5	545254	1396359
SAM 5	3/31/94	09:02	34.5	GRAB	0.7	548030	1397957
SAM 6 A	4/1/94	09:54	35.7	GRAB	0.5	547562	1397303
SAM 6 B	3/31/94	16:34	33.9	4.1	3.1	548139	1397482
SAM 6 C	3/31/94	12:10	34.9	3.2	2.1	548418	1397752
SAM 7D	3/31/94	08:36	35.9	GRAB	0.7	548030	1397957
Eureka Upper Channel (EKUP):							
EK 1	4/2/94	13:48	35.8	GRAB	0.5	541580	1395533
EK 2	4/2/94	09:25	24.7	3.5	3.3	543195	1396863
EK 3	4/2/94	14:48	21.9	6.5	6.1	543562	1397576
EK 4	4/2/94	16:46	27.2	GRAB	0.5	543841	1399100
Fields Landing Lower Channel and Turning Basin (FLTBT):							
FL 1	4/4/94	11:15	27.8	GRAB	0.3	513355	1384535
FL 2	4/4/94	12:44	26.5	GRABS	0.5	514065	1384547
FL 3	4/3/94	12:09	27.2	GRABS	0.5	514488	1384092
FL 4	4/3/94	09:23	25.9	3.1	2.1	515355	1384535
FL 5	4/3/94	11:27	26.3	GRAB	0.5	517271	1385416
FL 6	4/3/94	11:05	30.2	GRAB	0.5	519202	1385029
FL 7	4/3/94	10:51	28.4	GRAB	0.5	521204	1383853
FL 8	4/3/94	10:45	25.2	GRAB	0.5	523214	1384976
Entrance Channel, Bar and Reference Site:							
ENT 1	4/5/94	12:00	36	GRAB	0.5	526000	1382500
ENT 2	4/5/94	12:10	48	GRAB	0.5	529100	1380400
BAR 1	4/5/94	11:45	42	GRAB	0.5	530800	1377700
REF 1	4/5/94	08:46	165	GRAB	0.5	524700	1351300

¹ Field measurements of station locations were made in latitude x longitude (see Field Logs, Appendix A), and converted here to California State Plane Coordinates.

² Grab samples (except Entrance and Bar) were taken only where depth from bottom to project depth was less than 1.5 ft; Entrance and Bar stations were grab sampled due to wind and sea conditions.

Table 3. Biological Assessments, Humboldt Bay Baseline Survey II (FY 1994).

Test Species:	SP	SPP	BA
<i>R. abronius</i>	X	-	-
<i>M. edulis</i>	-	X	-
<i>H. costata</i>	X	X	-
<i>C. stigmaeus</i>	-	X	-
<i>N. caecoides</i>	X	-	(x)
<i>M. nasuta</i>	-	-	(x)

X = test performed; (x) = exposure only, no tissue evaluation

SP = Solid Phase; SPP = Suspended Particulate Phase; BA = Bioaccumulation.

Table 4. Sediment Chemistry Summary, Humboldt Bay Baseline Survey II (FY 1994): Composites only; for individual sample results, see Appendix C.

Analyte	Sampling Sections				Detection Limit
	SAMTB	EKUP	FLT B	REF	
METALS (ppm, dry wt)					
Arsenic	5.7	6.3	7.0	7.3	0.1
Cadmium	0.1	0.2	0.2	0.1	0.1
Chromium	100	97	100	110	0.1
Copper	12	20	28	21	0.1
Lead	5.8	7.7	8.1	7.4	0.1
Mercury	0.05	0.06	0.08	0.20	0.02
Nickel	62	81	98	97	0.1
Selenium	ND	ND	ND	ND	0.1
Silver	ND	ND	ND	ND	0.1
Zinc	41	55	66	62	1.0
ORGANOTINS (ppb, dry weight)					
Monobutyltin	ND	ND	ND	ND	1.0
Dibutyltin	ND	ND	ND	ND	1.0
Tributyltin	1	ND	ND	ND	1.0
PAHs (ppb, dry wt)					
2-Methylnaphthalene	ND	41	78	40	20
Naphthalene	43	37	43	ND	20
Acenaphthylene	ND	ND	ND	ND	20
Acenaphthene	ND	ND	ND	ND	20
Fluorene	ND	ND	ND	ND	20
Phenanthrene	49	ND	ND	ND	20
Anthracene	ND	ND	ND	58	20
Fluoranthene	30	39	42	ND	20
Pyrene	36	47	ND	ND	20
Chrysene	ND	ND	ND	ND	20
Benzo(a)anthracene	ND	ND	ND	ND	20
Benzo(b)fluoranthene	ND	ND	ND	ND	20
Benzo(k)fluoranthene	ND	ND	ND	ND	20
Benzo(a)pyrene	52	ND	ND	ND	20
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	20
Dibenzo(a,h)anthracene	ND	ND	ND	ND	20
Benzo[ghi]perylene	ND	ND	ND	ND	20
total PAHs	160	160	160	98	20
PHTHALATES (ppb, dry wt)					
total phthalates	160	160	170	1200	10
DIOXINS (pptr, dry wt)					
2,3,7,8-TCDD	ND	ND	ND	ND	0.22-0.33
Total TCDD	ND	ND	ND	ND	"
2,3,7,8-TCDF	ND	0.51	ND	ND	0.13-0.45
Total TCDF	ND	0.94	ND	ND	"

Table 4, continued. Sediment Chemistry Summary, Humboldt Bay Baseline Survey II (FY 1994): Composites only; for individual sample results, see Appendix C.

Analyte	Sampling Sections				Detection Limit
	SAMTB	EKUP	FLTB	REF	
GRAIN SIZE (% dry)					
Coarse Sand/Gravel ($\Phi < -1$)	0.8	0.3	0.2	0.0	-
Sand ($-1 \leq \Phi \leq 4$)	80.1	60.8	41.4	59.3	-
Silt ($5 \leq \Phi \leq 8$)	12.4	26.2	39.4	33.8	-
Clay ($\Phi \geq 9$)	6.7	12.7	19.0	6.9	-
MISCELLANEOUS CHEMISTRIES					
Total sulfides (ppm, dry)	29	110	35	0.3	0.1
Water soluble sulfides (ppm, dry)	ND	ND	0.2	ND	0.1
Oil & Grease (ppm, dry)	ND	ND	31	ND	20
Petroleum Hydrocarbons (ppm, dry)	ND	ND	ND	ND	20
% Solids (%)	77	72	65	73	0.1
TOC (%)	0.3	0.7	0.8	0.4	0.1
CHLORINATED PESTICIDES (ppb, dry weight)					
Aldrin	ND	ND	ND	ND	0.5
alpha-BHC	ND	ND	ND	ND	1.0
beta-BHC	ND	ND	ND	ND	1.0
delta-BHC	ND	ND	ND	ND	1.0
gamma-BHC (lindane)	ND	ND	ND	ND	5.0
alpha-Chlordane	ND	ND	ND	ND	5.0
gamma-Chlordane	ND	ND	ND	ND	1.0
4,4'-DDD	ND	ND	ND	ND	1.0
4,4'-DDE	ND	ND	ND	ND	1.0
4,4'-DDT	ND	ND	ND	ND	0.5
Dieldrin	ND	ND	ND	ND	2.0
Endosulfan I	ND	ND	ND	ND	0.5
Endosulfan II	ND	ND	ND	ND	10
Endosulfan sulfate	ND	ND	ND	ND	0.5
Endrin	ND	ND	ND	ND	0.5
Endrin aldehyde	ND	ND	ND	ND	0.5
Heptachlor	ND	ND	ND	ND	10
Heptachlor epoxide	ND	ND	ND	ND	30
Toxaphene	ND	ND	ND	ND	
PCBs (ppb, dry weight)					
PCB 1242	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	20

Table 5. Sediment Pore Water Salinity and Total Ammonia, Humboldt Bay Baseline II (FY 1994).

Composite	Initial (As Received)		Final
	S‰	NH ₃	NH ₃
REF	34.5	8.7	6.2
EKUP	30.5	6.1	4.1
SAMTB	32.0	4.0	2.6
FLTB	33.0	57.7 ¹	8.6

¹ Exceeds threshold value for *R. abronius* bioassay; sample purged as per EPA memorandum of 12/23/93 (see text).

Table 6. Bivalve larvae (*M. edulis*) SPP Bioassays, Humboldt Bay Baseline Survey II (FY1994). See text for explanation of calculations (Mean initial recovery = 4795).

Sample ID	Rep.	Number Normal	Number Abnormal	Total Recovered per 1 mL	Resuspended Volume	Total Normal Larvae Recovered	% Survival	Mean % Survival \pm S.D.	% Normal Development	Mean % Normal Development \pm S.D.	Survival		Normal Development	
											Abbotts Corrected Value	Mean Corrected Value	Abbotts Corrected Value	Mean Corrected Value
Control	1	126	2	128	50.5	6363	132.7	101.8	98.4	99.0				
	2	91	3	94	51	4641	96.8	\pm	96.8	\pm				
	3	84	0	84	51	4284	89.3	19.24	100.0	1.42				
	4	104	0	104	49	5096	106.3		100.0					
	5	78	0	78	51.5	4017	83.8		100.0					
REF 100%	1	88	2	90	47	4136	86.3	86.4	97.8	98.2	84.8	84.9	98.7	99.1
	2	70	1	71	48.5	3395	70.8	\pm	98.6	\pm	69.6	\pm	99.5	\pm
	3	98	1	99	48	4704	98.1	10.16	99.0	1.00	96.4	9.98	99.9	1.01
	4	85	3	88	48	4080	85.1		96.6		83.6		97.5	
	5	90	1	91	49	4410	92.0		98.9		90.4		99.9	
EKUP 100%	1	90	0	90	47.5	4275	89.2	93.5	100.0	98.8	87.6	91.8	101.0	99.7
	2	92	4	96	49	4508	94.0	\pm	95.8	\pm	92.4	\pm	96.8	\pm
	3	78	0	78	49.7	3877	80.8	11.08	100.0	1.86	79.4	10.89	101.0	1.88
	4	94	2	96	47	4418	92.1		97.9		90.5		98.9	
	5	111	0	111	48	5328	111.1		100.0		109.2		101.0	
SAMTB 100%	1	89	2	91	47.9	4263	88.9	94.8	97.8	98.0	87.4	93.2	98.7	98.9
	2	101	2	103	49	4949	103.2	\pm	98.1	\pm	101.4	\pm	99.0	\pm
	3	104	3	107	48.5	5044	105.2	10.41	97.2	0.56	103.4	10.23	98.1	0.57
	4	80	1	81	48	3840	80.1		98.8		78.7		99.7	
	5	98	2	100	47.3	4635	96.7		98.0		95.0		98.9	
FLTB 100%	1	72	12	84	47.5	3420	71.3	78.0	85.7	87.5	70.1	76.6	86.5	88.3
	2	81	7	88	47	3807	79.4	\pm	92.0	\pm	78.0	\pm	92.9	\pm
	3	77	14	91	47	3619	75.5	7.61	84.6	2.90	74.2	7.48	85.4	2.93
	4	71	11	82	49.5	3515	73.3		86.6		72.0		87.4	
	5	91	12	103	47.7	4341	90.5		88.3		88.9		89.2	

ENDPOINT ESTIMATES:

LC₅₀ EC₅₀
EKUP: >100% >100%
SAMTB: >100% >100%
FLTB: >100% >100%

Table 7. Mysid SPP Bioassays, Humboldt Bay Baseline Survey II (FY 1994).

<i>Holmesimysis costata</i> Suspended Particulate Phase Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 10)					
Rep #	Control	REF	EKUP	SAMTB	FLTb
1	10	9	10	10	10
2	10	10	10	10	10
3	9	10	10	10	10
4	10	10	10	10	10
5	10	10	10	10	10
Mean	9.8	9.8	10.0	10.0	10.0
SD	0.45	0.45	0.0	0.0	0.0
Mean % Survival	98	98	100	100	100

1. Data **FAIL** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W=0.575$

$D = 1.600$

Critical $W_{(25, 0.01)} = 0.888$

2. Data **FAIL** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$: At least one group has zero variance.

3. Steel's Many-One Rank test shows **NO significant difference** among sample data and disposal site reference:

Critical value = 17 (0.05, $k=3$)

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTb</u>
Rank Sum:	30.0	30.0	30.0

Table 8. Fish (*C. stigmaeus*) suspended particulate phase bioassays, Humboldt Bay Baseline Survey II (FY 1994).

<i>Citharichthys stigmaeus</i> Suspended Particulate Phase Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 10)					
Rep #	Control	Reference	EKUP	SAMTB	FLTB
1	10	10	10	10	0
2	10	10	10	9	0
3	10	10	10	10	2
4	10	9	9	10	0
5	10	10	9	7	0
Mean	10.0	9.8	9.6	9.2	0.40*
SD	0.0	0.45	0.55	1.3	0.89
Mean % Survival	100	98	96	92	4.0

1. Data **PASS** SHAPIRO-WILKS TEST for normality at P=0.01:

W=0.992

D = 12.00

Critical $W_{(25, 0.01)} = 0.888$

2. Data **FAIL** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$: At least one group has zero variance.

3. Steel's Many-One Rank test shows **FLTB** significantly different from the disposal site reference composite.

Critical F value = 17 (0.05, k=4)

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTB</u>
Rank Sum:	9.6	9.2	0.40*

Table 9. Amphipod (*R. abronius*) solid phase static bioassays, Humboldt Bay Baseline Survey II (FY 1994). Home A and composite FLTb replicates were ammonia-purged (daily renewals) as per EPA/ACOE memo of 21 December 1993.

Rhepoxynius abronius
Solid Phase Static Bioassay Results
Humboldt Harbor Sediments

NUMBER OF SURVIVORS (Start n = 20)						
Rep #	Home A	Home B	REF	EKUP	SAMTB	FLTb
1	18	19	18	18	19	20
2	19	20	18	17	19	19
3	20	19	18	18	20	17
4	18	18	16	20	19	18
5	20	20	18	20	20	20
Mean	19.0	19.2	17.6	18.6	19.4	18.8
SD	1.00	0.84	0.89	1.34	0.55	1.30
Mean % Survival	95	96	88	93	97	94
Mean % Reburial	100	96.8	98.9	96.9	99.0	97.0

1. Data **PASS** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W = 0.936$

$D = 18.400$

Critical $W_{(20, 0.01)} = 0.868$

2. Data **PASS** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$:

Calculated B statistic = 3.14

Table Chi-square value = 11.34

3. ANOVA test shows **NO significant difference** among sample means and disposal site reference:

Critical F value = 3.24 (0.05, 3, 16)

Calculated F value = 2.435

Calculated $F > \text{Critical } F$; \therefore **Fail to Reject H_0** : all groups equal

4. DUNNETT'S TEST (Mean Comparison Test) shows **NO Humboldt Harbor sample composite with lower survival** than the Humboldt reference composite at $P = 0.05$:

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTb</u>
Dunnett's t:	-1.474	-2.654	-1.769

(1-tailed, $P=0.05$, d.f.=16,3)

Dunnett table value = 2.23

Table 10. Mysid (*H. costata*) solid phase flow-through bioassays, Humboldt Bay Baseline Survey II (FY 1994).

<i>Holmesimysis costata</i> Solid Phase Flow-Through Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 20)					
Rep #	Home	REF	EKUP	SAMTB	FLTB
1	19	20	18	19	19
2	19	19	20	19	18
3	20	19	20	19	20
4	18	18	20	20	18
5	19	19	19	19	20
Mean	19.0	19.0	19.4	19.2	19.0
SD	0.71	0.71	0.89	0.45	1.00
Mean % Survival	95	95	97	96	95

1. Data **PASS SHAPIRO-WILKS TEST** for normality at $P=0.01$:
- $W = 0.928$ $D = 10.000$ Critical $W_{(20, 0.01)} = 0.868$
2. Data **PASS BARTLETT'S TEST** for homogeneity of variance at $\alpha=0.01$:
- Calculated B statistic = 2.34 Table Chi-square value = 11.34
3. ANOVA test shows **NO significant difference** among sample means and disposal site reference:
- Critical F value = 3.24 (0.05, 3, 16) Calculated F value = 0.293
Calculated F > Critical F; \therefore **Fail to Reject H_0** : all groups equal
4. **DUNNETT'S TEST** (Mean Comparison Test) shows **NO Humboldt Harbor sample composite with lower survival** than the Humboldt reference composite at $P = 0.05$:

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTB</u>
Dunnett's t:	-0.800	-0.400	0.000
(1-tailed, $P=0.05$, d.f.=16,3)			
	Dunnett table value = 2.23		

Table 11. Polychaete worm (*N. caecoides*) solid phase flow-through bioassays, Humboldt Bay Baseline Survey II (FY 1994).

<i>Nephtys caecoides</i> Solid Phase Flow-Through Bioassay Results Humboldt Harbor Sediments					
NUMBER OF SURVIVORS (Start n = 20)					
Rep #	Home	Reference	EKUP	SAMTB	FLTB
1	20	18	19	18	17
2	20	16	18	20	20
3	20	18	18	18	18
4	20	18	19	18	19
5	20	19	20	20	19
Mean	20.0	17.8	18.8	18.8	18.6
SD	0.0	1.10	0.84	1.10	1.14
Mean % Survival	100	89	94	94	93

1. Data **PASS** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W = 0.918$

$D = 17.600$

Critical $W_{(20, 0.01)} = 0.868$

2. Data **PASS** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$:

Calculated B statistic = 0.40

Table Chi-square value = 11.34

3. ANOVA test shows **NO significant difference** among sample means and disposal site reference:

Critical F value = 3.24 (0.05, 3, 16)

Calculated F value = 5.652

Calculated F > Critical F; \therefore **Reject H_0** : all groups equal

4. DUNNETT'S TEST (Mean Comparison Test) shows **NO sample composites produce lower survival** than the Humboldt reference composite at $P = 0.05$:

	<u>EKUP</u>	<u>SAMTB</u>	<u>FLTB</u>
Dunnett's t:	-1.508	-1.508	-1.206
(1-tailed, $P=0.05$, $d.f.=16,3$)			

Dunnett table value = 2.23

FIGURES

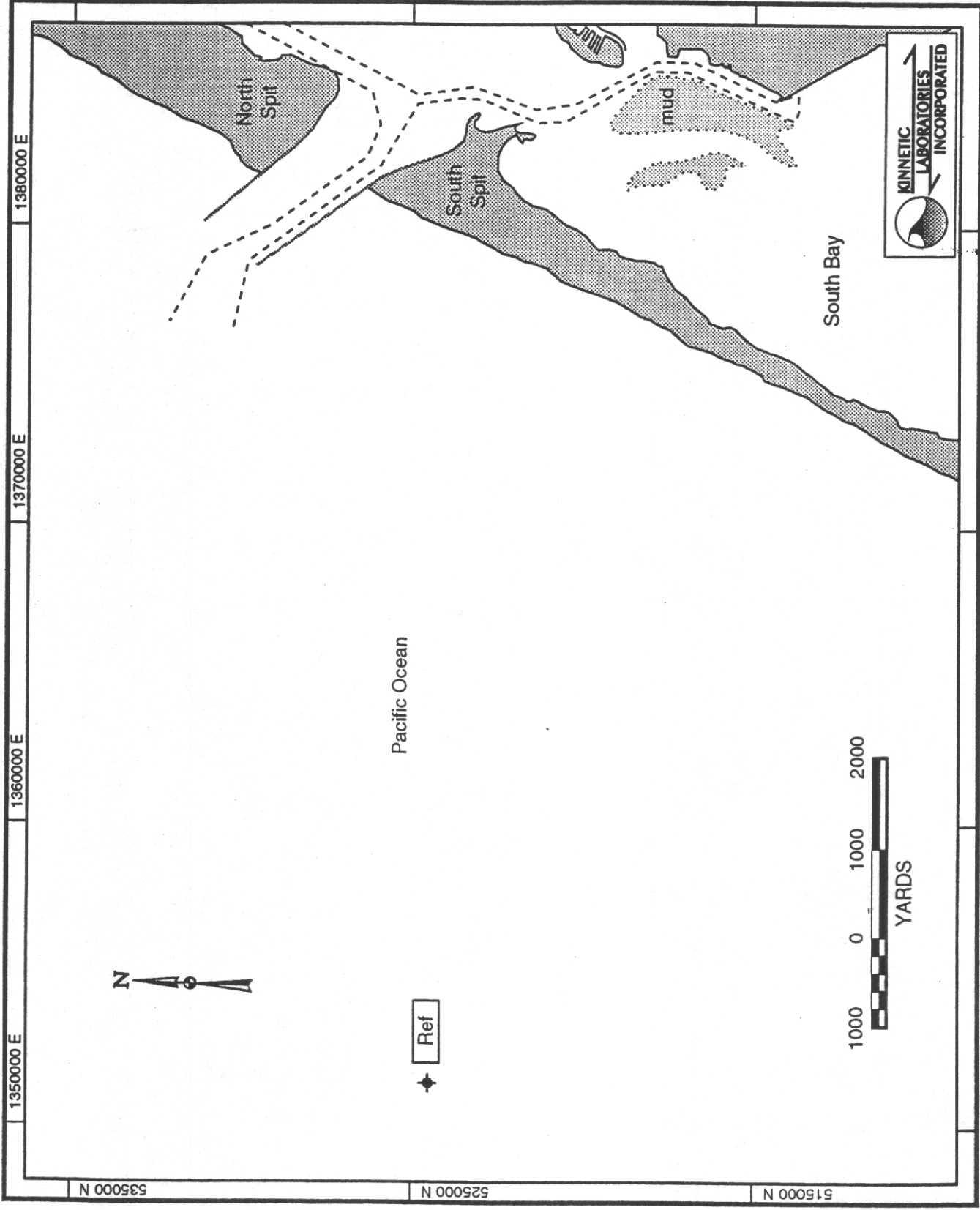


Figure 1. Humboldt Bay FY 1994 sampling locations. Reference station (solid) composite of six grab samples.

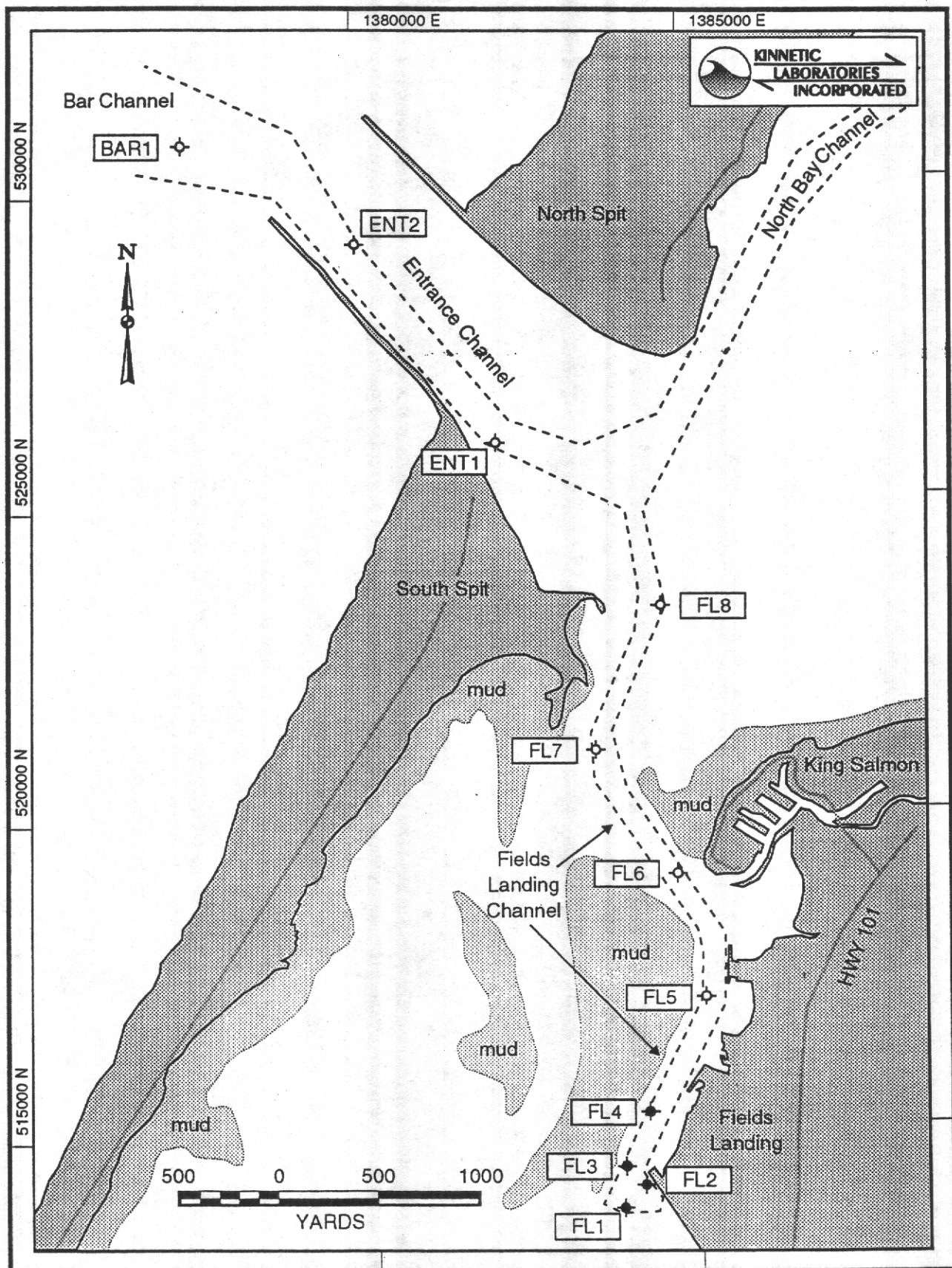


Figure 2. Humboldt Bay FY1994 sampling locations. Stations FL1 through FL8, ENT1, ENT2, and BAR1. Solid stations indicate those used in Fields Landing Lower Channel and Turning Basin (FLTB) composite.

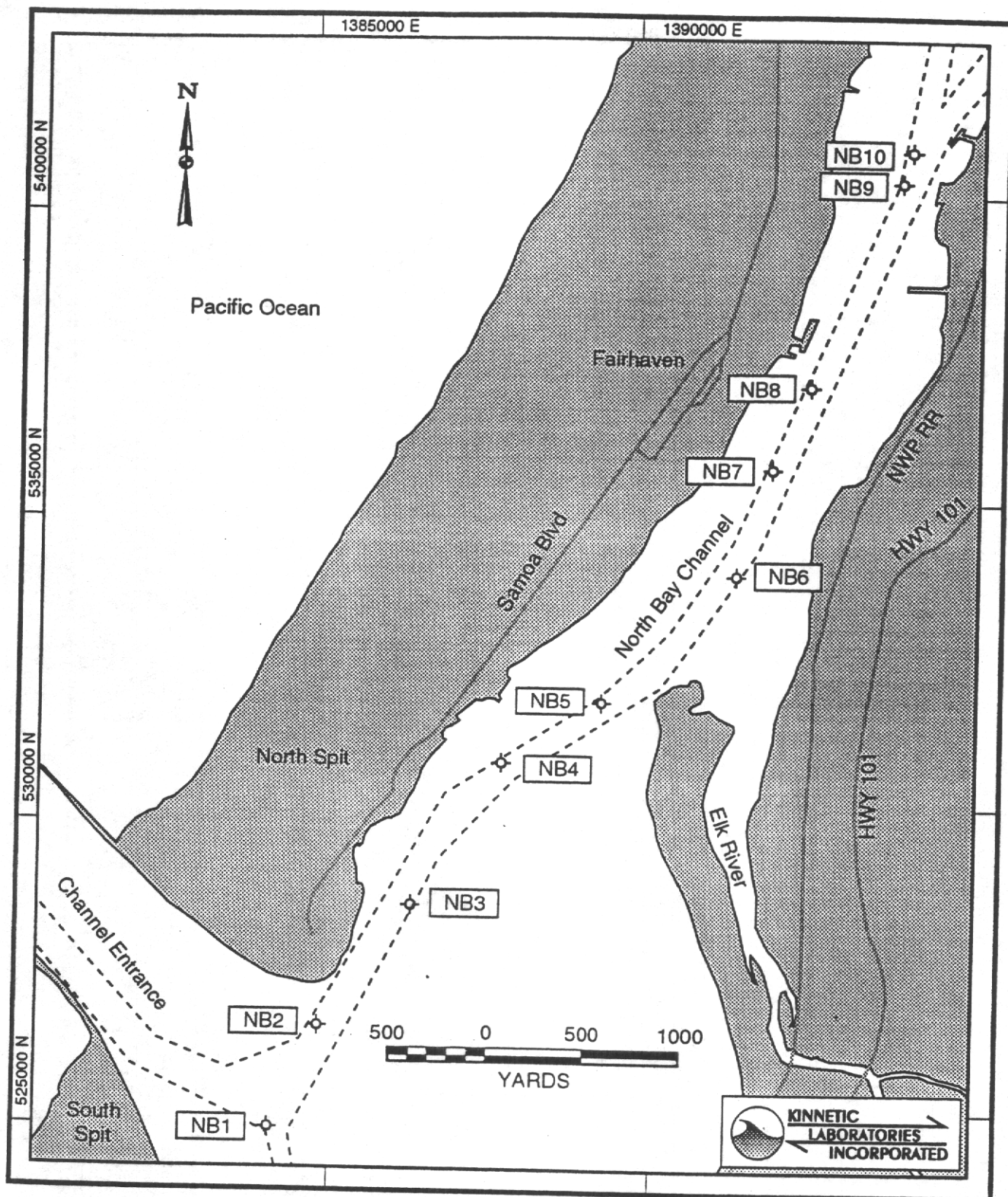


Figure 3. Humboldt Bay FY1994 sampling locations. Stations NB1 through NB10.

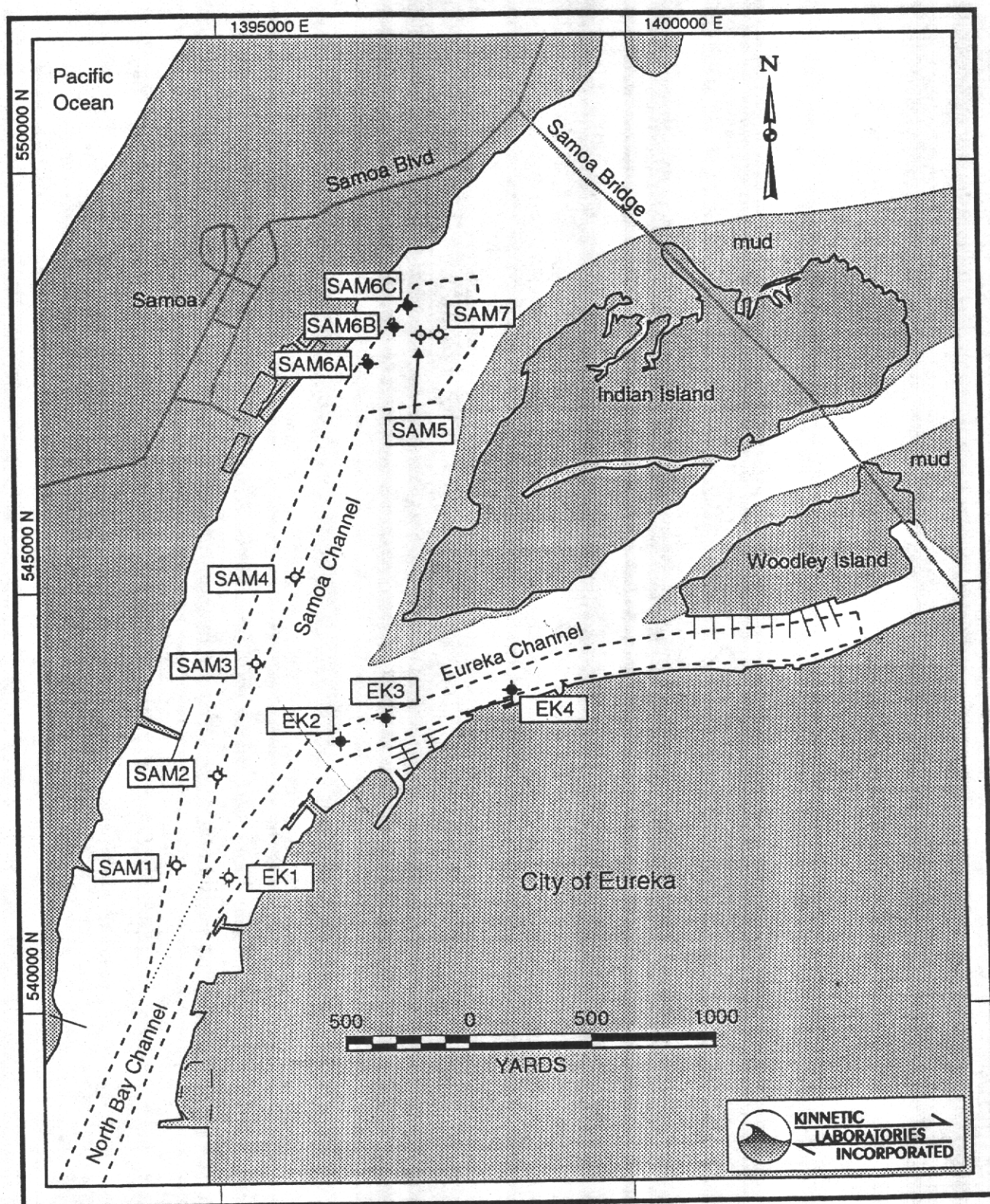


Figure 4. Humboldt Bay FY1994 sampling locations. Stations EK1 through EK4 and SAM1 through SAM7. Solid stations indicate those used in Eureka Upper Channel (EKUP) and Samoa Turning Basin (SAMTB) composites.

CHEMICAL ANALYSIS, TOXICITY EVALUATION
AND BIOACCUMULATION EXPOSURE
OF SEDIMENTS FROM
HUMBOLDT BAY:

BASELINE SURVEY III

Fiscal Year 1995

FINAL REPORT

Prepared for:

U.S. ARMY ENGINEERING DISTRICT
SAN FRANCISCO CORPS OF ENGINEERS
San Francisco, California

Prepared by:

TOXSCAN INC. and KINNETIC LABORATORIES, INC.
Watsonville, California

FEBRUARY 1996

Table 1. Analyses Performed, Humboldt Bay Baseline Survey III (FY 1995). Shaded samples composited; SP = Suspended Phase; SPP = Suspended Particulate Phase.

SAMPLE	Initial Grain Size	Sediment Chemistry	SP + SPP Bioassay	Bioaccumulation Exposure ¹
North Bay Channel:				
NB1	YES	NO	NO	NO
NB2	YES	NO	NO	NO
NB3	YES	NO	NO	NO
NB4	YES	NO	NO	NO
NB5	YES	NO	NO	NO
NB6	YES	NO	NO	NO
NB7	YES	NO	NO	NO
NB8	YES	NO	NO	NO
NB9	YES	NO	NO	NO
Samoa Turning Basin:				
SAM1	YES	YES	NO	NO
SAM2	YES	YES	NO	NO
SAM3	YES	YES	NO	NO
SAM4	YES	YES	NO	NO
SAM5	YES	YES	NO	NO
Comp SAMTB:	YES	YES ²	YES	YES
SAM6-A	YES	YES	NO	NO
SAM6-B	YES	YES	NO	NO
SAM6-C	YES	YES	NO	NO
SAM7	YES	YES	NO	NO
Eureka Upper Channel:				
EK1	YES	YES	NO	NO
Comp EKUP:	YES	YES ²	YES	YES
EK2	YES	YES	NO	NO
EK3	YES	YES	NO	NO
EK4	YES	YES	NO	NO
EK4A	YES	YES	NO	NO
Eureka Upper Channel Extension:				
Comp EKEX:	YES	YES ²	YES	YES
EK5	YES	YES	NO	NO
EK6	YES	YES	NO	NO
EK7	YES	YES	NO	NO
EK8	YES	YES	NO	NO
Field's Landing Lower Channel and Turning Basin:				
Comp FLTB:	YES	YES ²	YES	YES
FL1	YES	YES	NO	NO
FL2	YES	YES	NO	NO
FL3	YES	YES	NO	NO
FL4	YES	YES	NO	NO
FL5	YES	YES	NO	NO
FL6	YES	YES	NO	NO
FL7	YES	YES	NO	NO
FL8	YES	YES	NO	NO
Entrance Channel, Bar, Reference Site and Control:				
ENT1	YES	NO	NO	NO
ENT2	YES	NO	NO	NO
BAR1	YES	NO	NO	NO
REF	YES	YES ²	YES	YES
CONTROL	NO	NO	NO ³	YES

¹ Exposures only; no tissue analyses performed (see text).

³ Tetra to octa dioxins and furans only.

²Includes tetra to octa dioxins and furans.

Table 2. Sediments Collected, Humboldt Bay Baseline Survey III (FY 1995). Samples collected by vibracore or Smith-Macintyre grab; shaded samples composited.

SAMPLE	DATE	TIME	Core Penetration (Feet)		California Grid Zone Coordinates	
			ACHIEVED	SAMPLED	NORTH	EAST
North Bay Channel:						
NB 1	03/30/95	16:50	Grab	Grab	525028	1384350
NB 2	04/04/95	12:55	0.8	Grab	525717	1384680
NB 3	04/02/95	11:26	0.8	Grab	527595	1385835
NB 4	03/30/95	15:24	Grab	Grab	530564	1387808
NB 5	04/02/95	09:55	4.2	4.2	531952	1389996
NB 6	04/02/95	12:00	0.5	Grab	533740	1391373
NB 7	04/02/95	12:11	0.5	Grab	535714	1392302
NB 8	04/02/95	12:24	Grab	Grab	537125	1393099
NB 9	03/30/95	16:23	Grab	Grab	538749	1393646
Samoa Turning Basin (SAMTB):						
SAM 1	04/01/95	09:00	2.5	2.5	541987	1394449
SAM 2	04/01/95	17:51	Grab	Grab	544424	1395575
SAM 3	04/01/95	10:20	5.5	1.8	545539	1396198
SAM 4	04/01/95	17:26	0.5	Grab	546765	1396342
SAM 5	03/31/95	16:35	3.3	3.3	547455	1397822
SAM 6-A	04/01/95	11:25	3.9	3.6	548132	1397179
		12:02	3.0	3.0		
		12:25	4.8	3.6		
SAM 6-B	04/01/95	13:55	6.7	4.5	548384	1397352
		14:38	4.0	4.0		
		15:10	6.4	4.5		
SAM 6-C	04/01/95	16:00	5.1	3.6	548546	1397592
		16:22	4.6	3.6		
		16:50	6.1	3.6		
SAM 7	03/31/95	17:50	2.4	1.2	548109	1398059
Eureka Upper Channel (EKUP):						
EK 1	04/03/95	16:38	3.5	3.5	541497	1394908
EK 2	04/03/95	17:24	0.9	Grab	543132	1397078
		17:32	5.2	3.8		
		17:50	3.6	3.6		
		18:02	2.8	2.8		
		18:22	3.7	3.7		
EK 3	04/04/95	09:42	3.3	3.0	543794	1397913

Continued...

SAMPLE	DATE	TIME	Core Penetration (Feet)		California Grid Zone Coordinates	
			ACHIEVED	SAMPLED	NORTH	EAST
EK 4	04/04/95	08:14	0.5	Grab	543786	1398977
		08:22	3.6	2.5		
		08:38	3.0	2.5		
		08:50	2.4	2.4		
EK 4-A	04/04/95	10:22	3.5	2.3	543749	1398822
		10:42	5.0	2.3		
		10:55	0.8	0.8		
		11:05	3.6	2.3		
Eureka Upper Channel Extension:						
EK-5	04/03/95	14:16	9.8	8.0	543912	1399478
EK-6	04/03/95	12:55	10.0	9.8	544050	1399545
EK-7	04/03/95	11:55	8.3	8.3	543993	1399779
EK-8	04/03/95	10:55	9.0	9.0	544098	1400130
Fields Landing Lower Channel and Turning Basin (FLTB):						
FL-1	04/02/95	15:17	2.8	2.8	513810	1383995
		15:42	2.6	2.6		
		16:00	3.1	2.8		
FL-2	04/02/95	16:22	2.7	2.5	514037	1384139
		16:42	2.5	2.5		
		17:00	2.8	2.5		
FL-3	04/02/95	17:30	2.5	2.5	513846	1384313
		18:00	5.8	3.8		
		18:15	4.0	3.8		
		18:30	4.4	3.8		
FL-4	04/02/95	14:00	0.8	Grab	517329	1385130
		14:12	0.8	Grab		
FL-5	04/02/95	13:43	0.8	Grab	519655	1384129
FL-6	04/02/95	13:30	0.8	Grab	521141	1383493
	04/04/95	12:20	4.0	3.8		
FL-7	04/02/95	13:10	0.5	Grab	523228	1384574
Entrance Channel, Bar and Reference Site:						
ENT-1	03/30/95	17:02	0.8	Grab	525995	1382030
ENT-2	03/30/95	17:14	0.8	Grab	529195	1379874
BAR-1	03/30/95	14:02	0.5	Grab	530955	1377446
RF	03/30/95	11:18-13:00	8 Grabs	8 Grabs	552952	1361615

¹ Field measurements of station locations were made in latitude x longitude (see Field Logs, Appendix A), and converted here to California State Plane Coordinates.

² Grab samples (except Entrance and Bar) were taken only where depth from bottom to project depth was less than 1.5 ft; Entrance and Bar stations were grab sampled due to wind and sea conditions.

Table 3. Biological Assessments, Humboldt Bay Baseline Survey III (FY 1995).

Test Species:	SP	SPP	BA
<i>R. abronius</i>	X	-	-
<i>M. edulis</i>	-	X	-
<i>H. costata</i>	X	X	-
<i>C. stigmaeus</i>	-	X	-
<i>N. caecoides</i>	X	-	E
<i>M. nasuta</i>	-	-	E

X = test performed; E = exposure only, no tissue evaluation

SP = Solid Phase; SPP = Suspended Particulate Phase; BA = Bioaccumulation.

Table 4. Sediment Chemistry Summary, Humboldt Bay Baseline Survey III (FY 1995): Composites only; for individual sample results, see Appendix C.

Analyte	Sampling Sections				Ref.	Detection Limit
	SAMTB	EKUP	EKEX	FLTB		
Chlorinated Pesticides (ppb, dry weight)						
Aldrin	ND	ND	ND	ND	ND	2.0
alpha-BHC	ND	ND	ND	ND	ND	2.0
beta-BHC	ND	ND	ND	ND	ND	2.0
delta-BHC	ND	ND	ND	ND	ND	2.0
gamma-BHC (lindane)	ND	ND	ND	ND	ND	2.0
alpha-Chlordane	ND	ND	ND	ND	ND	2.0
gamma-Chlordane	ND	ND	ND	ND	ND	2.0
4,4'-DDD	ND	ND	ND	ND	ND	2.0
4,4'-DDE	ND	ND	ND	ND	ND	2.0
4,4'-DDT	ND	ND	ND	ND	ND	2.0
Dieldrin	ND	ND	ND	ND	ND	2.0
Endosulfan I	ND	ND	ND	ND	ND	2.0
Endosulfan II	ND	ND	ND	ND	ND	2.0
Endosulfan sulfate	ND	ND	ND	ND	ND	10
Endrin	ND	ND	ND	ND	ND	2.0
Heptachlor	ND	ND	ND	ND	ND	2.0
Heptachlor epoxide	ND	ND	ND	ND	ND	10
Toxaphene	ND	ND	ND	ND	ND	30
Dioxins (PCDD) and Furans (PCDF): Tetra- to Octa- Chlorinated* (pg/g)						
Total PCDD	274	342.4	502.9	87.03	621.49	0.17-0.36
Total PCDF	33.7	63.1	84.7	18	3.65	0.048-0.45
TEQs	1.4	2.7	3.5	0.81	0.76	—
PCBs (ppb, dry weight)						
PCB 1242	ND	ND	ND	ND	ND	20
PCB 1248	ND	ND	ND	ND	ND	20
PCB 1254	ND	ND	ND	ND	ND	20
PCB 1260	ND	ND	ND	ND	ND	20
total PCBs	ND	ND	ND	ND	ND	
PAHs (ppb, dry wt)						
2-Methylnaphthalene	ND/14	51	39/64	77	71	11-13
Naphthalene	ND/13	44	ND/37	32	27	11-13
2-Chloronaphthalene	ND/ND	ND	ND/ND	ND	ND	11-13
Acenaphthylene	ND/ND	ND	ND/ND	ND	ND	11-13
Acenaphthene	ND/ND	13	ND/ND	ND	ND	11-13
Fluorene	ND/ND	30	32/27	28	24	11-13
Phenanthrene	31/24	110	110/81	100	110	11-13
Anthracene	ND/ND	17	ND/ND	ND	ND	11-13
total detectable LPAHs	31/51	270	180/210	240	230	11-13
Fluoranthene	25/20	160	90/63	47	35	11-13
Pyrene	35/25	150	73/59	46	35	11-13
Chrysene	ND/ND	59	42/31	33	35	11-13
Benzo(a)anthracene	ND/ND	41	22/17	16	16	11-13
Benzo(b)fluoranthene	ND/ND	51	37/24	25	23	11-13
Benzo(k)fluoranthene	ND/ND	29	19/ND	ND	ND	11-13
Benzo(a)pyrene	ND/ND	51	22/16	16	ND	11-13
Indeno[1,2,3-CD]pyrene	ND/ND	32	19/ND	ND	ND	11-18
Dibenzo(a,h)anthracene	ND/ND	ND	ND/ND	ND	ND	11-18
Benzo[ghi]perylene	ND/ND	51	31/22	23	19	11-18
total detectable HPAHs	60/45	620	360/230	210	160	11-18
total detectable PAHs	91/96	890	540/440	450	390	11-18
Phthalates (ppb, dry wt)						
total phthalate esters	220/200	1700	510/300	1300	370	11-13

* See Appendix C-1 for PCDD and PCDF congener identifications.

Continued...

Table 4 (continued). Bulk Sediment Chemistry Summary: Humboldt Bay Baseline Survey III (FY1995): Composites only; for individual sample results, see Appendix C.

Analyte	Sampling Sections					Detection Limit	
	SAMTB	EKUP	EKEX	FLTb	Ref.		
Grain Size (% dry)							
Coarse Sand/Gravel ($\Phi < -1$)	1.1	0.2	0.0	0.0	0.0	-	
Sand ($-1 \leq \Phi \leq 4$)	78.24	34.90	15.94	16.90	4.26	-	
Silt ($5 \leq \Phi \leq 8$)	12.7	43.94	54.64	54.29	74.57	-	
Clay ($\Phi \geq 9$)	7.93	20.93	29.41	28.8	21.16	-	
Sediment Conventional							
Total sulfides (ppm, dry)	79	170	300	160	1.3	0.1	
Water soluble sulfides (ppm, dry)	ND	0.3	ND	ND	ND	0.1	
Oil & Grease* (ppm, dry)	ND	23	80	27	ND	20	
Petroleum Hydrocarbons (ppm, dry)	ND	ND	46	ND	ND	20	
Total Volatile Solids (%)	2.0	4.0	4.3	3.7	3.9	0.1	
% Solids (%)	71	63	59	57	62	1.0	
TOC (%)	0.54	0.67	0.66	0.62	0.72	0.1	
Metals (ppm, dry wt)							
Arsenic	3.7	4.0	4.7	4.9	5.2	0.1	
Cadmium	0.2	0.1	0.2	0.2	0.1	0.1	
Chromium	120	130	130	120	120	0.1	
Copper	11	27	30	25	28	0.1	
Lead	4.9	15	11	8.6	10	0.1	
Mercury	0.096	0.10	0.13	0.10	0.12	0.02	
Nickel	86	120	130	120	130	0.1	
Selenium	0.1	0.2	0.2	0.2	0.2	0.1	
Silver	1.4	1.4	1.6	1.3	1.7	0.1	
Zinc	44	81	94	56	69	0.1	
Organotins (ppb, dry weight)							
Monobutyltin	ND	ND	ND	ND	ND	1.0	
Dibutyltin	ND	2	2	ND	ND	1.0	
Tributyltin	ND	ND	10	ND	ND	1.0	
SP Bioassay Interstitial Water							
Salinity (‰):	Initial	25	23.4	28.6	30.3	32.0	—
	Day 0	33	31	33	32	32	—
	Day 10	32	32	32	32	32	—
pH:	Initial	8.1	7.5	8.0	7.4	7.3	—
	Day 0	7.8	7.1	7.2	7.3	7.5	—
	Day 10	7.6	7.0	7.1	7.2	7.4	—
Total NH ₃ (ppm):	Initial	8.9	35.8	59.6	18.7	4.9	—
	Day 0	6.1	14.5	21.5 ^b	11.6	3.7	—
	Day 10	3.3	2.1	5.2	7.3	1.7	—
SPP Bioassay Elutriate Water							
Total NH ₃ (ppm):		2.1	11.5	15.8	5.9	1.8	—

^a Freon[®]-extractable

^b Remeasured after Day 0 renewal; Total NH₃ = 9.9 mg/L.

ND = None Detected

Table 5. Summary of bivalve larvae (*M. edulis*) suspended particulate phase bioassays for Humboldt Bay Baseline Survey III, FY1995 Maintenance dredging project. See text for explanation of calculations (Mean initial recovery = 5319).

Sample ID	Rep	Number		Total Recovered per 1 MI	Resuspended Volume	Total #		Mean % Survival \pm S.D.	% Normal Development	Mean % Normal Development \pm S.D.		Survival		Normal Development	
		Normal	Abnormal			Normal Larvae Recovered	% Survival					Abbotts Corrected Value	Mean Corrected Value	Abbotts Corrected Value	Mean Corrected Value
CONTROL	1	95	7	102	48	4560	85.7	94.6	93.1	94.6	\pm				
	2	109	10	119	47	5123	96.3	\pm	91.6	\pm	2.45				
	3	104	2	106	48	4992	93.8	2.45	98.1						
	4	92	5	97	47.5	4370	82.2		94.8						
	5	100	5	105	47.5	4750	89.3		95.2						
REF.	1	95	5	100	48	4560	85.7	80.9	95.0	91.9	\pm	90.6	85.6	100.4	97.1
	2	89	8	97	46	4094	77.0	\pm	91.8	\pm	2.65	81.4	\pm	97.0	\pm
	3	89	8	97	46.5	4139	77.8	4.79	91.8			82.3	5.06	97.0	2.81
	4	94	7	101	49	4606	86.6		93.1			91.5		98.4	
	5	86	12	98	48	4128	77.6		87.8			82.0		92.8	
SAMTB 100%	1	21	91	112	47.5	998	18.8	6.4	18.8	7.0	\pm	19.8	6.8	19.8	7.4
	2	2	95	97	46	92	1.7	\pm	2.1	\pm		1.8	\pm	2.2	\pm
	3	13	80	93	48	624	11.7	8.44	14.0			12.4	8.92	14.8	9.29
	4	0	94	94	48	0	0.0		0.0	8.79		0.0		0.0	
	5	0	108	108	46	0	0.0		0.0			0.0		0.0	
SAMTB 50%	1	0	81	81	47	0	0.0		0.0			0.0		0.0	
	2	0	93	93	48	0	0.0	0.0	0.0	0.0	\pm	0.0	0.0	0.0	0.0
	3	0	95	95	46	0	0.0	\pm	0.0	\pm		0.0	\pm	0.0	\pm
	4	0	70	70	47	0	0.0	0.00	0.0	0.00		0.0	0.00	0.0	0.00
	5	0	105	105	46	0	0.0		0.0			0.0		0.0	
SAMTB 10%	1	85	16	101	46.5	3953	74.3	73.4	84.2	77.7	\pm	78.6	77.6	89.0	82.1
	2	109	10	119	47	5123	96.3	\pm	91.6	\pm		101.8	\pm	96.8	\pm
	3	94	11	105	48	4512	84.8	25.39	89.5			89.7		94.6	
	4	35	74	109	46	1610	30.3		32.1	25.65		32.0	26.85	33.9	27.12
	5	92	9	101	47	4324	81.3		91.1			85.9		96.3	
EKUP 100%	1	0	118	118	47	0	0.0	0.2	0.0	0.2	\pm	0.0	0.2	0.0	0.3
	2	0	94	94	49	0	0.0	\pm	0.0	\pm		0.0	\pm	0.0	\pm
	3	0	105	105	46	0	0.0	0.40	0.0	0.53		0.0	0.43	0.0	0.56
	4	0	117	117	48	0	0.0		0.0			0.0		0.0	
	5	1	83	84	48	48	0.9		1.2			1.0		1.3	

Table 5, continued. Summary of bivalve larvae (*M. edulis*) suspended particulate phase bioassays for Humboldt Bay Baseline Survey III, FY1995 Maintenance dredging project. See text for explanation of calculations (Mean initial recovery = 5319).

Sample ID	Rep	Number Normal	Number Abnormal	Total Recovered per 1 mL	Resuspended Volume	Total # Normal Larvae Recovered	% Survival	Mean % Survival \pm S.D.	% Normal Development	Mean % Normal Development \pm S.D.	Survival Abbotts Corrected Value	Mean Corrected Value	Normal Development Abbotts Corrected Value	Mean Corrected Value
EKUP 50%	1	64	35	99	47	3008	56.6	47.1	64.6	47.6	59.8	49.8	68.3	50.3
	2	97	41	138	45.5	4414	83.0	\pm	70.3	\pm	87.7	\pm	74.3	\pm
	3	79	34	113	47.5	3753	70.5	\pm	69.9	\pm	74.6	\pm	73.9	\pm
	4	28	57	85	48	1344	25.3	33.99	32.9	30.76	26.7	35.93	34.8	32.52
	5	0	103	103	47	0	0.0		0.0		0.0		0.0	
EKUP 10%	1	50	30	80	46.5	2325	43.7	30.1	62.5	33.6	46.2	31.8	66.1	35.5
	2	79	38	117	46.5	3674	69.1	\pm	67.5	\pm	73.0	\pm	71.4	\pm
	3	33	74	107	48	1584	29.8	\pm	30.8	\pm	31.5	\pm	32.6	\pm
	4	0	109	109	47	0	0.0	27.86	0.0	30.95	0.0	29.45	0.0	
	5	9	120	129	46.5	419	7.9		7.0		8.3		7.4	32.72
EKEK 100%	1	0	104	104	47.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0	104	104	47	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0	99	99	48.5	0	0.0	\pm	0.0	\pm	0.0	\pm	0.0	\pm
	4	0	99	99	47	0	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	5	0	94	94	48	0	0.0		0.0		0.0		0.0	
EKEK 50%	1	0	95	95	48.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0	87	87	48	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0	96	96	48	0	0.0	\pm	0.0	\pm	0.0	\pm	0.0	\pm
	4	0	89	89	47.5	0	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	5	0	105	105	46	0	0.0		0.0		0.0		0.0	
EKEK 10%	1	7	82	89	47	329	6.2		7.9		6.5		8.3	
	2	26	86	112	48	1248	23.5	11.5	23.2	13.0	24.8	12.2	24.5	13.8
	3	24	69	93	48	1152	21.7	\pm	25.8	\pm	22.9	\pm	27.3	\pm
	4	6	75	81	49	294	5.5	10.28	7.4	10.87	5.8	10.87	7.8	11.49
	5	1	110	111	47	47	0.9		0.9		0.9		1.0	
FLTB 100%	1	70	29	99	48	3360	63.2	68.1	70.7	73.9	66.8	72.0	74.8	78.2
	2	58	22	80	50	2900	54.5	\pm	72.5	\pm	57.6	\pm	76.6	\pm
	3	78	21	99	49.5	3861	72.6	\pm	78.8	\pm	76.7	\pm	83.3	\pm
	4	81	36	117	46	3726	70.0	9.80	69.2	4.43	74.1	10.36	73.2	4.68
	5	91	25	116	47	4277	80.4		78.4		85.0		82.9	

For sample SAMTB: LC₅₀ = 17.26% (10.89%, 24.90%); EC₅₀ = 18.55% (12.10%, 26.50%)
For sample EKUP: LC₅₀ = 9.81% (4.66%, 19.47%); EC₅₀ = 9.85% (4.62%, 19.96%)
For sample EKEK: LC₅₀ = Not calculable; EC₅₀ = Not Calculable

Table 6. Mysid SPP Bioassays, Humboldt Bay Baseline Survey III (FY 1995).

<i>Holmesimysis costata</i> Suspended Particulate Phase Bioassay Results Humboldt Harbor Sediments						
NUMBER OF SURVIVORS (Start n = 10)						
Rep #	Control	REF	SAMTB	EKUP	EKEX	FLTb
1	10	10	10	5	0	7
2	10	10	10	5	0	7
3	10	8	10	8	0	5
4	10	8	10	3	0	4
5	10	8	9	5	0	8
Mean	10.0	8.8	9.8	5.2	0.0	6.2
SD	0.0	1.10	0.447	1.79	0.00	1.64
Mean % Survival	100	88.0	98.0	52.0	0.0	62.0

1. Data **PASS** SHAPIRO-WILKS TEST for normality at P=0.01:
W=0.947 D = 29.20 Critical $W_{(25, 0.01)} = 0.888$
2. Data **FAIL** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$: At least one group has zero variance.
3. Steel's Many-One Rank test shows **EKUP, EKEX, and FLTb** with significantly diminished survival compared to disposal site reference:

	<u>SAMTB</u>	<u>EKUP</u>	<u>EKEX</u>	<u>FLTb</u>
Rank Sum:	34.0	16.5	15.0	16.5
Critical value = 17 (0.05, k=4)				

Table 7. Sanddab SPP bioassays, Humboldt Bay Baseline Survey III (FY 1995).

<i>Citharichthys stigmaeus</i> Suspended Particulate Phase Bioassay Results (100% only) Humboldt Harbor Sediments						
NUMBER OF SURVIVORS (Start n = 10)						
Rep #	Control	REF	SAMTB	EKUP	EKEX	FLTB
1	9	8	10	9	0	1
2	9	10	9	8	0	1
3	9	7	10	9	0	0
4	9	10	10	9	0	6
5	10	9	9	8	0	0
Mean	9.2	8.8	9.6	8.6	0.0	1.6
SD	0.45	1.30	0.55	0.55	0	2.51
Mean % Survival	92	88	96	86	0	16

1. Data **FAIL** SHAPIRO-WILKS TEST for normality at $P=0.01$:

$W = 0.813$

$D = 34.4000$

Critical $W_{(30, 0.01)} = 0.888$

2. Data **FAIL** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$: At least one group has zero variance.
3. Steel's Many-One Rank test shows **EKEX** and **FLTB** as significantly different from the disposal site reference composite.

	<u>SAMTB</u>	<u>EKUP</u>	<u>EKEX</u>	<u>FLTB</u>
Rank Sum:	32.0	25.5	15.0	15.0

Critical value = 17 (0.05, $k=4$)

Table 8. EC/LC₅₀ values for SPP bioassays, Humboldt Bay Baseline Survey III, FY 1995.

Sample	Bivalve		Mysid	Sanddab
	EC ₅₀	LC ₅₀	LC ₅₀	LC ₅₀
Control	>100	>100	>100	>100
Reference	>100	>100	>100	>100
SAMTB	18.6	17.3	>100	>100
EKUP	9.8	9.8	>100	>100
EKEX	<10.0	5.1	51.2	61.6
FLTB	>100	>100	>100	65.6

Table 9. Amphipod SP static bioassays, Humboldt Bay Baseline Survey III (FY 1995). Home A and composites EKUP and EKEX (**bold typeface**) were ammonia-purged (daily renewals) as per EPA/ACOE memo of 21 December 1993.

Rhepoxynius abronius
Solid Phase Static Bioassay Results
Humboldt Harbor Sediments

NUMBER OF SURVIVORS (Start n = 20)							
Rep #	Home A	Home B	REF	SAMTB	EKUP	EKEX	FLTB
1	19	19	14	17	19	15	19
2	20	20	12	19	17	14	18
3	20	20	13	16	11	16	18
4	20	20	14	19	14	19	17
5	19	20	12	18	10	11	17
Mean	19.6	19.8	13.0	17.8	14.2	15.0	17.8
SD	0.55	0.45	1.00	1.30	3.83	2.92	0.84
Mean % Survival	98.0	99.0	65.0	89.0	71.0	75.0	89.0
Mean % Reburial	100	100	98.5	96.5	93.5	97.4	92.0

Statistical analyses unnecessary: mean survival in harbor composites exceeded survival in reference.

Table 10. Mysid SP flow-through bioassays, Humboldt Bay Baseline Survey III (FY 1995).

<i>Holmesimysis costata</i> Solid Phase Flow-Through Bioassay Results Humboldt Harbor Sediments						
NUMBER OF SURVIVORS (Start n = 20)						
Rep #	Home	REF	SAMTB	EKUP	EKEX	FLTB
1	18	18	20	17	20	19
2	20	18	19	18	20	19
3	20	19	19	19	20	19
4	18	19	20	19	20	19
5	20	19	20	19	20	20
Mean	19.2	18.6	19.6	18.4	20	19.2
SD	1.10	0.55	0.55	0.89	0	0.45
Mean % Survival	96	93	98	92	100	96

1. Data **PASS** SHAPIRO-WILKS TEST for normality at P=0.01:

W = 0.931

D = 6.400

Critical W_(25, 0.01) = 0.888

2. Data **FAIL** BARTLETT'S TEST for homogeneity of variance at $\alpha=0.01$:

3. ANOVA test shows **NO significant difference** among sample means and disposal site reference:

4. STEEL'S MANY-ONE RANK TEST (Mean Comparison Test) shows **NO Humboldt Harbor sample composite with lower survival** than the Humboldt reference composite at P = 0.05:

	<u>SAMTB</u>	<u>EKUP</u>	<u>EKEX</u>	<u>FLTB</u>
Rank Sum:	37.0	26.5	40.0	34.0
Critical value = 17 (0.05, k=4)				

Table 11. Polychaete worm SP flow-through bioassays, Humboldt Bay Baseline Survey III (FY 1995).

<p><i>Nephtys caecoides</i> Solid Phase Flow-Through Bioassay Results Humboldt Harbor Sediments</p>						
<p>NUMBER OF SURVIVORS (Start n = 20)</p>						
Rep #	Home	REF	SAMTB	EKUP	EKEX	FLTB
1	18	18	19	18	20	18
2	18	16	18	17	18	19
3	19	17	18	18	19	20
4	20	17	18	20	19	18
5	20	16	17	19	19	19
Mean	19.0	16.8	18.0	18.4	19.0	18.8
SD	1.00	0.84	0.71	1.14	0.71	0.84
Mean % Survival	95	84	90	92	95	94

Statistical analyses unnecessary: mean survival in harbor composites exceeded survival in reference.

FIGURES

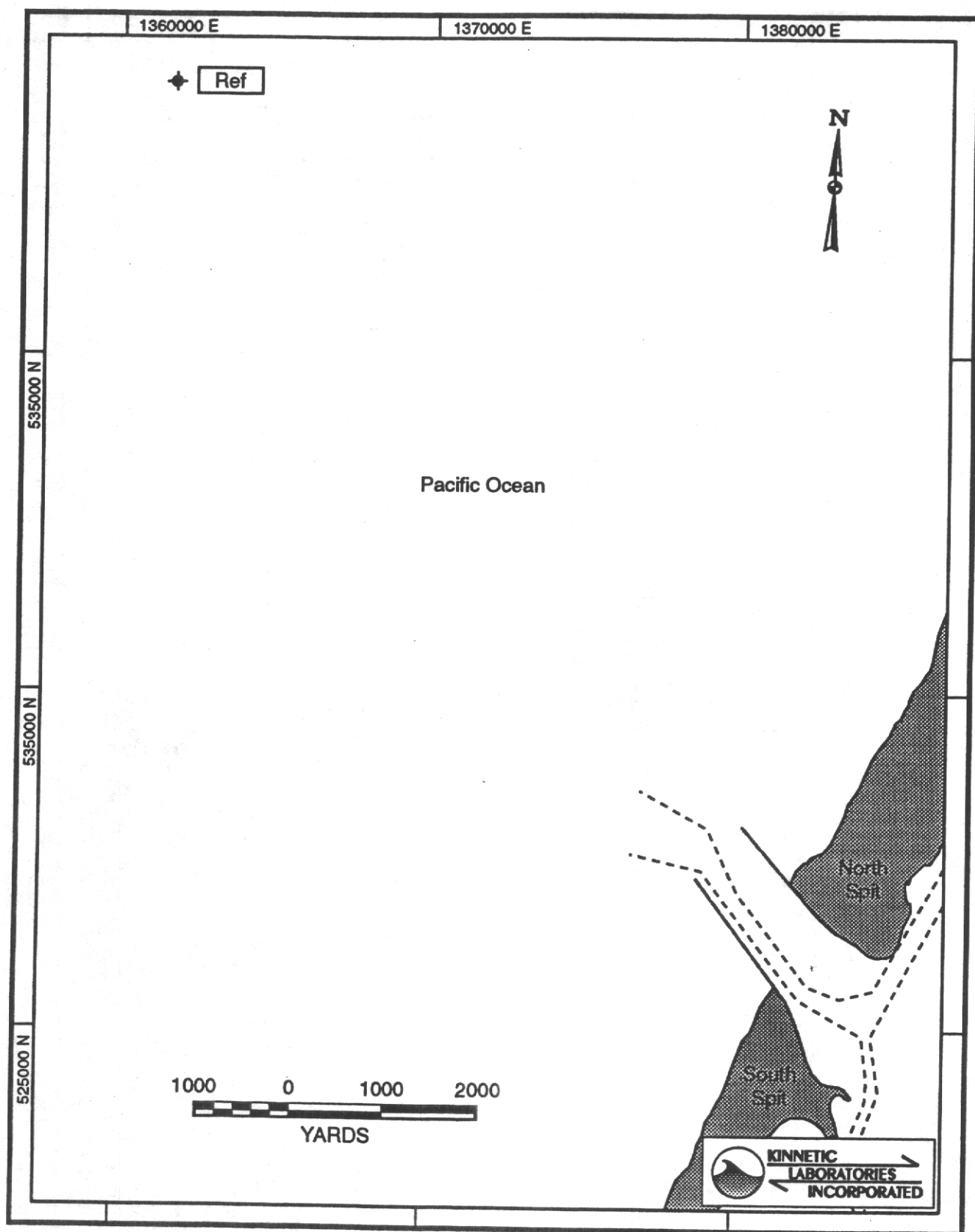


Figure 1. Humboldt Bay FY 1995 sampling locations. Reference station (solid) composite of eight grab samples.

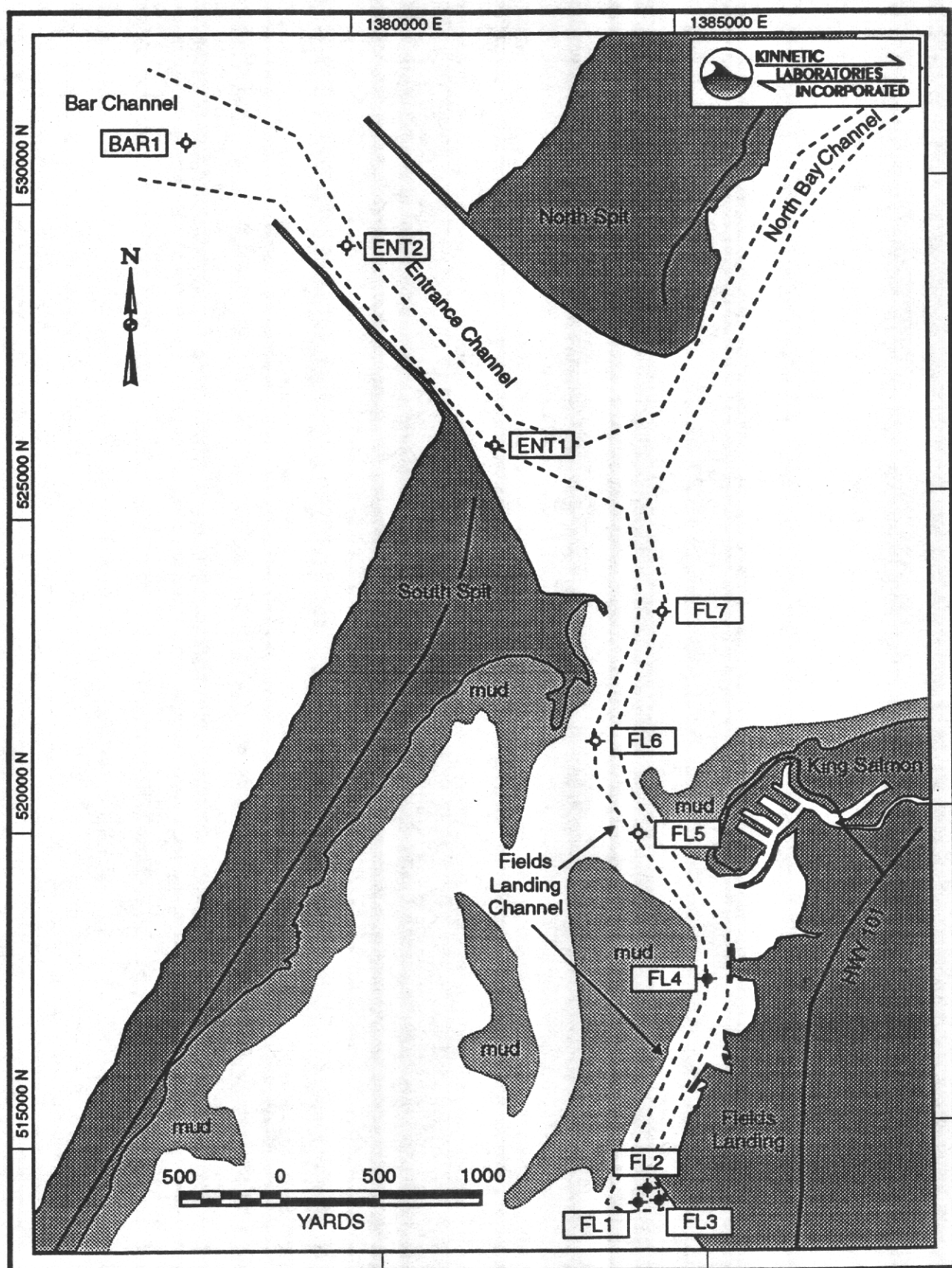


Figure 2. Humboldt Bay FY1995 sampling locations. Stations FL1 through FL8, ENT1, ENT2, and BAR1. Solid stations indicate those used in Fields Landing Lower Channel and Turning Basin (FLTBC) composite.

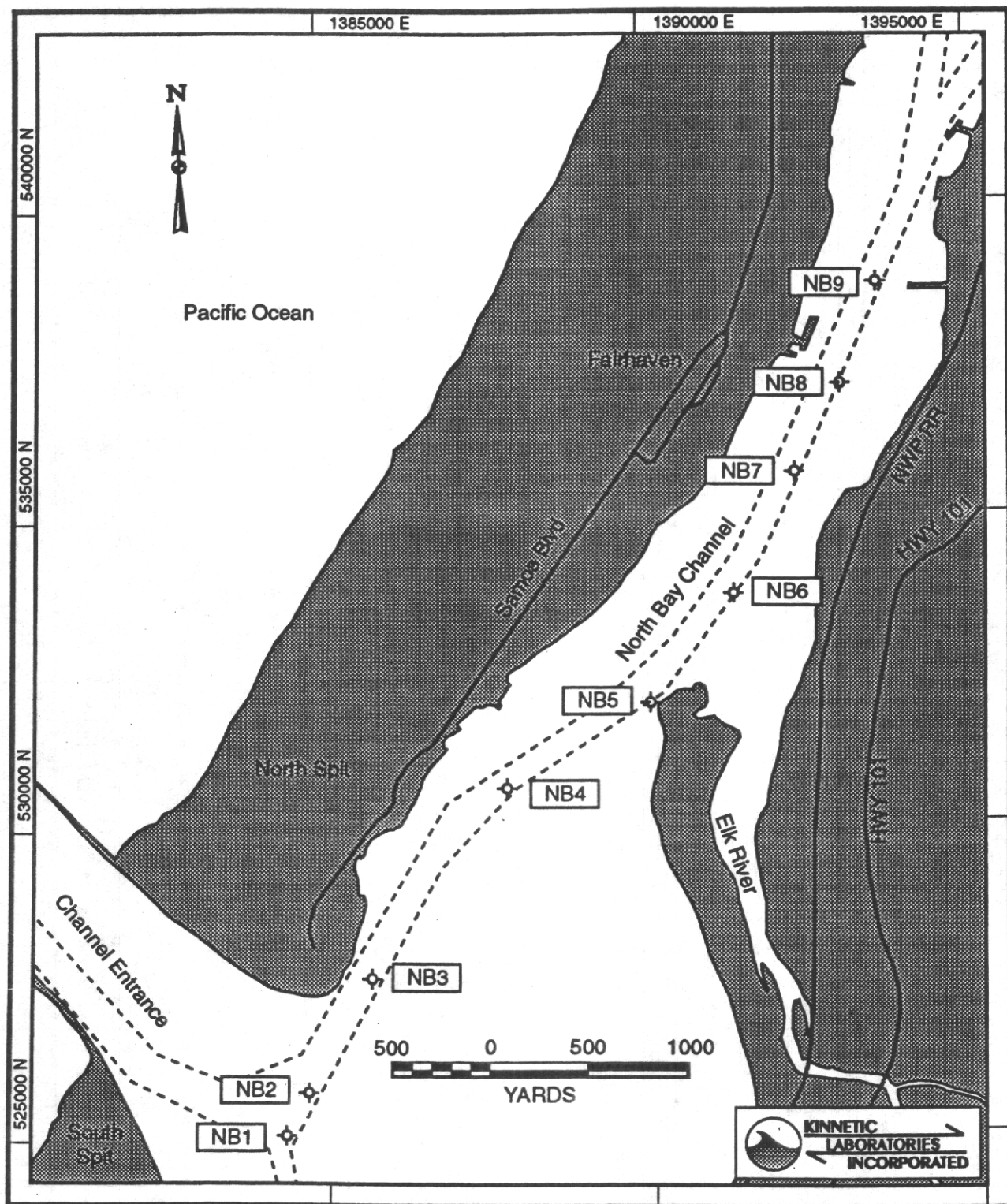


Figure 3. Humboldt Bay FY1995 sampling locations. Stations NB1 through NB9.

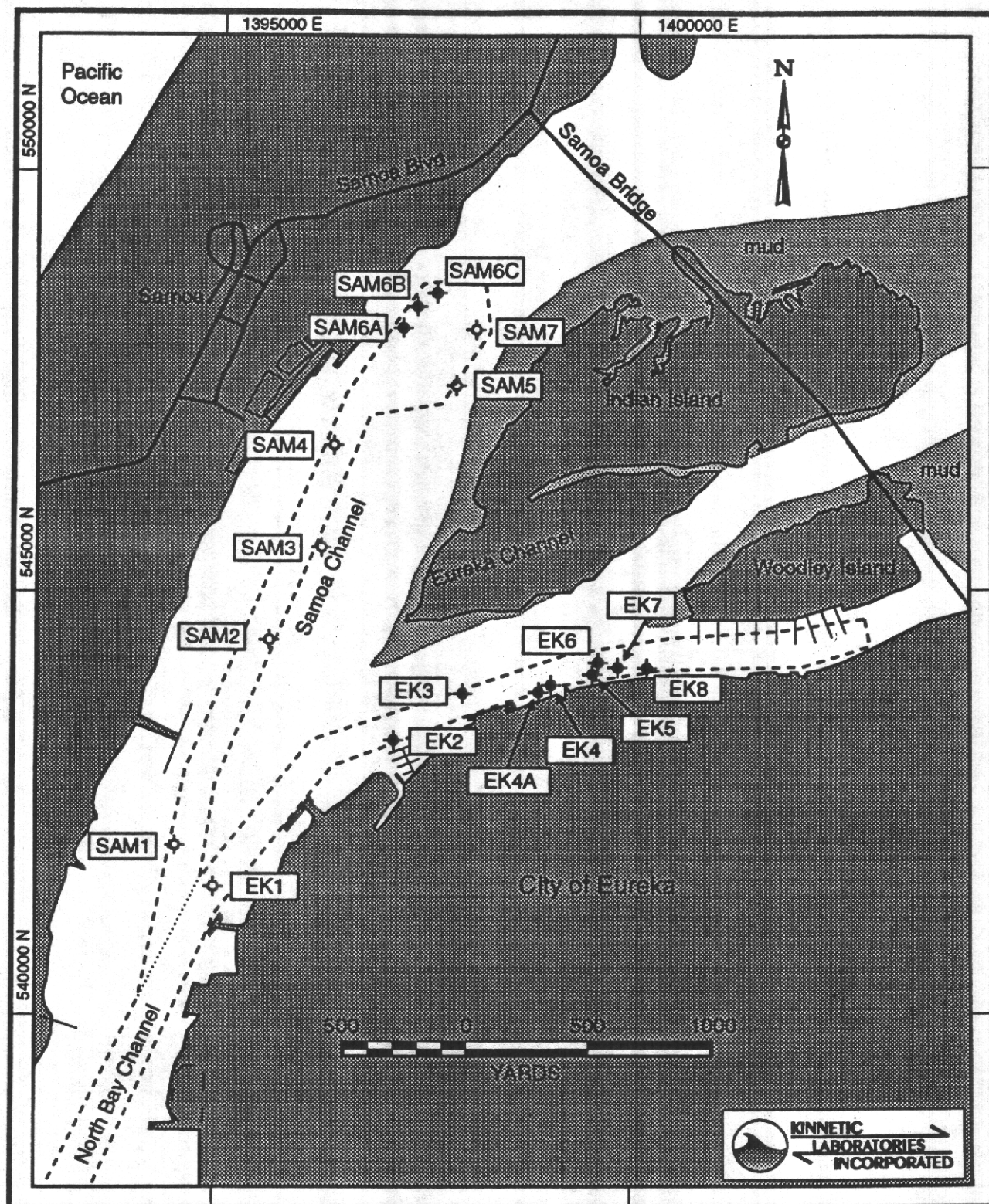


Figure 4. Humboldt Bay FY 1995 sampling locations. Stations EK1 through EK8 and SAM1 through SAM7. Solid stations indicate those used in Eureka Upper Channel (EK2 through EK4 = EKUP), Eureka Upper Channel Extension (EK5 through EK8 = EKEX), and Samoa Turning Basin (SAMTB) composites.

**CHEMICAL ANALYSIS AND TOXICITY EVALUATION
OF SEDIMENTS FROM
EUREKA CHANNEL EXTENSION, HUMBOLDT HARBOR**

FOR 1999 MAINTENANCE DREDGING

FINAL REPORT

Prepared for:

**SAN FRANCISCO DISTRICT
U.S. ARMY CORPS OF ENGINEERS
San Francisco, California**

Prepared by:

**TOXSCAN, INC./KINETIC LABORATORIES, INC.
Watsonville, California**

June 15, 1999

F:\BIOASSAYS\FCOE\HUMBOLT9\17145RPT.WPD

Table 1. Summary of sediment samples collected, Eureka Channel Extension FY 1999 Maintenance Dredging. Samples collected by Vibracore or van Veen Grab. Depths in feet.

SAMPLE	DATE	TIME	Mud-line *	CORE LENGTH		California Grid Zone Coordinates	
				Achieved	Sampled	NORTH	EAST
COMP EK-1							
1-1	3/9/99	1246	-13.0	4.3	3.0	543890	1399625
1-2	3/9/99	1345	-7.1	10.0	8.9	544349	1400275
1-3	3/9/99	1448	-9.8	5.5	5.5	544371	1400629
1-4	3/9/99	1602	-8.0	9.1	8.0	544060	1400906
COMP EK-2							
2-1	3/9/99	0835	-13.3	4.5	2.7	544225	1401226
2-2	3/9/99	0931	-12.9	4.4	3.1	544244	1401649
2-3	3/9/99	1007	-9.8	7.1	6.2	544052	1401652
2-4	3/9/99	1046	-10.5	7.8	5.5	544050	1401314
COMP EK-3							
3-1	3/8/99	1355	-12.4	5.0	3.6	544299	1402320
3-2	3/8/99	1510	-12.3	4.9	3.7	544125	1402377
3-3	3/8/99	1555	-12.6	4.5	3.4	544503	1402663
3-4	3/8/99	1636	-11.8	4.7	4.2	544273	1402950
HOODS Ref	3/7/99	0730	--	[Grab Sample]		525998	1351857
Σ CORE LENGTH:				71.8	57.8		

* Depth to mudline from MLLW.

Table 2. Summary of analyses performed, San Francisco Army Corps of Engineers, Eureka Channel Extension FY 1999 Maintenance Dredge Sediments.

SAMPLE	Bulk Sediment Chemistry	ANALYSIS SP Bioassay (1 Species)	SPP Bioassay (1 Species)	Bioaccumulation Exposure
COMP EK-1	YES+Backup	YES+Backup	YES	NO
1-1	YES+Archive	NO	NO	NO
1-2	Archive	NO	NO	NO
1-3	Archive	NO	NO	NO
1-4	Archive	NO	NO	NO
COMP EK-2	YES+Backup	YES+Backup	YES	NO
2-1	Archive	NO	NO	NO
2-2	Archive	NO	NO	NO
2-3	Archive	NO	NO	NO
2-4	YES+Archive	NO	NO	NO
COMP EK-3	YES+Backup	YES+Backup	YES	NO
3-1	Archive	NO	NO	NO
3-2	Archive	NO	NO	NO
3-3	Archive	NO	NO	NO
3-4	YES+Archive	NO	NO	NO
HOODS Reference	YES+Backup	YES	YES	NO

Table 3. Biological Assessments, Eureka Channel Extension, FY 1999.

Test Species:	SPP	SP
Bivalve larvae (<i>Mytilus edulis</i>)	X	
Amphipod (<i>Ampelisca abdita</i>)		X

SP = Solid Phase; SPP = Suspended Particulate Phase

Table 4. Bulk Sediment Chemistry Summary: San Francisco Army Corps of Engineers, Eureka Channel Extension 1999 Maintenance Dredging.

Analyte	COMPOSITE SAMPLES				INDIVIDUAL CORES			HOODS		Reporting Limits	
	EK-1	EK-2	EK-3		1-1	3-2	3-4	Reference	Target (PN 93-2)	Achieved#	
GRAIN SIZE (% dry)											
Sand/Gravel (>0.063 mm)	50.9	6.4	17.0	28	10.3	8.9	23.2	36.4	NA	--	
Silt (0.004 mm - 0.063 mm)	33.4	60.0	54.6	49	60.5	58.9	48.4	58.6	NA	--	
Clay (<0.004 mm)	15.6	33.6	28.4	20	29.2	32.1	28.4	5.0	NA	--	
SEDIMENT											
Total sulfides (mg/Kg, dry)	220	830	360	470	650	630	0.88	0.30	0.10	0.10	
Water soluble sulfides (mg/Kg)	0.29	ND	ND	1	0.94	ND	0.20	ND	0.10	0.10	
Total Volatile Solids (%)	3.0	4.8	4.7		6.6	5.0	4.2	2.4	0.10	0.10	
Oil and Grease*	220	380	230		350	340	270	ND	20	100	
TRPH** (mg/Kg, dry)	140	180	170	163	190	180	160	ND	20	100	
% Solids (%)	71	62	59	61	57	55	62	74	0.10	0.10	
TOC (%)	0.44	1.0	1.1	0.85	1.3	1.1	0.85	0.40	0.10	0.10	
METALS (mg/Kg, dry wt)											
Arsenic	5.6	9.2	9.4	8.1	10	8.2	9.7	7.9	0.10	0.10	
Cadmium	ND	0.19	0.26	0.15	0.23	0.22	0.16	ND	0.10	0.10	
Chromium	83	110	120	104	130	120	130	100	0.10	0.10	
Copper	26	41	46	38	44	41	45	25	0.10	0.10	
Lead	7.9	11	14	11	18	13	12	7.1	0.10	0.10	
Mercury	0.061	0.080	0.11	0.09	0.086	0.092	0.096	0.045	0.02	0.02	
Nickel	84	140	130	118	150	140	130	110	0.10	0.10	
Selenium	0.18	0.24	0.26	0.23	0.28	0.28	0.24	0.13	0.10	0.10	
Silver	0.12	0.21	0.18	0.17	0.17	0.19	0.19	ND	0.10	0.10	
Zinc	72	110	120		120	120	120	81	1.0	1.0	

(Continued...)

Table 4. Bulk Sediment Chemistry Summary: San Francisco Army Corps of Engineers, Eureka Channel Extension FY 1999 Maintenance Dredging.

Analyte	COMPOSITE SAMPLES			INDIVIDUAL CORES			HOODS Reference	Reporting Limits Target (PN 93-2) Achieved†
	EK-1	EK-2	EK-3	1-1	3-2	3-4		
ORGANOTINS (µg/Kg, dry weight)								
Monobutyltin	ND	ND	ND	ND	ND	ND	ND	1.0 1.0
Dibutyltin	ND	ND	ND	ND	ND	ND	ND	1.0 1.0
Tributyltin	ND	1.6	ND	ND	ND	ND	ND	1.0 1.0
Tetrabutyltin	ND	ND	ND	ND	ND	ND	ND	1.0 1.0
CHLORINATED PESTICIDES (µg/Kg, dry								
Aldrin	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
alpha-BHC	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
beta-BHC	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
delta-BHC	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
gamma-BHC (lindane)	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	2.0 2.3-2.8
Σ DDT	--	--	--	--	--	--	--	-- --
Dieldrin	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Endrin	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Endrin Aldehyde	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Endrin Ketone	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Heptachlor	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	2.0 1.3-1.8
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	1† 6.7-9.0
Toxaphene	ND	ND	ND	ND	ND	ND	ND	30† 20-27
PCBs (µg/Kg, dry weight)								
PCB 1242	ND	ND	ND	ND	ND	ND	ND	20 13-18
PCB 1248	ND	ND	ND	ND	ND	ND	ND	20 13-18
PCB 1254	ND	ND	ND	ND	ND	ND	ND	20 13-18
PCB 1260	ND	ND	ND	ND	ND	ND	ND	20 13-18
Σ PCBs	--	--	--	--	--	--	--	-- --

(Continued...)

Table 4. Bulk Sediment Chemistry Summary: San Francisco Army Corps of Engineers, Eureka Channel Extension FY 1999 Maintenance Dredging.

Analyte	COMPOSITE SAMPLES			INDIVIDUAL CORES			HOODS Reference	Reporting Limits Target PN93-2 Achieved ±
	EK- 1	EK-2	EK-3	1-1	3-2	3-4		
Dioxin (PCDD) and Furan (PCDF): Tetra- to Octa- Chlorinated* (pg/g)								
Total PCDD	144.1	373.4	10.5	176	--	--	43.4	-- See Report Apdx C-1
Total PCDF	20.9	73.8	1.00	319	--	--	5.37	--
TEQs	0.95	2.2	0.092	--	--	--	0.31	--
SEMI-VOLATILES (µg/Kg, dry wt)								
Naphthalene	ND	26	21	16	17	18	11	20 10-14
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	20 10-14
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	20 10-14
Fluorene	ND	36	21	28	15	21	ND	20 10-14
Phenanthrene	44	110	70	110	52	58	30	20 10-14
Anthracene	ND	13	ND	ND	ND	ND	ND	20 10-14
Fluoranthene	24	58	75	49	49	42	ND	20 10-24
Pyrene	27	58	79	51	47	50	ND	20 10-24
Benzo(a)anthracene	ND	18	22	21	ND	12	ND	20 10-24
Chrysene	14	32	41	44	23	27	ND	20 10-24
Benzo(b)fluoranthene	ND	24	34	25	18	24	ND	20 10-24
Benzo(k)fluoranthene	ND	ND	22	15	ND	ND	ND	20 10-24
Benzo(a)pyrene	ND	13	26	16	ND	13	ND	20 10-24
Indeno[1,2,3-CD]pyrene	ND	ND	ND	ND	ND	ND	ND	20 14-54
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	20 14-54
Benzo[ghi]perylene	ND	18	ND	ND	ND	ND	ND	20 14-54
Σ detectable LPAHs	44	75	110	140	84	97	41	--
Σ detectable HPAHs	65	220	300	220	140	170	ND	--
Σ detectable PAHs	110	300	410	380	220	270	41	--
Dimethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA NA
Diethylphthalate	NA	NA	NA	NA	NA	NA	NA	NA NA
Di-n-butylphthalate	NA	NA	NA	NA	NA	NA	NA	NA NA
Butyl benzyl phthalate	NA	NA	NA	NA	NA	NA	NA	NA NA
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA NA

Table 4. Bulk Sediment Chemistry Summary (Solid Phase Bioassay Interstitial Waters): San Francisco District, U.S. Army Corps of Engineers, Eureka Channel Extension FY 1999 Maintenance Dredging.

Analyte	COMPOSITE SAMPLES				HOODS		Reporting Limits	
	EK-1	EK-2	EK-3		Reference		Achieved	
SP BIOASSAY INTERSTITIAL WATER - <i>Ampelisca abdita</i>								
Salinity (‰):								
Initial	22.9	30.7	29.2		33.5		0.1	
Day 0	24.8	26.8	24.8		30.6		0.1	
Day 10	26.8	26.8	27.8		28.7		0.1	
pH:								
Initial	7.8	7.5	7.5		7.7		0.1	
Day 0	7.7	7.5	7.6		7.8		0.1	
Day 10	6.9	6.6	6.9		7.5		0.1	
Total NH ₃ (ppm):								
Initial	37.3	29.2	19.4		1.51		0.1	
Day 0	19.1	13.0	11.4		1.83		0.1	
Day 10	2.9	1.6	2.6		0.87		0.1	
Dissolved Sulfides (mg/Kg):								
Initial	ND	ND	ND		ND		0.1	
Day 0	ND	ND	ND		ND		0.1	
Day 10	ND	ND	ND		ND		0.1	
SPP ELUTRIATE WATER (100%)								
Total NH ₃ (ppm):								
Initial	10.1	8.1	5.6		--		0.1	
Final	--	--	--		--		0.1	

-- Data Not Available
‡ Bulk sediment chemistry analyses are calibrated to default of 50% moisture in sediments. If moisture content exceeds 50%, Achieved Reporting Limits increase accordingly.
* Reporting Limits were raised on one or more samples because matrix interference required that those samples be diluted. Please see laboratory reports (Appendix C) for sample-specific details.
** Hexane-extractable.
*** Silica gel extractable from Oil and Grease extractant.
† Toxaphene achievable Reporting Limit.

Table 5. EC/LC₅₀ values for SPP bioassays, San Francisco District, United States Army Corps of Engineers, Eureka Channel Extension FY 1999 Maintenance Dredging. Values are percent elutriate.

Sample I. D.	EC ₅₀	SPP - <i>Mytilus</i>	
		Exceeds LPC?	LC ₅₀
COMP EK-1	55.3	No	52.4
COMP EK-2	67.8	No	64.0
COMP EK-3	>100	No	>100

Table 6. Amphipod (*A. abdita*) solid phase static bioassays, San Francisco District, United States Army Corps of Engineers, Eureka Channel Extension FY 1999 Maintenance Dredging.

Ampelisca abdita
Solid Phase Static Bioassay Results

Rep #	Home	NUMBER OF SURVIVORS (Start n = 20)				HOODS REF
		COMP EK-1	COMP EK-2	COMP EK-3		
1	20	18	20	19		19
2	19	20	19	20		20
3	20	20	19	20		19
4	20	20	20	20		19
5	19	20	18	19		20
Mean	19.6	19.6	19.2	19.6		19.4
SD	0.55	0.89	0.84	0.55		0.55
Mean % Survival	98	98	96	98		97
Mean % Reburial	NA	NA	NA	NA		NA

FIGURES

INTENTIONAL BLANK PAGE

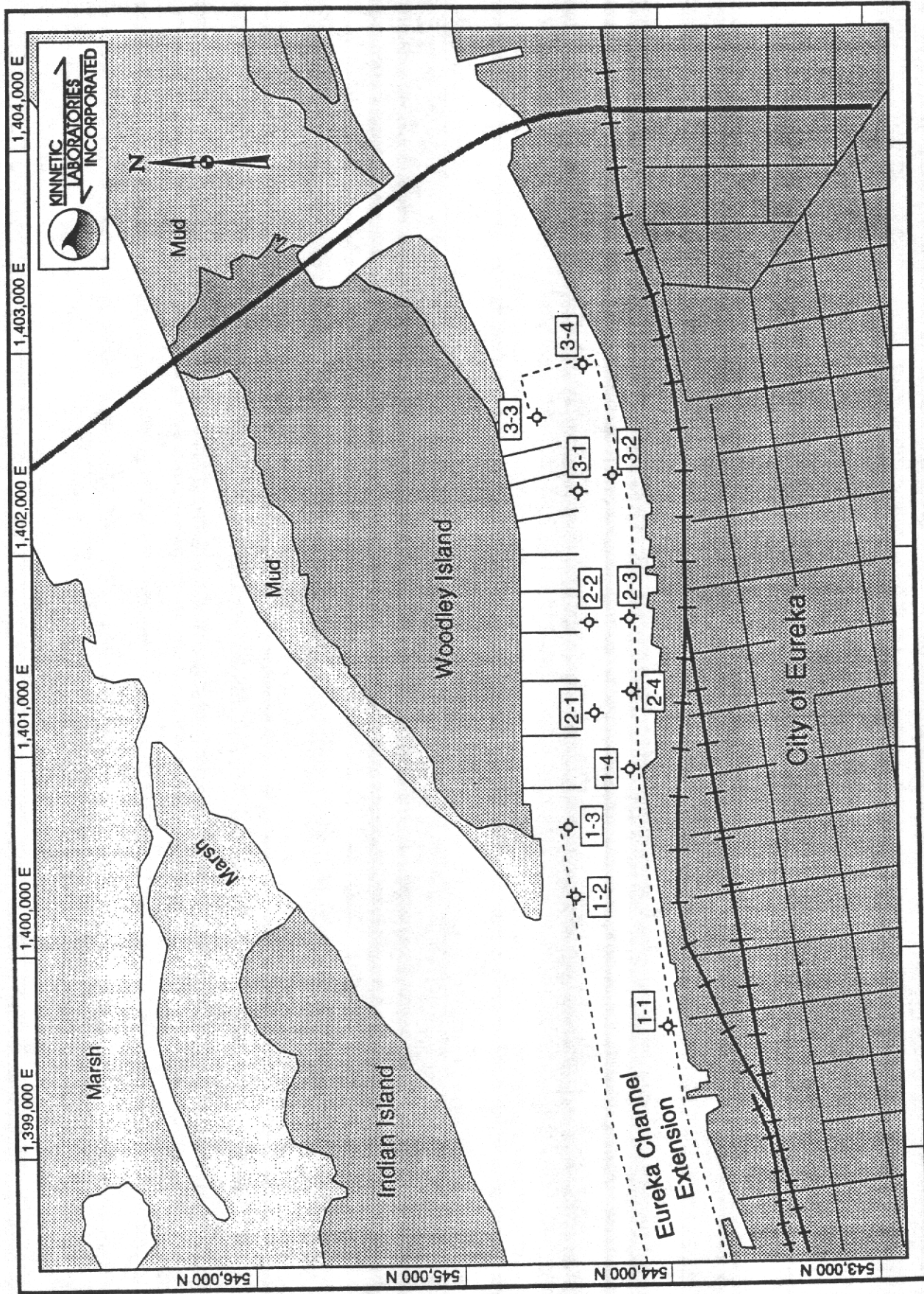


Figure 1. Sediment sampling locations for Eureka Channel Extension, Humboldt Bay, 1999 maintenance dredging.

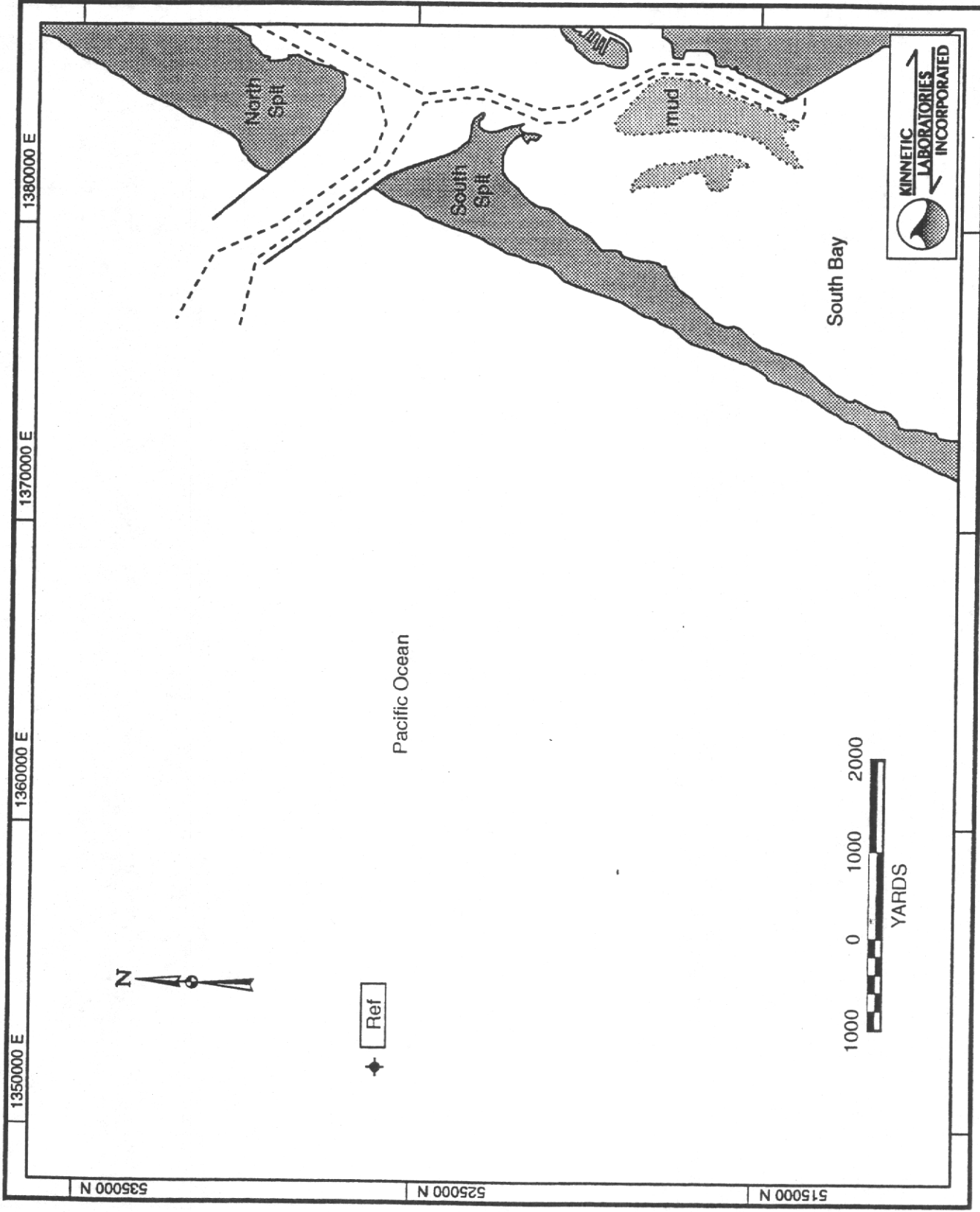
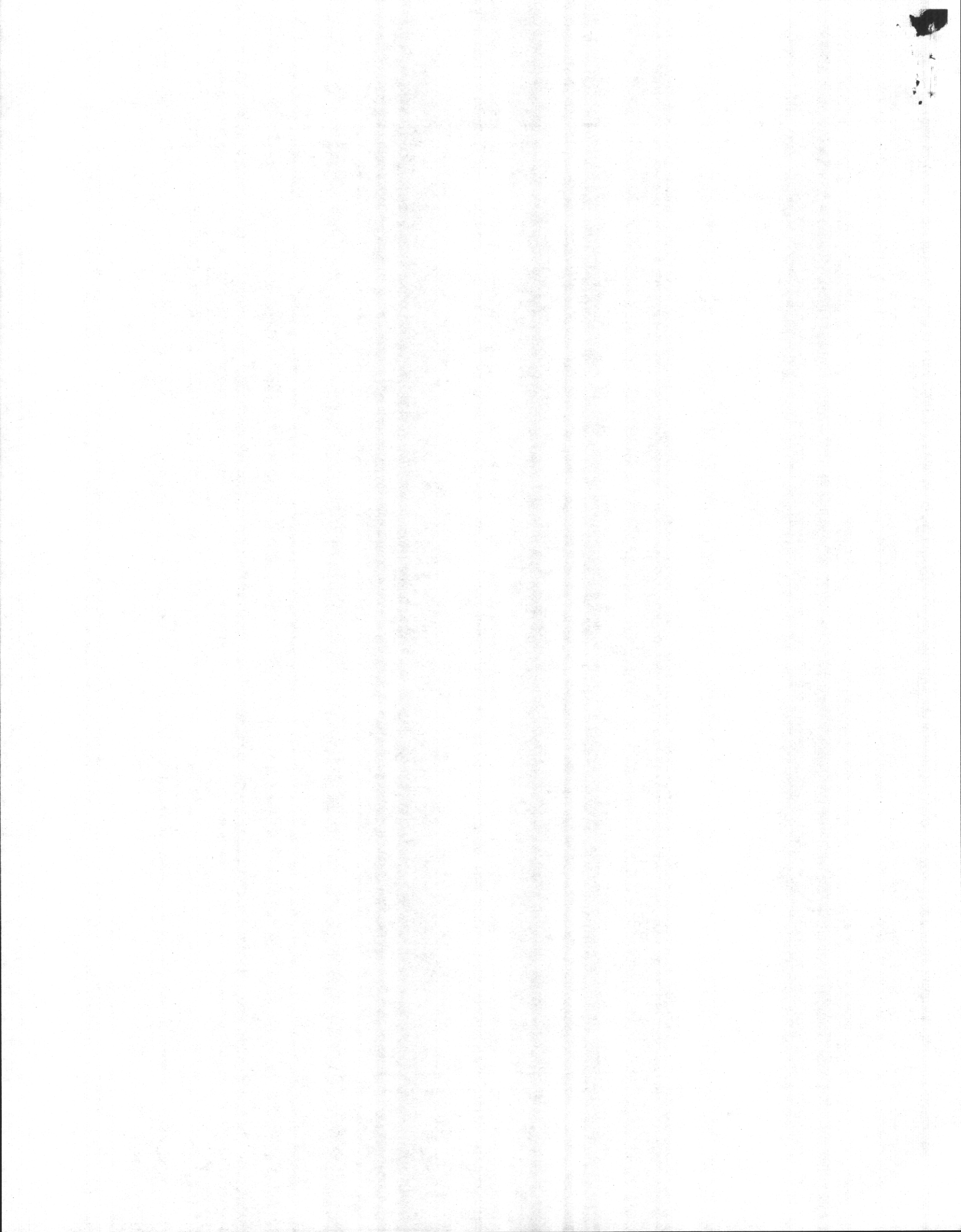


Figure 2. Reference station location for Eureka Channel Extension, Humboldt Bay, 1999 maintenance dredging.



United States Army Corps of Engineers
Humboldt Harbor Bar and Entrance Channel
FY 2000 O&M Maintenance Dredging

SAMPLING AND ANALYSIS RESULTS

Prepared for

U.S. Army Corps of Engineers
San Francisco District
333 Market Street
San Francisco, CA 94105

Prepared by

EVS Environment Consultants, Inc.
2363 Mariner Square Drive, Suite 241
Alameda, CA 94501

EVS Project No.

2/277-04.11

MAY 2000

2.0

FIELD SAMPLE COLLECTION

All field activities were performed on April 17, 2000, under the direction of Ms. Chris Boudreau of EVS Environment Consultants (EVS), Alameda, California. Mr. Phil Glenn provided the sampling vessel, the *R/V Celtic*. A Trimble differential global positioning system (DGPS) receiver and a van Veen grab sampler were provided by EVS.

2.1 SEDIMENT COLLECTION

All samples were collected in accordance with guidelines and procedures outlined in the SAP/QAPP (USACE 2000). Surface sediment samples were collected with a 0.1-m² stainless steel van Veen grab at seven sampling locations: one representing sediment in the Bar Channel, six representing sediment in the Entrance Channel, of which a portion was formerly known as the North Bay Middle Ground (Figure 1-1), and two from in the Dog Leg area of Humboldt Bay (Figure 2-1).

Figure 2-1 presents the locations where grab samples were collected. Positions were determined with the DGPS and are accurate to ± 3 m. Table 2-1 lists station identifiers, coordinates for all grab locations, and the depth for all stations. Recent bathymetric charts with the proposed station locations are included in Appendix A.

Table 2-1. Surface sediment sampling locations and water depth

SAMPLE ID	NORTHING (m)	EASTING (m)	LATITUDE (° N)	LONGITUDE (° W)	WATER DEPTH (ft MLLW)
BAR1	4513507.6	394720.8	40.76595	124.24621	43.6
ENT1	4513434.3	395203.5	40.76536	124.24048	44.1
ENT2	4513255.4	395334.9	40.76376	124.23890	43.2
ENT3	4513044.4	395549.6	40.76189	124.23632	40.1
ENT4	4512755.1	395789.0	40.75931	124.23344	40.7
ENT6	4512273.2	396807.8	40.75510	124.22129	41.4
ENT7	4512161.4	396658.7	40.75407	124.22304	38.9

NOTE: Projection information:
Geographic - Longitude/Latitude NAD83, decimal degrees
Northing/easting are UTM-Zone 10 NAD83, meters

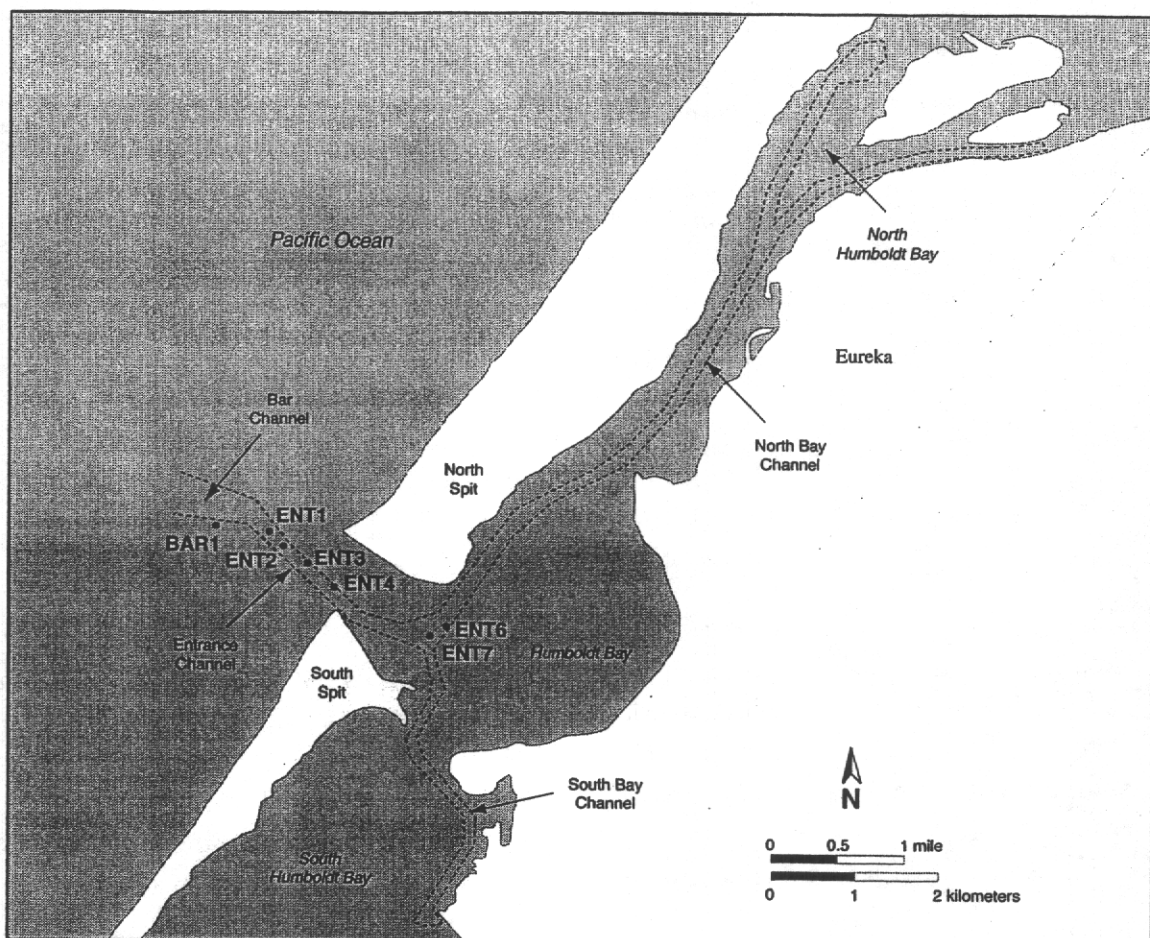


Figure 2-1. Surface sediment sample locations

2.2 DEVIATIONS FROM THE SAP/QAPP

Deviations from the SAP are listed below:

- Coordinates for each station were not provided in the SAP/QAPP. EVS attempted to collect samples in the area designated on the bathymetric charts provided in Appendix A. However, discrepancies between the estimated depths provided in Table 4 of the SAP/QAPP and the actual depths at sampled locations were observed at stations ENT5, ENT6, and ENT7. To address these differences in depth, EVS staff had the captain of the Celtic move outward from the area of the proposed station in concentric circles to find an appropriate depth to sample. If it was determined that the sampling location was too deep or was positioned over the slope of the channel, a more adequate sampling location was investigated. Stations were then relocated to sample at appropriate depths in the same approximate areas.

4.0

LABORATORY RESULTS

Grain size was analyzed according to procedures defined by the American Society for Testing and Materials (ASTM 1992) as specified in the SAP/QAPP (USACE 2000). The results are presented below (Table 4-1) as percent weight within these general size classes:

Gravel	2,000- μ m diameter and larger
Sand	<2,000- μ m and >62.5- μ m diameter
Silt	\leq 62.5- μ m diameter and >3.9- μ m diameter
Clay	\leq 3.9- μ m diameter

Results for these samples were reviewed, and the data quality assessment found that all data were usable for the purposes of this evaluation. Original data from the laboratory are provided in Appendix B. An evaluation of the data, using best professional judgment and comparing data with historical grain size data, showed that the grain size of surface sediments collected is similar to grain size distributions determined from past sampling events. These results would indicate that these sediments meet the requirements under 40 CFR Part 227.13(b)(1) and are acceptable for ocean disposal with no further testing.

Table 4-1. Grain size of surface sediments

STATION ID	GRAIN SIZE (%) ^a			
	GRAVEL	SAND	CLAY	SILT
BAR1	0.06	98.37	0.99	0.12
ENT1	0.13	98.5	0.89	0.07
ENT2	0	98.52	0.96	0.2
ENT3	0.13	99.2	0.79	0.05
ENT4	0.1	100.64	0.61	0.29
ENT6	0.97	98.32	0.76	0.04
ENT7	7.93	94.3	0.6	0.2

- ^a Sediments are wet-sieved and then dried and weighed individually, so the total weight of the combined size fractions may be slightly greater or less than 100%; there is a $\pm 10\%$ criterion for acceptable recovery on grain size determinations.

United States Army Corps of Engineers
Humboldt Harbor Interior Channels
FY 2001 O&M Maintenance Dredging

SAMPLING AND ANALYSIS RESULTS

Prepared for

U.S. Army Corps of Engineers
San Francisco District
333 Market Street
San Francisco, CA 94105

Prepared by

EVS Environment Consultants, Inc.
2363 Mariner Square Drive, Suite 241
Alameda, CA 94501

EVS Project No.

2/277-04.3

MARCH 2001

2.0

FIELD SAMPLE COLLECTION

All field activities were performed during the period January 7–17, 2001, under the direction of Ms. Chris Boudreau of EVS Environment Consultants (EVS), Alameda, California. Mr. Phil Glenn provided the sampling vessel, the *R/V Celtic*. A Trimble differential global positioning system (DGPS) receiver, vibracorer, and a van Veen grab sampler were provided by EVS. One weather day was utilized on January 9 during the sampling period. Details of the weather conditions are provided in Appendix A.

2.1 SEDIMENT COLLECTION

Surface sediment grab samples and sediment cores were collected. All samples were collected in accordance with guidelines and procedures outlined in the SAP/QAPP (USACE 2001). Appendix B contains field collection forms. Surface sediment samples were collected with a 0.1-m² stainless steel van Veen grab at eight sampling locations within the North Bay Channel. Sediment cores were collected at 41 locations within the Eureka, Samoa, and Fields Landing Channels using an electric vibracorer. The vibracorer used 1/8-in. thick by 4-in. diameter lengths of rigid polycarbonate core tube. Core tubes were cut to the appropriate length for each sampling station and decontaminated following standard protocols. Sediment coring was continued at each location until reaching project depth plus 2 ft overdepth or encountering refusal. Refusal was determined when the vibracorer stopped penetrating into the sediment and did not penetrate farther after approximately 1 minute of continuous vibration. Consideration of the vibracorer duty cycle and the influence of wind and tides in forcing the sampling vessel off station against one anchor rope or the other led to selecting 1 minute as the standard interval for determining refusal. After collection, the core tube was discarded.

A three-point anchor spread was used to position the sampling vessel at each location. Positions were determined with the DGPS and are accurate to ± 3 m. The vibracorer and van Veen grab were deployed and retrieved by two field technicians while the vessel operator controlled the winch. Figure 2-1 shows the overall sampling region, and Figures 2-2 and 2-3 present the locations where sediment cores and grab samples were collected. Table 2-1 summarizes the station parameters for all sediment sampling locations.

According to the record of actual sampling locations, the following stations in North Humboldt Bay (see Figure 2-2) lie outside the channel boundaries: EK35-3 (25 ft outside); EK26-2-1 (20 ft); EK20-1-1 (25 ft); and SAM2-4 (12 ft). All are in close

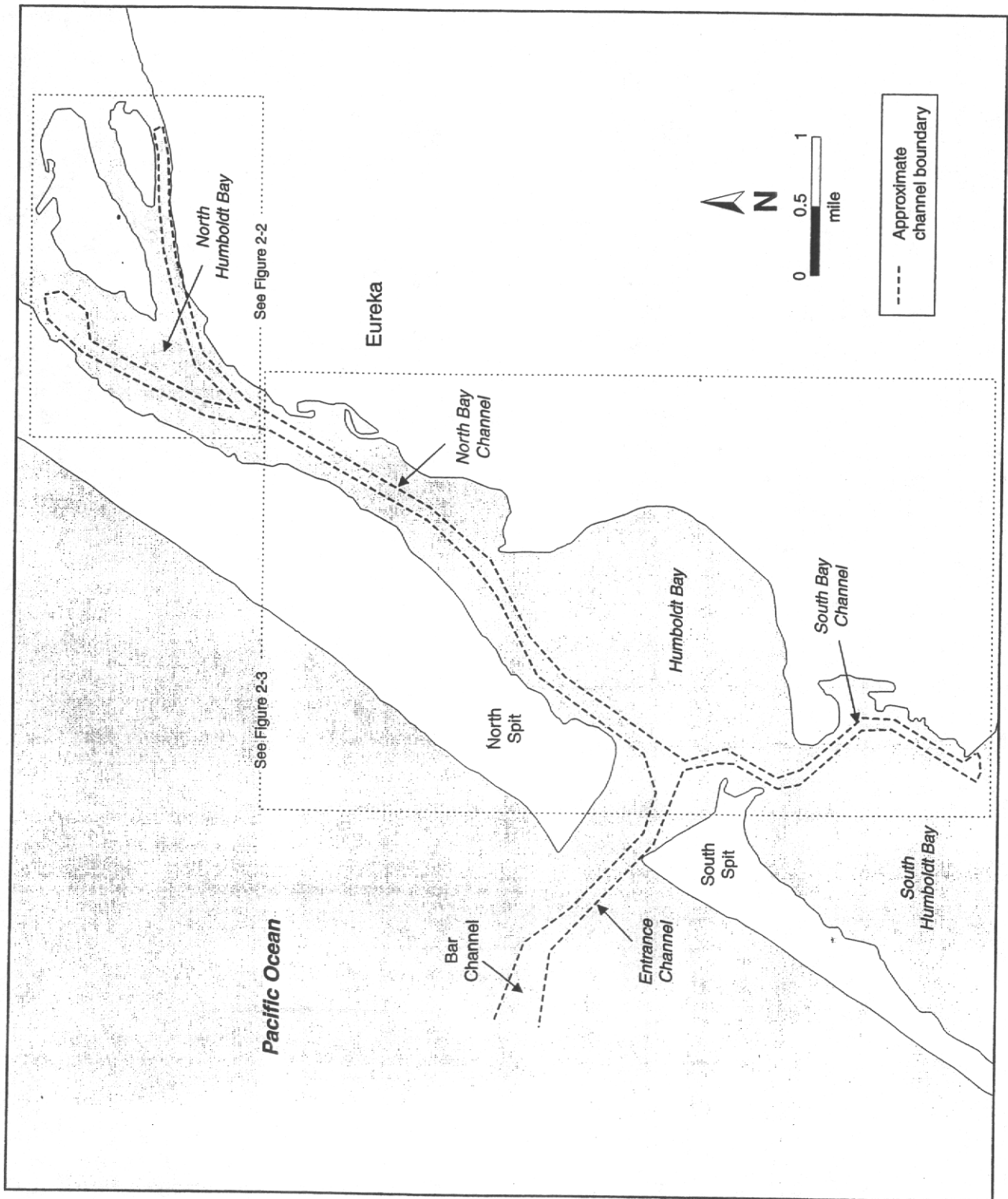


Figure 2-1. Location map for Humboldt Bay and vicinity

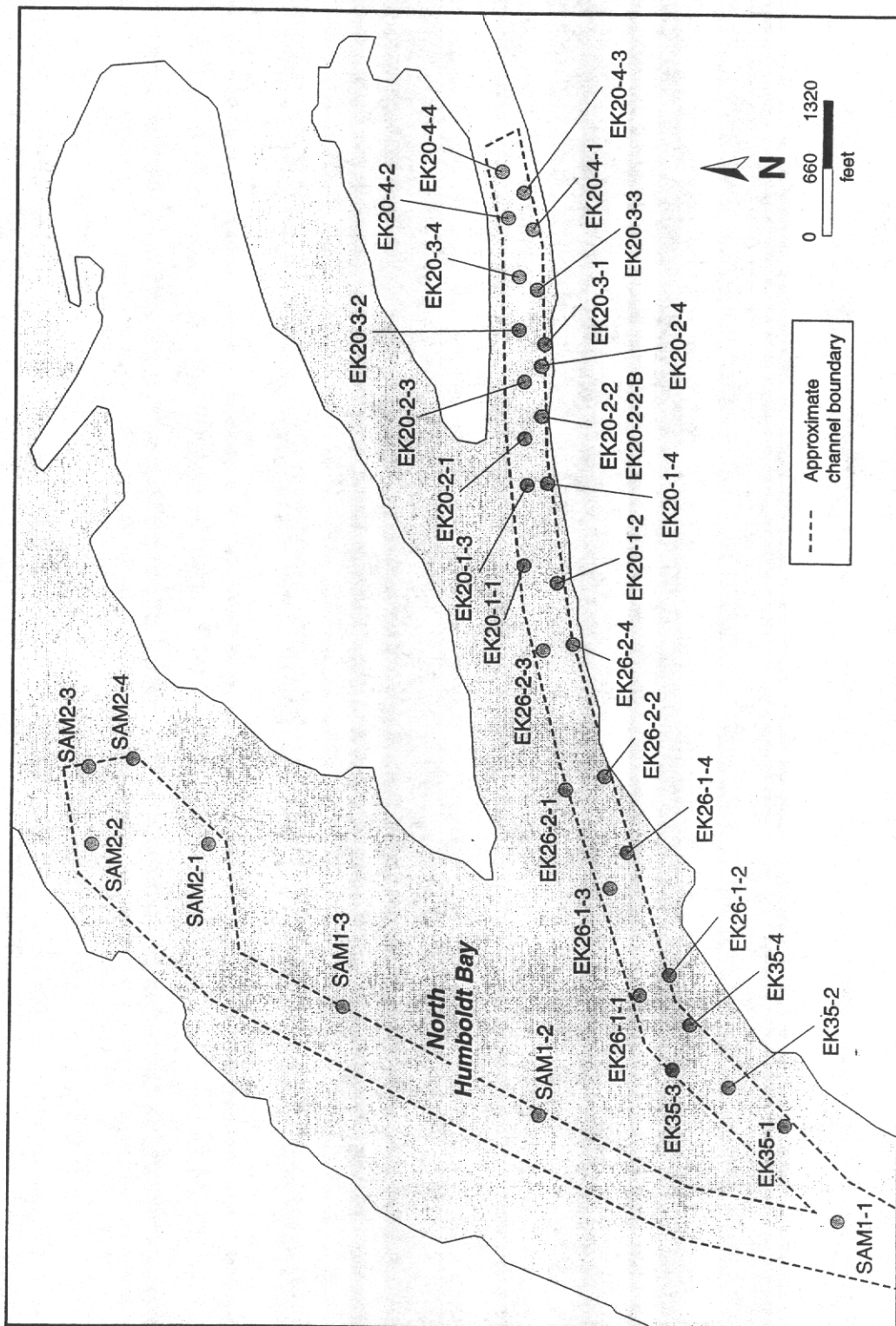


Figure 2-2. Station locations in North Humboldt Bay

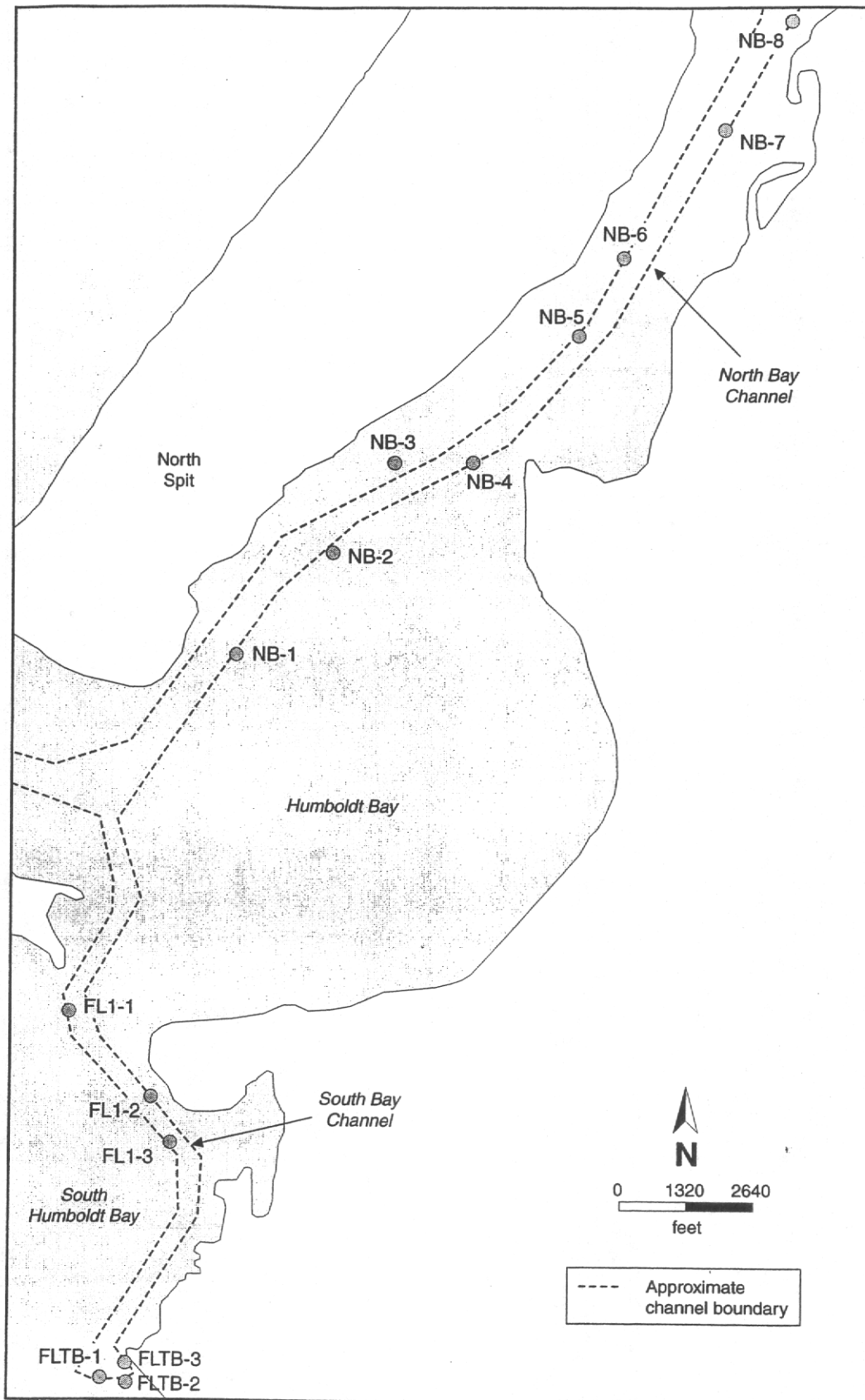


Figure 2-3. Station locations in North and South Humboldt Bay Channels

Table 2-1. Summary table of station parameters
for Humboldt Harbor sediment sample locations

STATION ID	LONGITUDE (°N)	LATITUDE (°W)	MUDLINE ELEVATION (ft MLLW)	CORE LENGTH (ft)	CORE DEPTH ACHIEVED (ft MLLW)	PROJECT		ACHIEVED?	REFUSAL?	SEDIMENT TYPE/COLOR
						DEPTH + 1 FT OVERDEPTH (ft MLLW)	DEPTH			
EK20-1-1	124.169503	40.806877	-17.4	6.5	-23.9	-21	Y	N		Clay/gray-black
EK20-1-2	124.170020	40.806054	-18.6	6	-24.6	-21	Y	N		Silt clay/gray
EK20-1-3	124.167400	40.806618	-15.1	5.8	-20.9	-21	N	Y		Clay/gray-black
EK20-1-4	124.167296	40.806325	-14.9	3.4	-18.3	-21	N	Y		Clay/gray
EK20-2-1	124.166102	40.806862	-16.2	3.6	-19.8	-21	N	Y		Clay/gray-black
EK20-2-2A	124.165539	40.806403	-13	5.4	-18.4	-21	N	Y		Clay/gray-black
EK20-2-2B	124.165560	40.806408	-17.7	4.9	-22.6	-21	Y	N		Silt clay/gray-black
EK20-2-3	124.164683	40.806750	-17.2	3.9	-21.1	-21	Y	N		Silt clay/gray-black
EK20-2-4	124.164161	40.806463	-16	4.6	-20.6	-21	N	Y		Silt clay/gray-black
EK20-3-1	124.163594	40.806366	-15.1	4.6	-19.7	-21	N	Y		Clay/gray
EK20-3-2	124.163252	40.806874	-14.5	4	-18.5	-21	N	Y		Silt clay/gray
EK20-3-3	124.162118	40.806541	-16.1	5.2	-21.3	-21	Y	N		Silt clay/gray-black
EK20-3-4	124.161802	40.806941	-15.7	5.4	-21.1	-21	Y	N		Silt clay/gray-black
EK20-4-1	124.160436	40.806712	-14.5	6.7	-21.2	-21	Y	N		Silt clay/gray-black
EK20-4-2	124.160165	40.807271	-10.9	6	-16.9	-21	N	Y		Silt clay/gray-black
EK20-4-3	124.159464	40.806921	-15.6	2.7	-18.3	-21	N	Y		Silt clay/gray-black
EK20-4-4	124.158927	40.807450	-11.9	3.9	-15.8	-21	N	Y		Silt clay/gray-black
EK26-1-1	124.181198	40.803984	-25.7	1.5	-27.2	-27	Y	N		Fine sand/gray
EK26-1-2	124.180674	40.803205	-23.7	4	-27.7	-27	Y	N		Clay/gray
EK26-1-3	124.178200	40.804713	-25.3	4.2	-29.5	-27	Y	N		Sand/clay/gray
EK26-1-4	124.177312	40.804222	-21.5	6	-27.5	-27	Y	N		Silt clay/gray
EK26-2-1	124.175698	40.805792	-23	1.2	-24.2	-27	N	N		Sand/gray
EK26-2-2	124.175234	40.804776	-25.5	3.9	-29.4	-27	Y	N		Silt clay/gray-black
EK26-2-3	124.171873	40.806394	-25.2	2.2	-27.4	-27	Y	N		C-m sand/gray
EK26-2-4	124.171638	40.805630	-20.7	6.3	-27	-27	Y	N		Clay/gray-black
EK35-1	124.184525	40.800330	-34.4	3	-37.4	-36	Y	N		Sand clay/gray-black
EK35-2	124.183637	40.801734	-34.5	1.4	-35.9	-36	N	Y		C-m-f sand/gray
EK35-3	124.183264	40.803250	-34	1	-35	-36	N	Y		C-m-f sand/gray-black
EK35-4	124.181960	40.802712	-31	5	-36	-36	Y	N		Silt clay/gray-black

Table 2-1, continued

STATION ID	LONGITUDE (°N)	LATITUDE (°W)	MUDLINE ELEVATION (ft MLLW)	CORE LENGTH (ft)	CORE DEPTH ACHIEVED (ft MLLW)	PROJECT		DEPTH ACHIEVED?	REFUSAL?	SEDIMENT TYPE/COLOR
						DEPTH + 1 FT OVERDEPTH (ft MLLW)	DEPTH			
FL1-1	124.226470	40.742012	-26	1	-27	-26	Y	N		Sand clay/gray-black
FL1-2	124.222065	40.737373	-26.1	2	-28.1	-26	Y	N		Sand clay/gray
FL1-3	124.221011	40.734837	-24.4	1.6	-26	-26	Y	N		C-m-f sand/gray
FLTB1	124.224558	40.722051	-23.2	5.6	-28.8	-26	Y	N		Silt clay/gray
FLTB2	124.223215	40.721741	-20.6	8.5	-29.1	-26	Y	N		Silt clay/gray
FLTB3	124.223206	40.722840	-20.1	8	-28.1	-26	Y	N		Silt clay/gray
SAM1-1	124.188090	40.798440	-38.4	0.9	-39.3	-39	Y	N		C-m-f sand/gray-black
SAM1-2A	124.184407	40.806495	-35	1.2	-36.2	-39	N	Y		M-f sand/gray-black
SAM1-2B	124.184407	40.806495	-37	1.1	-38.1	-39	N	Y		M-f sand/gray-black
SAM1-3	124.181844	40.811678	-37.8	1.2	-39	-39	Y	N		M-f sand/gray-black
SAM2-1	124.177569	40.815217	-36.8	1.5	-38.3	-39	N	Y		M-f sand/gray-black
SAM2-2	124.177755	40.818327	-37.2	1.9	-39.1	-39	Y	N		M-f sand/gray-black
SAM2-3	124.175631	40.818332	-37.3	1	-38.3	-39	N	Y		C-m sand/gray-black
SAM2-4	124.175297	40.817163	-34.2	2.9	-37.1	-39	N	Y		M-f sand/gray-black
NB-1	124.216944	40.761944	-31.8	NA	NA	NA	NA	NA		Not entered on log sheets, but all NB surface grab samples were typically C-m sand/gray-black
NB-2	124.212111	40.767194	-31.5	NA	NA	NA	NA	NA		
NB-3	124.209167	40.771667	-31.7	NA	NA	NA	NA	NA		
NB-4	124.204722	40.771944	-34.7	NA	NA	NA	NA	NA		
NB-5	124.199444	40.778333	-37.7	NA	NA	NA	NA	NA		
NB-6	124.197222	40.782194	-36.2	NA	NA	NA	NA	NA		
NB-7	124.192194	40.788611	-38.4	NA	NA	NA	NA	NA		
NB-8	124.189056	40.794000	-37.4	NA	NA	NA	NA	NA		

NOTE: Longitude/Latitude NAD83, decimal degrees

Sands: C = coarse; M = medium; F = fine

NA - Not applicable; NB-1 through NB-8 are surface grab samples

5.0

LABORATORY RESULTS

Table 5-1 provides a summary of the chemical and conventional analyses for the test samples. Summary data packages from the chemical laboratories, including QA/QC narratives, are provided in Appendix D.

5.1 COMPARISON TO HISTORICAL CONCENTRATIONS

The range of sediment concentrations measured in the Humboldt Harbor Interior Channel is compared to the historical range of baseline concentrations measured in evaluations of Humboldt Harbor that were undertaken in 1993, 1994, 1996, and 1999. The range of concentrations reported from the historical data was compared to the range of concentrations reported in the current study (Table 5-2). In general, the chemical concentrations measured in the current study were within the historical baseline range. Two samples, EK20-2 and EK20-3, contained concentrations of total PAHs, lead, and total sulfide that were slightly higher than the highest baseline concentrations. In addition, three samples contained total sulfide concentrations that exceeded the highest baseline concentrations of total sulfide (EK20-1, EK20-4, and FLTB).

Table 5-1. Summary of chemical and conventional analyses

REPORTING		STATION										
ANALYTE	LIMITS	EK 20-1	EK 20-2	EK-20-3	EK-20-4	EK-26-1	EK-26-2	EK35	FL 1-1	FLTB	SAM1	SAM2
Pesticides (µg/kg)												
Aldrin	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	0.89-1	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND
gamma-Chlordane	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total DDT	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	1.8-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	0.89-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	89-100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs (µg/kg)												
Aroclor 1242	18-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	18-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	18-20	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	18-20	NR	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total PCBs	18-20	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PAHs (µg/kg)												
Benzo(a)anthracene	7.9-8.5	26	52	38	23	27	16	9.7	ND	15	ND	5.4 J
Benzo(a)pyrene	7.9-11	17	65	36	17	11	8.7 J	ND	3.4 J	ND	ND	2.7 J
Benzo(g,h,i)perylene	7.9	29	91	49	31	16	16	11	19	20	ND	5.4 J
Benzo(b)fluoranthene	7.9	41	81	52	31	27	22	14	11	35	ND	8.2 J
Benzo(k)fluoranthene	7.9-11	20	54	29	23	10	ND	ND	3.4 J	ND	ND	ND

Table 5-1, continued

REPORTING			STATION										
ANALYTE	LIMITS	EK 20-1	EK 20-2	EK 20-3	EK 20-4	EK 26-1	EK 26-2	EK35	FL 1-1	FLTB	SAM1	SAM2	
PAHs, continued													
Chrysene	7.9	52 M	74	67 M	42	39 M	30 M	15	17 M	41 M	ND	10 M	
Dibenz(a,h)anthracene	7.9-22	ND	22 Y	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Fluoranthene	6.7	110	110	120	74	62 B	53 B	35	42	41 B	8	14 B	
Indeno(1,2,3-cd)pyrene	7.9-8.8	14	57	24	15	6.0 J	6.8 J	ND	3.4 J	8.6 J	ND	1.8 J	
Pyrene	6.7	110	120	130	86	72	55	36	150	55	7.2 J	17	
Total HPAH	NA	420	700	570	340	270	210	120	250	220	15	65	
Acenaphthene	7.9-9.7	17	18	18	13	12	ND	ND	ND	12	ND	6.4 J	
Acenaphthylene	7.9-8.8	9.8 J	15	11	9.7 J	8.1 J	5.8 J	ND	21	11 J	ND	5.4 J	
Anthracene	7.9-11	14	16	14	13	10	8.7 J	ND	4.2 J	ND	ND	ND	
Dibenzofuran	7.9-8.8	23	23	22	18	15	13	ND	ND	22	ND	5.4 J	
Fluorene	7.95	38	38	37	31	30	21	17	15	45	ND	12	
2-Methylnaphthalene	6.7	75	78	72	70	72	50	34	42	110	15	72	
Naphthalene	6.7	63	69	56	59	49	39	31	39	73	10	30	
Phenanthrene	6.7	120	130	120	100	98	68	65	64	130	22	33	
Total LPAH	NA	360	390	350	310	290	210	150	190	400	55	160	
Total PAHs	NA	780	1100	920	660	560	410	270	430	620	70	230	
Metals (mg/kg)													
Arsenic	0.5-1.0	6.1	6.8	7.4	6.2	6.1	5.1	6.3	4.4	6.6	5	4.3	
Cadmium	0.13-0.14	0.17	0.18	ND	ND	0.15	0.11	0.1	0.06	0.17	0.06	0.07	
Chromium	0.2-0.4	70.1	70.3	83.5	82.9	67.3	55.2	76.9	53	72	52.2	45.8	
Copper	0.1-0.2	28	32.7	31.9	29.1	28	19.3	19.9	14	32.9	11.5	11.3	
Lead	0.05-0.10	11.2	11.6	12.9	10.9	9.07	7.06	7.69	4.69	9.25	4.55	4.48	
Mercury	0.10-0.20	0.07	0.07	0.09	0.08	0.06	0.08	0.02	0.03	0.08	0.02	0.03	
Nickel	0.20-0.40	85.4 N	92.1 N	94	90.8	86.3 N	65.4 N	86.4	60.6 N	92.8 N	56.1	54.6 N	
Selenium	0.93-2.74	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Silver	0.02-0.04	0.138	0.126	0.18	0.13	0.118	0.129	0.05	0.093	0.151	0.04	0.068	
Zinc	0.5-1.0	67	76.2	79.1	74.7	65.8	49.8	60.8	41.6	71.1	38.3	37.2	
Butylins (µg/kg dw)													
n-Butyltin	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Di-n-butyltin	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Tri-n-butyltin	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Tetra-n-butyltin	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Table 5-1, continued

ANALYTE	REPORTING		STATION										
	LIMITS		EK 20-1	EK 20-2	EK-20-3	EK-20-4	EK-26-1	EK-26-2	EK35	FL 1-1	FLTB	SAM1	SAM2
Total/Dissolved Sulfides (mg/kg)													
Soluble sulfide	0.44-1.8		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sulfide	3-89		780	960	800	740	390	300	340	110	750	21	35
Conventionals (%)													
Total organic carbon	0.05		1.26	1.32	1.24	1.16	1.01	0.87	0.35	0.38	1.08	0.39	0.26
Total solids	0.01		63.6	59.6	61	63	67.7	71.4	79.6	78.6	63.7	79.5	79.1
Gravel	NA		0	0	0	0	1.27	0.4	NR	0	0	0.93	0.11
Sand	NA		23.6	11.9	14.1	27	37.4	52.5	71.7	73.8	10.2	82.3	87.1
Silt	NA		50.8	56	53.9	48.7	41.2	30.6	15.3	17.6	61.2	7.45	8.28
Clay	ND		23.1	28.4	29.7	25.9	19.8	14.1	9.91	7.51	27.8	6.37	4.92

Grain Size (%)	REPORTING		STATION							
	LIMITS		NB-1	NB-2	NB-3	NB-4	NB-5	NB-6	NB-7	NB-8
Total solids	0.1		80.0	83.3	81.3	80.4	79.1	84.5	84.0	82.9
Gravel	0.1		0.33	17.85	4.02	0.35	0.18	6.12	6.81	2.26
Sand	0.1		98.75	80.76	95.27	98.75	98.63	90.74	91.32	98.85
Clay	0.1		0.64	0.52	0.58	0.52	0.19	0.47	0.45	0.29
Silt	0.1		0.01	0.33	0.14	0.12	0.44	0.16	0.22	0.02

NOTE:

dw - dry weight
NR - not reported
NA - not applicable

QUALIFIERS:

B - Indicates possible/probable blank contamination. Flagged when the analyte is detected in the blank as well as the sample
J - Estimated concentration when the value is less than the calculated reporting limit
M - Estimated value
N - Matrix spike sample recovery was not within control limits
ND - not detected
Y - Raised reporting limit due to background interference or to activity on the instrument. compound is still not detected at or above the raised level

Totals are given as a sum of contributing compounds. If no concentration is detected, the highest undetected concentration is reported.

**Table 5-2. Comparison of historical concentrations
and results of current study**

ANALYTE	HISTORICAL BASELINE (1993-1999)		CURRENT (2001) STUDY	
	RANGE	MEDIAN	RANGE	MEDIAN
Metals (mg/kg):				
Arsenic	3.7-8.1	5.3	4.3-7.4	6.1
Cadmium	ND-0.2	0.15	ND-0.18	0.1
Chromium	97-160	120	45.8-83.5	70.1
Copper	11-38	20	11.3-32.9	28
Lead	4.4-11	7.7	4.48-12.9	9.1
Mercury	0.02-0.13	0.07	0.02-0.09	0.07
Nickel	60-130	86	54.6-92.8	86.3
Selenium	ND-0.23	0.13	ND	ND
Silver	ND-1.6	ND	0.04-0.18	0.126
Zinc	41-101	56	37.2-79.1	65.8
Total sulfides (mg/kg)	11-470	110	21-960	390
Water-soluble sulfides (mg/kg)	ND-0.3	ND	ND	ND
Organotins (µg/kg)	ND-12	1	ND	ND
Pesticides (µg/kg)	ND	ND	ND	ND
PCBs (µg/kg))	ND	ND	ND	ND
Total PAH (µg/kg)	ND-890	160	70-1,100	580

5.2 QA/QC RESULTS

The results of the QA/QC reviews conducted by each laboratory are presented in Appendix D in the case narratives contained in the laboratory reports. The QA/QC results for each analyte group are summarized below. All data were determined to be acceptable for use as qualified in the data reports.

Pesticides and PCBs

No QA/QC issues raised.

Polycyclic Aromatic Hydrocarbons

No QA/QC issues raised.

Metals

The matrix spike recovery of nickel for sample EK 20-1, Batch QC, was outside the control limits because of suspected matrix interference. The associated laboratory control sample indicated that the analysis was in control. No further corrective action was taken.

Butyltins

The control criteria were exceeded for the surrogate tri-n-propyltin in the laboratory control sample K210122-LCS. All other QA/QC parameters associated with the analysis of these samples were within control limits so no further corrective action was taken.

The spike recovery of tetra-n-butyltin for laboratory control sample L210122-LCS was outside the lower control criterion. The analyte was not detected in the associated field samples. The reduced recovery appeared to be isolated to the laboratory control sample because all sample surrogate and matrix spike recoveries were within acceptance limits.

Total/Dissolved Sulfides

The percent recoveries for the matrix spike samples associated with the soluble sulfide analyses were lower than criteria. Since the percent recoveries for the corresponding laboratory control samples were acceptable, it was concluded that the sample matrices were responsible for the low matrix spike recoveries.

Conventionals

No QA/QC issues raised.

5.3 SUMMARY

No detected concentrations were reported for pesticides, PCBs, or butyltins. Reported concentrations of PAHs, metals, sulfides, and conventionals were compared to regional background sediment concentrations. The results suggest that none of the sediment analytes were measured at concentrations that would suggest significant environmental effects. The results indicate that these sediments are acceptable for ocean disposal.