APPENDIX A

Sampling Station Locations

Station Coordinates and Distance Measurements for Oakland Bay

Station ID	Grab (Longitude)	Grab (Latitude)	Core (Longitude)	Core (Latitude)	Distance Between Locations (feet)
HI-1	NA	NA	-123.06186478100	47.20341579850	NA
HI-2	-123.06265470800	47.20581639150	-123.06264309700	47.20580846400	4
HI-3	-123.07259705300	47.20655272470	-123.07261674400	47.20655199380	5
HI-4	-123.06715469400	47.20853458370	-123.06716775800	47.20852586990	5
HI-5	-123.07373601000	47.20906665470	NA	NA	NA
HI-6	-123.07100659800	47.21237601390	-123.07100083800	47.21238658340	4
HI-7	-123.07699091900	47.21443693790	-123.07700348500	47.21442568520	5
OB-01	-123.07887272400	47.21887562460	-123.07887912500	47.21887732460	2
OB-02	-123.07389820600	47.21931120310	-123.07387257200	47.21930204200	7
OB-03	-123.07006785400	47.21789463320	-123.07014404600	47.21789751920	19
OB-04	-123.07049568800	47.22478953330	-123.07051964900	47.22481564420	11
OB-05	-123.06252068000	47.22488778020	-123.06255589400	47.22491976580	15
OB-06	-123.05406788600	47.22245083040	-123.05409015000	47.22244292200	6
OB-07	-123.04333695300	47.22726002770	-123.04334092000	47.22727625020	6
OB-08	-123.03392214600	47.22344766410	-123.03392324800	47.22346465280	6
OB-09	-123.05593256200	47.23156738460	-123.05345334900	47.23156708660	0
OB-10	-123.04957508700	47.23761421800	-123.04956324000	47.23761663500	3
OB-11	-123.03303135400	47.24819012540	-123.03197266100	47.24797175140	275
OB-12	-123.03991156900	47.25071179150	-123.03987706600	47.25071754690	9
OB-12	-123.03991156900	47.25071179150	-123.03989479200	47.25069922410	6
OB-13	-123.03273395900	47.25315443220	-123.03280221600	47.25311188930	23
OB-14	-123.02082195100	47.25595244660	-123.02085843600	47.25590105910	21
OB-15	NA	NA	-123.06266431400	47.22252493930	NA
OB-16	NA	NA	-123.04827054700	47.23934280190	NA
OB-17	-123.08204120400	47.21575074100	-123.08202347900	47.21574911320	4
OB-18	-123.06920923300	47.21566621750	-123.06923457800	47.21566958710	6
OB-19	-123.05270579700	47.22642819030	-123.05272549600	47.22644244090	7
SH-01	-123.08389115200	47.21334477520	-123.08390129400	47.21335497520	4
SH-02	-123.08749854500	47.21349810910	-123.08751239600	47.21350524800	4
SH-03	-123.09010516200	47.21254176020	NA	NA	NA
SH-04	-123.09183859000	47.21270122450	-123.09174971200	47.21275481350	29
SH-05	-123.09186803800	47.21151916100	-123.09187754300	47.21151688890	3
SH-06	NA	NA	NA	NA	NA
SH-07	-123.08914280200	47.21023903320	-123.08914471100	47.21025962210	8
SH-08	NA	NA	-123.08909798000	47.21076343980	NA
SH-09	-123.08565440900	47.21065387270	-123.08575402000	47.21070792290	32
SH-10	-123.08325747900	47.21152197990	-123.08323576800	47.21157508540	20
SH-11	-123.09420286900	47.20798277340	-123.09419544300	47.20796617640	6
SH-12	-123.09411211500	47.20726145540	-123.09408099000	47.20733837220	29
SH-12	-123.09411211500	47.20726145540	-123.09404812400	47.20733070280	30
SH-13	-123.09281278800	47.20653855680	-123.09271726000	47.20635626150	71
SH-14	-123.08075899400	47.20874047970	-123.08077485800	47.20874931040	5
SH-15	-123.07722888900	47.21006334590	-123.07723804000	47.21010270710	15
SH-16	-123.07812231800	47.21360553360	-123.07811223500	47.21359558360	4
SH-17	NA	NA	-123.08636254400	47.21152052450	NA
SH-18	-123.09409762300	47.20872030020	-123.09409767900	47.20872030020	0
SH-19	-123.09242525100	47.20789361500	-123.09244809000	47.20788623740	6
SH-20	-123.09052937500	47.20688034320	-123.09048935500	47.20689392930	11
SH-21	-123.08969746500	47.20876542200	-123.08970996700	47.20877194160	4
SH-21	-123.08969746500	47.20876542200	-123.08965092000	47.20875413020	12
SH-22	-123.08682557900	47.20802185350	-123.08682309200	47.20804167870	7
SH-23	-123.08448272900	47.20827006810	-123.08448747400	47.20829185680	8
SH-24	-123.08446632700	47.20652846720	NA	NA	NA
SH-25	-123.08094422000	47.20698476490	NA	NA	NA
SH-26	-123.08992895400	47.21161791950	-123.08990835100	47.21160437220	7
SH-27	-123.08788647400	47.21217525930	-123.08778797400	47.21203765620	56
SH-28	-123.08197625700	47.21042360530	-123.08199411600	47.21042679150	0
SH-29	-123.07817573800	47.21187824130	-123.07813487700	47.21188009680	10
SH-30	-123.08401792200	47.21434825230	-123.08396491900	47.21433563550	14

Coordinates are in NAD 83.
NA No sample collected from this station

APPENDIX B

Sample Core Logs

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number HI-01-SC

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Diana Phelan
Photo number 055
Date/Time Core Collected 10/16/08 14:59
Date/Time Core Processed 10/16/08 17:00
Latitude 47.203416 Longitude -123.061865
Core Penetration 7 feet, 10 inches
Core Recovery (percent) 4 feet, 6 inches (57%)
Notes Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	HI-01-SC-01	1	Olive gray sandy GRAVEL, trace amounts of silt.	GW
No	HI-01-SC-12	2	Same as above. Olive gray silty CLAY, very stiff.	CL
No	HI-01-SC-23	3	Same as above.	
No	HI-01-SC-34	4	Same as above.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number HI-01-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/16/08 14:59
Project number	06-03386-007	Date/Time Core Processed	10/16/08 17:00
Client	Ecology	Latitude / Longitude	47.203416 / -123.061865
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	7 feet, 10 inches
Photo number	055	Core Recovery (percent)	4 feet, 6 inches (57%)

Notes Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY, very stiff.	CL
		5	Total core recovery 4 feet, 6 inches.	
		6		
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: HI-02-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/14/08 13:50
Project number	06-03386-007	Date/Time Core Processed	10/15/08 10:30
Client	Ecology	Latitude 47.205808	Longitude -123.062643
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	6 feet, 6 inches
Photo number	056	Core Recovery (percent)	4 feet, 7 inches (70%)

Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	HI-02-SC-01	1	Olive gray sandy SILT.	ML
No	HI-02-SC-12	2	Same as above.	
			Olive gray silty SAND, trace amounts of clay, abundant shell fragments.	SM
No	HI-02-SC-23	3	Same as above.	
			Olive gray sandy GRAVEL, trace amounts of silt, shell fragments.	GW
No	HI-02-SC-34	4	Same as above.	
			Olive gray clayey SILT, trace amounts of sand.	ML

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SEDIMENT CORE LOG

Sample Station Number: HI-02-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/14/08 13:50
Project number	06-03386-007	Date/Time Core Processed	10/15/08 10:30
Client	Ecology	Latitude 47.205808	Longitude -123.062643
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	6 feet, 6 inches
Photo number	056	Core Recovery (percent)	4 feet, 7 inches (70%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray clayey SILT, trace amounts of sand.	ML
		5	Total core recovery 4 feet, 7 inches.	
		6		
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: HI-03-SC

Sheet 1 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 057

Date/Time Core Collected: 10/14/08 14:35
Date/Time Core Processed: 10/14/08 15:40
Latitude: 47.206552 Longitude: -123.072617
Core Penetration: 7 feet, 2 inches
Core Recovery (percent): 6 feet, 11 inches (97%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 1% bark	HI-03-SC-01	1	Olive gray sandy SILT, trace amounts of clay, abundant shell fragments.	ML
No	HI-03-SC-12	2	Olive gray silty CLAY, trace amounts of gravel, shell fragments.	CL
No	HI-03-SC-23	3	Olive gray slightly silty CLAY, trace amounts of gravel.	
No	HI-03-SC-34	4	Olive gray slightly sandy CLAY, few shell fragments.	

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SEDIMENT CORE LOG

Sample Station Number: HI-03-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/14/08 14:35
Project number	06-03386-007	Date/Time Core Processed	10/14/08 15:40
Client	Ecology	Latitude / Longitude	47.206552 / -123.072617
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	7 feet, 2 inches
Photo number	057	Core Recovery (percent)	6 feet, 11 inches (97%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray slightly clayey SILT.	ML
		5		
No			Same as above.	
		6		
No			Same as above.	
		7	Total core recovery 6 feet, 11 inches.	
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: HI-04-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 058

Date/Time Core Collected: 10/14/08 15:20
Date/Time Core Processed: 10/14/08 16:50
Latitude: 47.208526 Longitude: -123.067168
Core Penetration: 8 feet, 9 inches
Core Recovery (percent): 5 feet, 7 inches (64%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 5% bark	HI-04-SC-01	1	Olive gray silty SAND. Slight hydrogen sulfide odor present.	SM
Yes 1% bark	HI-04-SC-12	2	Olive gray silty SAND, few shell fragments. Slight hydrogen sulfide odor present.	
No	HI-04-SC-23	3	Olive gray silty SAND.	
Yes Less than 1% wood chips	HI-04-SC-34	4	Same as above, few shell fragments.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number HI-04-SC

Sheet 2 of 2

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Diana Phelan
Photo number 058
Date/Time Core Collected 10/14/08 15:20
Date/Time Core Processed 10/14/08 16:50
Latitude 47.208526 Longitude -123.067168
Core Penetration 8 feet, 9 inches
Core Recovery (percent) 5 feet, 7 inches (64%)
Notes Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Olive gray silty SAND, abundant shell fragments.	SM
No			Olive gray silty CLAY.	CL
		6 7 8	Total core recovery 5 feet, 7 inches.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: HI-06-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 059
Date/Time Core Collected: 10/5/08 15:45
Date/Time Core Processed: 10/6/08 11:45
Latitude: 47.212386 Longitude: -123.071001
Core Penetration: 7 feet, 1 inch
Core Recovery (percent): 5 feet, 4 inches (75%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 5% bark	HI-06-SC-01	1	Dark gray to black gravelly SAND, trace amounts of silt, shell fragments. Slight hydrogen sulfide odor present.	SW
Yes 2% bark	HI-06-SC-12	2	Dark olive gray sandy GRAVEL, with cobbles, trace amounts of silt.	GW
No	HI-06-SC-23	3	Dark gray silty fine-grained, poorly-graded SAND, trace amounts of gravel.	SP
No	HI-06-SC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: HI-06-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 059
Date/Time Core Collected: 10/5/08 15:45
Date/Time Core Processed: 10/6/08 11:45
Latitude: 47.212386 Longitude: -123.071001
Core Penetration: 7 feet, 1 inch
Core Recovery (percent): 5 feet, 4 inches (75%)
Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Dark gray silty fine-grained poorly-graded SAND.	SP
		5		
No			Very dark gray fine- to coarse-grained SAND, trace amounts of gravel.	SW
			Total core recovery 5 feet, 4 inches.	
		6		
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: HI-07-SC

Project name: Oakland Bay Sediment Characterization

Project number: 06-03386-007

Client: Ecology

HEC Samplers: Bruce Carpenter/Brady Hanson

Photo number: 060

Date/Time Core Collected: 10/3/08 11:30

Date/Time Core Processed: 10/3/08 15:10

Latitude: 47.214426 Longitude: -123.077003

Core Penetration: 7 feet, 1 inch

Core Recovery (percent): 5 feet, 2 inches (73%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	HI-07-SC-01	1	Dark gray poorly-graded medium-grained SAND, shell fragments.	SP
Yes Less than 1% wood fibers	HI-07-SC-12	2	Same as above.	
No	HI-07-SC-23	3	Same as above.	
No	HI-07-SC-34		Same as above.	
		4	Dark olive gray silty CLAY, occasional shell fragment. Hydrogen sulfide odor present.	CL

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SEDIMENT CORE LOG

Sample Station Number HI-07-SC

Project name Oakland Bay Sediment Characterization
Date/Time Core Collected 10/3/08 11:30
Project number 06-03386-007
Date/Time Core Processed 10/3/08 15:10
Client Ecology
Latitude 47.21442647 .
Longitude -123.077003
HEC Samplers Bruce Carpenter/Brady Hanson
Core Penetration 7 feet, 1 inch
Photo number 060
Core Recovery (percent) 5 feet, 2 inches (73%)
Notes Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Dark olive gray silty CLAY.	CL
		6 7 8	Total core recovery 5 feet, 2 inches.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number OB-01-SC

Sheet 1 of 2

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Brady Hanson
Photo number 032
Date/Time Core Collected 10/3/08 13:43
Date/Time Core Processed 10/3/08 16:00
Latitude 47.218877 Longitude -123.078879
Core Penetration 7 feet, 2 inches
Core Recovery (percent) 5 feet, 3 inches (73%)
Notes Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-01-SC-01	1	Dark gray sandy GRAVEL, shell fragments.	GW
No	OB-01-SC-12	2	Same as above.	
Yes Less than 1% bark	OB-01-SC-23	3	Same as above.	
No	OB-01-SC-34		Same as above.	
		4	Dark olive gray sandy SILT, trace amounts of gravel.	ML

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-01-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/3/08 13:43
Project number	06-03386-007	Date/Time Core Processed	10/3/08 16:00
Client	Ecology	Latitude / Longitude	47.218877 / -123.078879
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	032	Core Recovery (percent)	5 feet, 3 inches (73%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Dark olive gray gravelly SAND with silt, shell fragments. Hydrogen sulfide odor present.	SW
No		5	Brown clayey SILT. Hydrogen sulfide odor present.	ML
		6 7 8	Total core recovery 5 feet, 3 inches.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-02-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 033
Date/Time Core Collected: 10/3/08 11:01
Date/Time Core Processed: 10/3/08 13:25
Latitude: 47.219302 Longitude: -123.073872
Core Penetration: 8 feet
Core Recovery (percent): 7 feet, 3 inches (91%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 1% bark	OB-02-SC-01	1	Dark olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
Yes Less than 1% bark	OB-02-SC-12	2	Same as above.	
No	OB-02-SC-23	3	Same as above.	
Yes Less than 1% bark	OB-02-SC-34	4	Same as above.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-02-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/3/08 11:01
Project number	06-03386-007	Date/Time Core Processed	10/3/08 13:25
Client	Ecology	Latitude / Longitude	47.219302 / -123.073872
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	033	Core Recovery (percent)	7 feet, 3 inches (91%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 1% bark			Dark olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
		5		
No			Same as above.	
		6		
No			Same as above.	
		7		
No			Same as above.	
			Total core recovery 7 feet, 3 inches.	
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number OB-03-SC

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Brady Hanson
Photo number 034
Date/Time Core Collected 10/3/08 10:08
Date/Time Core Processed 10/3/08 11:25
Latitude 47.217897 Longitude -123.070144
Core Penetration 7 feet, 2 inches
Core Recovery (percent) 6 feet (84%)
Notes Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-03-SC-01	1	Dark olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
No	OB-03-SC-12	2	Same as above.	
No	OB-03-SC-23	3	Dark olive gray silty CLAY, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	CL
No	OB-03-SC-34	4	Same as above.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-03-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/3/08 10:08
Project number	06-03386-007	Date/Time Core Processed	10/3/08 11:25
Client	Ecology	Latitude / Longitude	47.217897 / -123.070144
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	034	Core Recovery (percent)	6 feet (84%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Dark olive gray silty CLAY, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	CL
No		6	Same as above.	
		7	Total core recovery 6 feet.	
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number OB-04-SC

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Brady Hanson
Photo number 035

Date/Time Core Collected 10/4/08 10:20
Date/Time Core Processed 10/4/08 11:40
Latitude 47.224816 Longitude -123.070519
Core Penetration 7 feet, 3 inches
Core Recovery (percent) 5 feet, 3 inches (72%)

Notes Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 15% bark	OB-04-SC-01	1	Olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
No	OB-04-SC-12	2	Olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	
No	OB-04-SC-23	3	Olive gray silty CLAY. Hydrogen sulfide odor present.	CL
No	OB-04-SC-34	4	Same as above.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-04-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/4/08 10:20
Project number	06-03386-007	Date/Time Core Processed	10/4/08 11:40
Client	Ecology	Latitude / Longitude	47.224816 / -123.070519
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 3 inches
Photo number	035	Core Recovery (percent)	5 feet, 3 inches (72%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Olive gray silty CLAY. Hydrogen sulfide odor present.	CL
		6 7 8	Total core recovery 5 feet, 3 inches.	

SEDIMENT CORE LOG

Sample Station Number: OB-05-SC

Sheet 1 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 036
Notes: Processed samples from third core of three attempts.

Date/Time Core Collected: 10/4/08 12:20
Date/Time Core Processed: 10/4/08 16:55
Latitude: 47.224919 Longitude: -123.062555
Core Penetration: 7 feet, 2 inches
Core Recovery (percent): 5 feet, 1 inch (71%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-05-SC-01	1	Olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
No	OB-05-SC-12	2	Same as above.	
No	OB-05-SC-23	3	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
No	OB-05-SC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: OB-05-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/4/08 12:20
Project number	06-03386-007	Date/Time Core Processed	10/4/08 16:55
Client	Ecology	Latitude / Longitude	47.224919 / -123.062555
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	036	Core Recovery (percent)	5 feet, 1 inch (71%)

Notes: Processed samples from third core of three attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
		6	Total core recovery 5 feet, 1 inch.	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: OB-06-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 037
Date/Time Core Collected: 10/5/08 13:47
Date/Time Core Processed: 10/5/08 16:45
Latitude: 47.222443 Longitude: -123.054090
Core Penetration: 7 feet, 2 inches
Core Recovery (percent): 6 feet, 8.5 inches (94%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-06-SC-01	1	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.	ML
No	OB-06-SC-12	2	Dark olive gray clayey SILT. Hydrogen sulfide odor present.	
Yes Less than 1% bark	OB-06-SC-23	3	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
Yes Less than 1% bark	OB-06-SC-34	4	Same as above.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-06-SC

Sheet 2 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 037

Date/Time Core Collected: 10/5/08 13:47
Date/Time Core Processed: 10/5/08 16:45
Latitude: 47.222443 Longitude: -123.054090
Core Penetration: 7 feet, 2 inches
Core Recovery (percent): 6 feet, 8.5 inches (94%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
		5		
No			Same as above.	
		6		
No			Same as above.	
			Total core recovery 6 feet, 8.5 inches.	
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-07-SC

Project name: Oakland Bay Sediment Characterization
Date/Time Core Collected: 10/15/08 16:30
Project number: 06-03386-007
Date/Time Core Processed: 10/16/08 08:00
Client: Ecology
Latitude: 47.227276 Longitude: -123.043341
HEC Samplers: Bruce Carpenter/Diana Phelan
Core Penetration: 7 feet, 8 inches
Photo number: 038
Core Recovery (percent): 6 feet, 7 inches (86%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-07-SC-01		Olive gray slightly sandy SILT, trace amounts of clay.	ML
		1	Olive gray sandy SILT, trace amounts of gravel, abundant shell fragments.	ML
No	OB-07-SC-12	2	Olive gray sandy GRAVEL, abundant shell fragments.	GW
Yes Less than 1% bark	OB-07-SC-23	3	Olive gray sandy SILT, few shell fragments.	ML
Yes 20% bark	OB-07-SC-34	4	Olive gray sandy SILT, trace amounts of gravel, abundant shell fragments.	

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SEDIMENT CORE LOG

Sample Station Number: OB-07-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 038
Date/Time Core Collected: 10/15/08 16:30
Date/Time Core Processed: 10/16/08 08:00
Latitude: 47.227276 Longitude: -123.043341
Core Penetration: 7 feet, 8 inches
Core Recovery (percent): 6 feet, 7 inches (86%)
Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray gravelly SILT, trace amounts of sand.	ML
No		5	Olive gray silty CLAY.	CL
No		6	Olive gray clayey SILT, trace amounts of fine-grained sand.	ML
		7 8	Total core recovery 6 feet, 7 inches.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-08-SC

Sheet 1 of 1

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/15/08 17:10
Project number	06-03386-007	Date/Time Core Processed	10/16/08 10:15
Client	Ecology	Latitude / Longitude	47.223464 / -123.033923
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	4 feet, 7 inches
Photo number	039	Core Recovery (percent)	4 feet (87%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 1% bark	OB-08-SC-01	1	Olive gray sandy SILT, trace amounts of clay.	ML
No	OB-08-SC-12	2	Olive gray silty CLAY.	CL
No	OB-08-SC-23	3	Mottled olive gray and brown silty CLAY, very stiff.	
No	OB-08-SC-34	4	Same as above.	
			Total core recovery 4 feet.	

SEDIMENT CORE LOG

Sample Station Number: OB-09-SC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/5/08 11:38
Project number	06-03386-007	Date/Time Core Processed	10/5/08 13:30
Client	Ecology	Latitude / Longitude	47.231567 / -123.053453
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	040	Core Recovery (percent)	5 feet (70%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-09-SC-01	1	Dark olive gray clayey SILT. Hydrogen sulfide odor present.	ML
No	OB-09-SC-12	2	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
No	OB-09-SC-23	3	Same as above.	
No	OB-09-SC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: OB-09-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/5/08 11:38
Project number	06-03386-007	Date/Time Core Processed	10/5/08 13:30
Client	Ecology	Latitude / Longitude	47.231567 / -123.053453
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	040	Core Recovery (percent)	5 feet (70%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
		6 7 8	Total core recovery 5 feet.	

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SEDIMENT CORE LOG

Sample Station Number OB-10-SC

Sheet 1 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 041

Date/Time Core Collected: 10/5/08 10:55
Date/Time Core Processed: 10/5/08 11:50
Latitude: 47.237616 Longitude: -123.049563
Core Penetration: 7 feet, 1 inch
Core Recovery (percent): 5 feet, 1 inch (72%)

Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-10-SC-01	1	Dark olive gray clayey SILT. Hydrogen sulfide odor present.	ML
No	OB-10-SC-12	2	Same as above, shell fragments.	
Yes Less than 1% bark	OB-10-SC-23	3	Olive gray clayey SILT. Hydrogen sulfide odor present.	
No	OB-10-SC-34	4	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL

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SEDIMENT CORE LOG

Sample Station Number OB-10-SC

Sheet 2 of 2

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Brady Hanson
Photo number 041
Notes Processed samples from second core of two attempts.

Date/Time Core Collected 10/5/08 10:55
Date/Time Core Processed 10/5/08 11:50
Latitude 47.237616 Longitude -123.049563
Core Penetration 7 feet, 1 inch
Core Recovery (percent) 5 feet, 1 inch (72%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
		6	Total core recovery 5 feet, 1 inch.	
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-11-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/7/08 14:45
Project number	06-03386-007	Date/Time Core Processed	10/8/08 09:40
Client	Ecology	Latitude / Longitude	47.247972 / -123.031972
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	6 feet, 7 inches
Photo number	042	Core Recovery (percent)	4 feet, 4 inches (66%)

Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-11-SC-01	1	Dark olive gray slightly silty, gravelly SAND, abundant shell fragments.	SM
Yes Less than 1% bark	OB-11-SC-12	2	Same as above.	
No	OB-11-SC-23	3	Same as above.	
No	OB-11-SC-34	4	Same as above. Hydrogen sulfide odor present.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-11-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/7/08 14:45
Project number	06-03386-007	Date/Time Core Processed	10/8/08 09:40
Client	Ecology	Latitude / Longitude	47.247972 / -123.031972
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	6 feet, 7 inches
Photo number	042	Core Recovery (percent)	4 feet, 4 inches (66%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Dark olive gray slightly silty, gravelly SAND, abundant shell fragments.	SM
			Total core recovery 4 feet, 4 inches.	
		5		
		6		
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-12-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/4/08 14:35
Project number	06-03386-007	Date/Time Core Processed	10/4/08 16:00
Client	Ecology	Latitude 47.250699	Longitude -123.039894
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	043 and 044	Core Recovery (percent)	5 feet, 1 inch (71%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-12-SC-01	1	Olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes Less than 5% bark	OB-12-SC-12	2	Same as above.	
No	OB-12-SC-23	3	Olive gray silty CLAY.	CL
Yes 75% sawdust	OB-12-SC-34		Same as above.	
		4	Olive gray silty CLAY.	CL

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SEDIMENT CORE LOG

Sample Station Number: OB-12-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/4/08 14:35
Project number	06-03386-007	Date/Time Core Processed	10/4/08 16:00
Client	Ecology	Latitude / Longitude	47.250699 / -123.039894
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	043 and 044	Core Recovery (percent)	5 feet, 1 inch (71%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 100% sawdust		5	Sawdust.	
		6 7 8	Total core recovery 5 feet, 1 inch.	

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SEDIMENT CORE LOG

Sample Station Number: OB-12-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/20/08 13:55
Project number	06-03386-007	Date/Time Core Processed	10/20/08 15:10
Client	Ecology	Latitude / Longitude	47.250699 / -123.039895
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	11 feet, 9 inches
Photo number	045 and 046	Core Recovery (percent)	9 feet, 2 inches (78%)

Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		1	Olive gray silty CLAY. Hydrogen sulfide odor present.	CL
Yes 5% bark		2	Same as above.	
No		3	Same as above.	
No		4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: OB-12-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/20/08 13:55
Project number	06-03386-007	Date/Time Core Processed	10/20/08 15:10
Client	Ecology	Latitude / Longitude	47.250699 / -123.039895
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	11 feet, 9 inches
Photo number	045 and 046	Core Recovery (percent)	9 feet, 2 inches (78%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 50% sawdust	OB-12-SC-45	5	Olive gray silty CLAY.	CL
Yes 75% sawdust	OB-12-SC-56	6	Same as above.	
Yes 90% sawdust	OB-12-SC-67	7	Same as above.	
Yes 100% sawdust		8	Sawdust.	

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SEDIMENT CORE LOG

Sample Station Number: OB-12-SC

Sheet 3 of 3

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 045 and 046
Date/Time Core Collected: 10/20/08 13:55
Date/Time Core Processed: 10/20/08 15:10
Latitude: 47.250699 Longitude: -123.039895
Core Penetration: 11 feet, 9 inches
Core Recovery (percent): 9 feet, 2 inches (78%)
Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 100% sawdust		9	Sawdust.	
		10 11 12	Total core recovery 9 feet, 2 inches.	

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SEDIMENT CORE LOG

Sample Station Number: OB-13-SC

Sheet 1 of 1

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 047
Notes: Processed samples from third core of three attempts.

Date/Time Core Collected: 10/7/08 16:15
Date/Time Core Processed: 10/8/08 10:40
Latitude: 47.253112 Longitude: -123.032802
Core Penetration: 4 feet, 7 inches
Core Recovery (percent): 2 feet, 10 inches (62%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-13-SC-01	1	Very dark olive gray to black slighty clayey, gravelly SILT, trace amounts of sand.	ML
Yes Less than 1% bark	OB-13-SC-12	2	Olive gray clayey SILT, trace amounts of sand., shell fragments.	ML
No	OB-13-SC-23	3	Same as above. Slight hydrogen sulfide odor present.	
		4	Total core recovery 2 feet, 10 inches.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number OB-14-SC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/7/08 14:00
Project number	06-03386-007	Date/Time Core Processed	10/7/08 17:10
Client	Ecology	Latitude 47.255901	Longitude -123.020858
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet, 8 inches
Photo number	048	Core Recovery (percent)	5 feet, 3 inches (68%)

Notes Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-14-SC-01	1	Olive gray clayey SILT, trace amounts of sand.	ML
Yes Less than 1% bark	OB-14-SC-12	2	Same as above. Olive gray silty SAND.	SM
No	OB-14-SC-23	3	Same as above. Olive gray silty CLAY. Olive gray fine- to coarse-grained SAND, trace amounts of silt.	CL SW
No	OB-14-SC-34	4	Same as above. Olive gray gravelly SAND, trace amounts of silt and twigs, shell fragments.	SW

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-14-SC

Sheet 2 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 048
Date/Time Core Collected: 10/7/08 14:00
Date/Time Core Processed: 10/7/08 17:10
Latitude: 47.255901 Longitude: -123.020858
Core Penetration: 7 feet, 8 inches
Core Recovery (percent): 5 feet, 3 inches (68%)
Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Alternating layers of olive gray SILT, trace amounts of clay and brown SILT, trace amounts of clay and twigs.	ML
		6 7 8	Total core recovery 5 feet, 3 inches.	

SEDIMENT CORE LOG

Sample Station Number: OB-15-RI

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/16/08 10:04
Project number	06-03386-007	Date/Time Core Processed	10/16/08 11:45
Client	Ecology	Latitude / Longitude	47.222525 / -123.062664
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	8 feet, 2 inches
Photo number	049	Core Recovery (percent)	7 feet, 6 inches (92%)

Notes: Processed samples from one core attempt at this location. Samples collected every 3-centimeter intervals to 4 feet.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY, occasional shell fragments.	CL
		1		
No			Same as above.	
		2		
			Hydrogen sulfide odor present.	
No			Same as above.	
		3		
No			Same as above.	
		4		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number OB-15-RI

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Diana Phelan
Photo number 049

Date/Time Core Collected 10/16/08 10:04
Date/Time Core Processed 10/16/08 11:45
Latitude 47.222525 Longitude -123.062664
Core Penetration 8 feet, 2 inches
Core Recovery (percent) 7 feet, 6 inches (92%)

Notes Processed samples from one core attempt at this location. Samples collected every 3-centimeter intervals to 4 feet.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY, occasional shell fragments.	CL
		5		
No			Same as above.	
		6		
No			Same as above.	
		7		
No			Same as above.	
			Total core recovery 7 feet, 6 inches.	
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-16-RI

Sheet 1 of 2

Project name: Oakland Bay Sediment Characterization
Date/Time Core Collected: 10/20/08 10:50
Project number: 06-03386-007
Date/Time Core Processed: 10/20/08 11:30
Client: Ecology
Latitude: 47.239343 Longitude: -123.048270
HEC Samplers: Bruce Carpenter/Diana Phelan
Core Penetration: 7 feet, 10 inches
Photo number: 050 and 051
Core Recovery (percent): 6 feet, 11 inches (88%)

Notes: Processed samples from second core of two attempts. Samples collected every 3-centimeter intervals to 4 feet.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		1	Olive gray silty CLAY, few shell fragments.	CL
No		2	Same as above.	
No		3	Same as above. Hydrogen sulfide odor present.	
No		4	Same as above. Hydrogen sulfide odor present.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-16-RI

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/20/08 10:50
Project number	06-03386-007	Date/Time Core Processed	10/20/08 11:30
Client	Ecology	Latitude / Longitude	47.239343 / -123.048270
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	7 feet, 10 inches
Photo number	050 and 051	Core Recovery (percent)	6 feet, 11 inches (88%)

Notes: Processed samples from second core of two attempts. Samples collected every 3-centimeter intervals to 4 feet.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY, few shell fragments.	CL
		5		
No			Same as above.	
		6		
No			Same as above, abundant shell fragments.	
		7	Total core recovery 6 feet, 11 inches.	
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: OB-17-WC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/5/08 15:12
Project number	06-03386-007	Date/Time Core Processed	10/6/08 10:25
Client	Ecology	Latitude / Longitude	47.215749 / -123.082023
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet, 2 inches
Photo number	052	Core Recovery (percent)	6 feet, 7 inches (92%)
Notes	One core attempt at this location.		

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 15% bark	OB-17-WC-01	1	Dark olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes Less than 1% bark	OB-17-WC-12	2	Same as above, shell fragments. Hydrogen sulfide odor present.	
Yes Less than 1% bark	OB-17-WC-23	3	Olive gray silty CLAY, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	CL
No	OB-17-WC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: OB-17-WC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/5/08 15:12
Project number	06-03386-007	Date/Time Core Processed	10/6/08 10:25
Client	Ecology	Latitude / Longitude	47.215749 / -123.082023
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet, 2 inches
Photo number	052	Core Recovery (percent)	6 feet, 7 inches (92%)
Notes	One core attempt at this location.		

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
		5		
Yes Less than 1% bark			Same as above.	
		6		
No			Same as above.	
			Total core recovery 6 feet, 7 inches.	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: OB-18-WC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/5/08 14:35
Project number	06-03386-007	Date/Time Core Processed	10/5/08 17:50
Client	Ecology	Latitude 47.2156696	Longitude -123.069246
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 2 inches
Photo number	053	Core Recovery (percent)	5 feet, 8 inches (79%)

Notes: One core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% bark	OB-18-WC-01	1	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.	ML
Yes Less than 5% bark	OB-18-WC-12	2	Dark olive gray clayey SILT. Hydrogen sulfide odor present.	
Yes 10% bark 1% wood fibers	OB-18-WC-23	3	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
No	OB-18-WC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: OB-18-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 053
Notes: One core attempt at this location.

Date/Time Core Collected: 10/5/08 14:35
Date/Time Core Processed: 10/5/08 17:50
Latitude: 47.2156696 Longitude: -123.069246
Core Penetration: 7 feet, 2 inches
Core Recovery (percent): 5 feet, 8 inches (79%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY. Hydrogen sulfide odor present.	CL
		5		
No			Same as above.	
			Total core recovery 5 feet, 8 inches.	
		6		
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: OB-19-WC

Sheet 1 of 1

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/5/08 12:23
Project number	06-03386-007	Date/Time Core Processed	10/5/08 15:40
Client	Ecology	Latitude / Longitude	47.226442 / -123.052725
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	5 feet, 8 inches
Photo number	054	Core Recovery (percent)	4 feet, 1 inch (72%)

Notes: One core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	OB-19-WC-01	1	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.	ML
Yes 5% bark	OB-19-WC-12	2	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.	
Yes Less than 1% bark	OB-19-WC-23	3	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.	CL
No	OB-19-WC-34	4	Same as above.	
			Total core recovery 4 feet, 1 inch.	

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SEDIMENT CORE LOG

Sample Station Number: SH-01-SC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/1/08 11:55
Project number	06-03386-007	Date/Time Core Processed	10/1/08 12:35
Client	Ecology	Latitude / Longitude	47.213354 / -123.083901
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	001	Core Recovery (percent)	7 feet, 4 inches (92%)

Notes: Processed samples from third core of three attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% bark	SH-01-SC-01	1	Dark olive gray, sandy SILT, with shell fragments, trace amounts of clay.	ML
No	SH-01-SC-12	2	Light olive gray, sandy, clayey SILT, with shell fragments. Hydrogen sulfide odor present.	
No	SH-01-SC-23	3	Same as above, shell fragments.	
No	SH-01-SC-34	4	Same as above, abundant amount of shell fragments.	

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SEDIMENT CORE LOG

Sample Station Number SH-01-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/1/08 11:55
Project number	06-03386-007	Date/Time Core Processed	10/1/08 12:35
Client	Ecology	Latitude / Longitude	47.213354 / -123.083901
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	001	Core Recovery (percent)	7 feet, 4 inches (92%)

Notes Processed samples from third core of three attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Light olive gray, clayey SILT, with shell fragments, trace amounts of sand. Slight hydrogen sulfide odor present.	ML
		5		
No			Same as above.	
		6		
No			Same as above.	
		7		
			Total core recovery 7 feet, 4 inches.	
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-02-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 002

Date/Time Core Collected: 10/6/08 15:50
Date/Time Core Processed: 10/7/08 10:30
Latitude: 47.213505 Longitude: -123.087512
Core Penetration: 7 feet, 8 inches
Core Recovery (percent): 6 feet, 7 inches (86%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 15% bark	SH-02-SC-01	1	Dark olive gray, slightly sandy, clayey SILT. Hydrogen sulfide and petroleum-like odor present.	ML
Yes 5% bark, less than 1% wood chips	SH-02-SC-12	2	Dark olive gray clayey SILT, with few shell fragments. Hydrogen sulfide and slight petroleum-like odor present.	
Yes 5% bark	SH-02-SC-23	3	Same as above, some shell fragments. Hydrogen sulfide and slight petroleum-like odor present.	
No	SH-02-SC-34		Dark olive gray, clayey SILT, with fine-grained gravel and shell fragments. Hydrogen sulfide odor present.	
No		4	Dark olive gray, silty SAND, with shell fragments, and trace amounts of clay and gravel, poorly graded. Hydrogen sulfide odor present.	SM

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SEDIMENT CORE LOG

Sample Station Number: SH-02-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/6/08 15:50
Project number	06-03386-007	Date/Time Core Processed	10/7/08 10:30
Client	Ecology	Latitude 47.213505	Longitude -123.087512
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet, 8 inches
Photo number	002	Core Recovery (percent)	6 feet, 7 inches (86%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray, silty SAND, with shell fragments, trace amounts of clay and gravel, and occasional lenses of sandy silt. Hydrogen sulfide odor present.	SM
		5		
No			Same as above.	
		6		
No			Same as above.	
			Total core recovery 6 feet, 7 inches.	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-04-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 003

Date/Time Core Collected: 10/15/08 09:39
Date/Time Core Processed: 10/15/08 11:40
Latitude: 47.212754 Longitude: -123.091749
Core Penetration: 8 feet, 10 inches
Core Recovery (percent): 6 feet, 8 inches (76%)

Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-04-SC-01	1	Dark olive gray, clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes 10% sawdust 1-inch distinct lense	SH-04-SC-12	2	Dark olive gray, clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	
Yes 75% sawdust, less than 5% bark	SH-04-SC-23	3	Dark olive gray, clayey SILT, trace amounts of sand. Hydrogen sulfide and petroleum-like odor present.	
Yes 75% sawdust, less than 5% bark	SH-04-SC-34	4	Same as above. Petroleum-like odor present.	

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SEDIMENT CORE LOG

Sample Station Number: SH-04-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/15/08 09:39
Project number	06-03386-007	Date/Time Core Processed	10/15/08 11:40
Client	Ecology	Latitude 47.212754	Longitude -123.091749
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	8 feet, 10 inches
Photo number	003	Core Recovery (percent)	6 feet, 8 inches (76%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 75% sawdust, less than 5% small wood chips			Dark olive gray, clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
		5		
Yes 75% sawdust, less than 5% small wood chips			Same as above.	
No		6	Dark olive gray, sandy GRAVEL, trace amounts of silt.	GW
Yes Less than 5% bark fibers			Dark olive brown, clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
		7	Total core recovery 6 feet, 8 inches.	
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-05-SC

Sheet 1 of 1

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 004
Date/Time Core Collected: 10/14/08 17:40
Date/Time Core Processed: 10/15/08 13:10
Latitude: 47.211516 Longitude: -123.091877
Core Penetration: 4 feet, 11 inches
Core Recovery (percent): 2 feet, 1 inch (42%)
Notes: Processed samples from third core of three attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-05-SC-01	1	Grayish brown sandy GRAVEL.	GW
No	SH-05-SC-12	2	Grayish black, gravelly SAND, well-graded.	SW
		3	Total core recovery 2 feet, 1 inch.	
		4		

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SEDIMENT CORE LOG

Sample Station Number: SH-07-SC

Sheet 1 of 1

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/15/08 10:45
Project number	06-03386-007	Date/Time Core Processed	10/15/08 14:00
Client	Ecology	Latitude / Longitude	47.210259 / -123.089144
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	5 feet, 7 inches
Photo number	005	Core Recovery (percent)	3 feet, 9 inches (67%)

Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-07-SC-01	1	Dark olive gray, clayey SILT, trace amounts of sand.	ML
No	SH-07-SC-12	2	Dark brown silty SAND, with shell fragments, occasional gravel, black stained sand.	SM
No	SH-07-SC-23	3	Gray brown sandy GRAVEL, trace amounts of silt.	GP
No	SH-07-SC-34	4	Grayish brown gravelly SAND, trace amounts of silt, well-graded.	SW
			Total core recovery 3 feet, 9 inches.	

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SEDIMENT CORE LOG

Sample Station Number: SH-08-SC

Sheet 1 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 006
Date/Time Core Collected: 10/6/08 14:45
Date/Time Core Processed: 10/6/08 16:30
Latitude: 47.210763 Longitude: -123.089097
Core Penetration: 7 feet, 8 inches
Core Recovery (percent): 5 feet (65%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-08-SC-01		Very dark olive gray, sandy GRAVEL with cobbles.	GW
		1	Very dark olive gray clayey SILT, trace amounts of sand, several small twigs. Slight hydrogen sulfide odor present.	ML
No	SH-08-SC-12	2	Very dark olive gray clayey SILT, trace amounts of sand, shell fragments. Slight hydrogen sulfide odor present.	
No	SH-08-SC-23	3	Same as above.	
No	SH-08-SC-34	4	Very dark olive gray gravelly SAND, shell fragments, trace amounts of silt. Slight hydrogen sulfide odor present.	SW

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SEDIMENT CORE LOG

Sample Station Number: SH-08-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/6/08 14:45
Project number	06-03386-007	Date/Time Core Processed	10/6/08 16:30
Client	Ecology	Latitude / Longitude	47.210763 / -123.089097
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet, 8 inches
Photo number	006	Core Recovery (percent)	5 feet (65%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Very dark olive gray gravelly SAND, shell fragments, trace amounts of silt. Slight hydrogen sulfide odor present.	SW
		6	Total core recovery 5 feet.	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-09-SC

Sheet 1 of 1

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Brady Hanson/Kyle Graunke
Photo number: 007 and 008
Date/Time Core Collected: 10/1/08 13:50
Date/Time Core Processed: 10/1/08 18:00
Latitude: 47.210707 Longitude: -123.085754
Core Penetration: 4 feet, 4 inches
Core Recovery (percent): 3 feet, 4 inches (77%)
Notes: Processed samples from second core of three attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 1% wood chips	SH-09-SC-01	1	Dark olive gray silty SAND.	SM
No	SH-09-SC-12	2	Dark olive gray sandy GRAVEL with silt; cobble layer at 1 foot, 5 inches. 2-inch thick layer of leaves and twigs from 6 to 8 inches.	GW
No	SH-09-SC-23	3	Same as above.	
		4	Total core recovery 3 feet.	

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SEDIMENT CORE LOG

Sample Station Number: SH-10-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 009

Date/Time Core Collected: 9/30/08 13:30
Date/Time Core Processed: 10/1/08 14:50
Latitude: 47.211575 Longitude: -123.083235
Core Penetration: 7 feet, 10 inches
Core Recovery (percent): 5 feet, 7 ½ inches (72%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-10-SC-01	1	Dark olive gray, clayey SAND, shell fragments, trace amounts of silt. Hydrogen sulfide odor present.	SC
Yes 20% bark	SH-10-SC-12	2	Dark olive gray sandy SILT, shell fragments, trace amounts of clay. Hydrogen sulfide odor present.	ML
Yes 20% bark	SH-10-SC-23	3	Same as above.	
Yes 10% bark	SH-10-SC-34	4	Dark olive gray sandy SILT, shell fragments, trace amounts of clay.	

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SEDIMENT CORE LOG

Sample Station Number: SH-10-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	9/30/08 13:30
Project number	06-03386-007	Date/Time Core Processed	10/1/08 14:50
Client	Ecology	Latitude / Longitude	47.211575 / -123.083235
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	7 feet, 10 inches
Photo number	009	Core Recovery (percent)	5 feet, 7 ½ inches (72%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Dark olive gray sandy SILT, shell fragments, trace amounts of clay. Hydrogen sulfide odor present.	ML
No			Same as above.	
		6 7 8	Total core recovery 5 feet, 7 ½ inches.	

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SEDIMENT CORE LOG

Sample Station Number SH-11-SC

Sheet 1 of 2

Project name Oakland Bay Sediment Characterization

Project number 06-03386-007

Client Ecology

HEC Samplers Bruce Carpenter/Diana Phelan

Photo number 011

Date/Time Core Collected 10/14/08 11:17

Date/Time Core Processed 10/14/08 12:00

Latitude 47.207966 Longitude -123.094195

Core Penetration 6 feet, 8 inches

Core Recovery (percent) 4 feet, 7 inches (69%)

Notes Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% wood chips	SH-11-SC-01	1	Dark olive gray SILT, with trace amounts of clay. Crab in core, some eel grass. Hydrogen sulfide odor present.	ML
Yes Less than 5% wood chips	SH-11-SC-12	2	Olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	
No	SH-11-SC-23	3	Same as above.	
			Dark brown sandy GRAVEL with cobbles, trace amounts of twigs. Hydrogen sulfide odor present.	GW
Yes Less than 1% bark (2 pieces)	SH-11-SC-34	4	Dark brown SILT, trace amounts of clay.	ML
			Dark brown sandy GRAVEL with cobbles.	GW

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SEDIMENT CORE LOG

Sample Station Number: SH-11-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 011
Notes: Processed samples from second core of two attempts.

Date/Time Core Collected: 10/14/08 11:17
Date/Time Core Processed: 10/14/08 12:00
Latitude: 47.207966 Longitude: -123.094195
Core Penetration: 6 feet, 8 inches
Core Recovery (percent): 4 feet, 7 inches (69%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Dark brown sandy GRAVEL with cobbles.	GW
			Total core recovery 4 feet, 7 inches.	
		5		
		6		
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-12-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 012
Notes: Processed samples from third core of three attempts.

Date/Time Core Collected: 10/2/08 13:20
Date/Time Core Processed: 10/2/08 15:30
Latitude: 47.207338 Longitude: -123.094080
Core Penetration: 6 feet, 11 inches
Core Recovery (percent): 5 feet, 4 inches (77%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% wood fibers Less than 5% wood chips	SH-12-SC-01	1	Olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes 10% wood fibers Less than 5% wood chips Less than 1% bark	SH-12-SC-12	2	Same as above.	
Yes 10% wood fibers Less than 5% wood chips	SH-12-SC-23	3	Same as above.	
Yes 10% wood fibers	SH-12-SC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: SH-12-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/2/08 13:20
Project number	06-03386-007	Date/Time Core Processed	10/2/08 15:30
Client	Ecology	Latitude / Longitude	47.207338 / -123.094080
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	6 feet, 11 inches
Photo number	012	Core Recovery (percent)	5 feet, 4 inches (77%)

Notes: Processed samples from third core of three attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% wood fibers			Gray silty SAND.	SM
Yes 50% wood fibers 10% bark 5% wood chips		5	Gray sandy SILT, trace amounts of clay.	ML
		6 7 8	Total core recovery 5 feet, 4 inches	

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SEDIMENT CORE LOG

Sample Station Number: SH-12-SC

Sheet 1 of 3

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/20/08 16:05
Project number	06-03386-007	Date/Time Core Processed	10/20/08 17:00
Client	Ecology	Latitude / Longitude	47.207330 / -123.094048
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	11 feet, 1 inch
Photo number	012 and 013	Core Recovery (percent)	10 feet, 5 inches (94%)
Notes	One core attempt at this location.		

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% wood fibers		1	Olive gray clayey SILT.	ML
Yes Less than 5% wood fibers		2	Same as above.	
Yes Less than 5% wood fibers		3	Same as above.	
Yes Less than 5% wood fibers		4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number SH-12-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/20/08 16:05
Project number	06-03386-007	Date/Time Core Processed	10/20/08 17:00
Client	Ecology	Latitude / Longitude	47.207330 / -123.094048
HEC Samplers	Bruce Carpenter/ Diana Phelan	Core Penetration	11 feet, 1 inch
Photo number	012 and 013	Core Recovery (percent)	10 feet, 5 inches (94%)
Notes	One core attempt at this location.		

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% bark	SH-12-SC-45	5	Olive gray clayey SILT. Hydrogen sulfide odor present.	ML
Yes 5% bark 10% wood fibers	SH-12-SC-56	6	Same as above.	
Yes 75% sawdust	SH-12-SC-67	7	Same as above.	
Yes 100% sawdust		8	Sawdust.	

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SEDIMENT CORE LOG

Sample Station Number SH-12-SC

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/ Diana Phelan
Photo number 012 and 013
Notes Log represents one core attempt at this location.

Date/Time Core Collected 10/20/08 16:05
Date/Time Core Processed 10/20/08 17:00
Latitude 47.207330 Longitude -123.094048
Core Penetration 11 feet, 1 inch
Core Recovery (percent) 10 feet, 5 inches (94%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 100% sawdust		9	Sawdust.	
Yes 100% sawdust		10	Same as above.	
Yes 85% sawdust	SH-12-SC-1011		Olive gray clayey SILT.	ML
		11 12	Total core recovery 10 feet, 5 inches	

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SEDIMENT CORE LOG

Sample Station Number: SH-13-SC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/14/08 16:20
Project number	06-03386-007	Date/Time Core Processed	10/15/08 09:00
Client	Ecology	Latitude 47.206356	Longitude -123.092717
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	6 feet, 8 inches
Photo number	014	Core Recovery (percent)	5 feet, 8 inches (85%)

Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 1% wood fibers	SH-13-SC-01	1	Olive gray sandy SILT. Slight hydrogen sulfide odor present.	ML
Yes Less than 1% wood fibers	SH-13-SC-12		Olive gray sandy GRAVEL with cobbles, few shell fragments. Hydrogen sulfide odor present.	GW
Yes Less than 1% wood chips		2	Olive gray clayey SILT, trace amounts of sand.	ML
Yes Less than 1% wood fibers	SH-13-SC-23		Same as above. Hydrogen sulfide odor present.	
Yes Less than 5% wood fibers; less than 5% bark		3	Olive gray sandy GRAVEL.	GW
Yes Less than 5% wood fibers; less than 5% bark	SH-13-SC-34		Same as above.	
Yes 5% wood fibers		4	Olive gray clayey SILT, trace amounts of sand.	ML

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SEDIMENT CORE LOG

Sample Station Number: SH-13-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization
Project number	06-03386-007
Client	Ecology
HEC Samplers	Bruce Carpenter/Diana Phelan
Photo number	014
Date/Time Core Collected	10/14/08 16:20
Date/Time Core Processed	10/15/08 09:00
Latitude	47.206356
Longitude	-123.092717
Core Penetration	6 feet, 8 inches
Core Recovery (percent)	5 feet, 8 inches (85%)
Notes	Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 5% wood fibers			Olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes			Olive gray sandy GRAVEL, trace amounts of silt.	GW
Yes		5	Olive gray sandy SILT. Hydrogen sulfide odor present.	ML
Yes Less than 1% bark			Olive gray clayey SILT.	ML
		6	Total core recovery 5 feet, 8 inches	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number SH-14-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 015
Date/Time Core Collected: 9/30/08 16:08
Date/Time Core Processed: 9/30/08 17:30
Latitude: 47.208749 Longitude: -123.080774
Core Penetration: 8 feet
Core Recovery (percent): 6 feet, 9 inches (84%)
Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% bark	SH-14-SC-01	1	Dark olive gray sandy SILT, shell fragments, trace amounts of clay. Hydrogen sulfide odor present.	ML
Yes 10% bark	SH-14-SC-12	2	Same as above.	
Yes 10% bark	SH-14-SC-23	3	Dark olive gray clayey SILT, shell fragments, trace amounts of sand. Hydrogen sulfide odor present.	ML
No	SH-14-SC-34	4	Light olive gray clayey SILT, shell fragments, trace amounts of sand. Hydrogen sulfide odor present.	

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SEDIMENT CORE LOG

Sample Station Number SH-14-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	9/30/08 16:08
Project number	06-03386-007	Date/Time Core Processed	9/30/08 17:30
Client	Ecology	Latitude 47.208749	Longitude -123.080774
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	015	Core Recovery (percent)	6 feet, 9 inches (84%)

Notes Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Light olive gray clayey SILT, shell fragments, trace amounts of sand.	ML
		5		
No			Same as above.	
		6		
No			Same as above	
			Total core recovery 6 feet, 9 inches.	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-15-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 016
Date/Time Core Collected: 10/1/08 14:31
Date/Time Core Processed: 10/1/08 16:20
Latitude: 47. 210102 Longitude: -123.077238
Core Penetration: 8 feet
Core Recovery (percent): 6 feet, 3 inches (78%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-15-SC-01	1	Dark olive gray to gray, fine-grained SAND, trace amounts of silt.	SW
No	SH-15-SC-12	2	Same as above, trace amounts of shell fragments.	
No	SH-15-SC-23	3	Same as above.	
No	SH-15-SC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number SH-15-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/1/08 14:31
Project number	06-03386-007	Date/Time Core Processed	10/1/08 16:20
Client	Ecology	Latitude 47. 210102	Longitude -123.077238
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	016	Core Recovery (percent)	6 feet, 3 inches (78%)

Notes Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Dark olive gray to gray SAND, trace amounts of silt and shell fragments.	SW
No		6	Same as above.	
		7 8	Total core recovery 6 feet, 3 inches.	

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SEDIMENT CORE LOG

Sample Station Number: SH-16-SC

Sheet 1 of 1

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/2/08 10:05
Project number	06-03386-007	Date/Time Core Processed	10/2/08 12:00
Client	Ecology	Latitude / Longitude	47.213596 / -123.078112
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	4 feet, 7 inches
Photo number	017	Core Recovery (percent)	2 feet, 8 inches (58%)

Notes: Processed samples from first core of three attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-16-SC-01		Tan medium- to coarse-grained SAND, shell fragments, trace amounts of silt.	SW
		1	Black medium- to coarse-grained SAND, shell fragments.	SW
Yes Less than 1% wood chips	SH-16-SC-12	2	Same as above.	
No			Same as above.	
		3	Total core recovery 2 feet, 8 inches.	
		4		

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SEDIMENT CORE LOG

Sample Station Number: SH-17-RI

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/15/08 12:50
Project number	06-03386-007	Date/Time Core Processed	10/15/08 16:00
Client	Ecology	Latitude / Longitude	47.211520 / -123.086362
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	9 feet
Photo number	018	Core Recovery (percent)	6 feet, 1 inch (68%)

Notes: Processed samples from second core of two attempts. Samples collected every 3-centimeter intervals to 4 feet.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% wood chips		1	Dark olive gray clayey SILT, trace amounts of sand.	ML
No		2	Dark olive gray gravelly SAND, trace amounts of silt.	SW
No			Dark olive gray sandy GRAVEL, trace amounts of silt.	GW
Yes 5% bark		3 4	Dark olive gray sandy SILT, trace amounts of gravel.	ML

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SEDIMENT CORE LOG

Sample Station Number SH-17-RI

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/15/08 12:50
Project number	06-03386-007	Date/Time Core Processed	10/15/08 16:00
Client	Ecology	Latitude 47.211520	Longitude -123.086362
HEC Samplers	Bruce Carpenter/Diana Phelan	Core Penetration	9 feet
Photo number	018	Core Recovery (percent)	6 feet, 1 inch (68%)

Notes Processed samples from second core of two attempts. Samples collected every 3-centimeter intervals to 4 feet.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% bark		5	Dark olive gray sandy SILT, trace amounts of clay.	ML
Yes Less than 5% bark		6	Same as above.	
		7 8	Total core recovery 6 feet, 1 inch.	

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SEDIMENT CORE LOG

Sample Station Number: SH-18-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 019
Notes: One core attempt at this location.

Date/Time Core Collected: 10/2/08 13:57
Date/Time Core Processed: 10/2/08 16:30
Latitude: 47.208720 Longitude: -123.094097
Core Penetration: 8 feet
Core Recovery (percent): 5 feet, 5 inches (68%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% wood fibers 5% bark 5% wood chips	SH-18-WC-01	1	Dark olive gray clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes 10% wood fibers 5% bark	SH-18-WC-12	2	Same as above.	
Yes 25% wood fibers 5% bark	SH-18-WC-23	3	Same as above.	
Yes 20% wood fibers 5% bark	SH-18-WC-34	4	Same as above, trace amounts of gravel.	

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SEDIMENT CORE LOG

Sample Station Number: SH-18-WC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/2/08 13:57
Project number	06-03386-007	Date/Time Core Processed	10/2/08 16:30
Client	Ecology	Latitude / Longitude	47.208720 / -123.094097
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	019	Core Recovery (percent)	5 feet, 5 inches (68%)

Notes: One core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
			Dark olive gray clayey SILT, trace amounts of sand.	ML
No			Gray sandy GRAVEL.	GW
No		5	Reddish brown poorly-graded medium-grained SAND	SP
		6	Total core recovery 5 feet, 5 inches.	
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-19-WC

Sheet 1 of 1

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/14/08 13:05
Project number	06-03386-007	Date/Time Core Processed	10/14/08 13:45
Client	Ecology	Latitude 47.207886	Longitude -123.092448
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	5 feet, 4 inches
Photo number	020	Core Recovery (percent)	4 feet, 1 inch (77%)

Notes: Second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 1% wood chips	SH-19-WC-01	1	Olive gray SILT, trace amounts of sand and clay.	ML
Yes Less than 1% wood chips	SH-19-WC-12	2	Same as above.	
No	SH-19-WC-23		Brown SILT, trace amounts of clay and sand.	ML
No		3	Grayish brown sandy GRAVEL with cobbles, trace amounts of silt.	GW
No	SH-19-WC-34	4	Same as above.	
			Total core recovery 4 feet, 1 inch.	

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SEDIMENT CORE LOG

Sample Station Number: SH-20-WC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/7/08 10:30
Project number	06-03386-007	Date/Time Core Processed	10/7/08 12:00
Client	Ecology	Latitude / Longitude	47.206894 / -123.090489
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	6 feet, 11 inches
Photo number	021	Core Recovery (percent)	5 feet, 3 inches (76%)
Notes	Second core of two attempts.		

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-20-WC-01	1	Dark olive gray slightly clayey SILT, trace amounts of sand, few shell fragments. Hydrogen sulfide odor present.	ML
Yes 5% bark	SH-20-WC-12	2	Dark olive gray clayey SILT, few shell fragments.	
Yes Less than 1% bark	SH-20-WC-23	3	Dark olive gray clayey SILT, trace amounts of sand and gravel.	
No	SH-20-WC-34		Same as above.	
No		4	Dark olive gray gravelly SAND, trace amounts of silt.	SW

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SEDIMENT CORE LOG

Sample Station Number: SH-20-WC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/7/08 10:30
Project number	06-03386-007	Date/Time Core Processed	10/7/08 12:00
Client	Ecology	Latitude / Longitude	47.206894 / -123.090489
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	6 feet, 11 inches
Photo number	021	Core Recovery (percent)	5 feet, 3 inches (76%)
Notes	Second core of two attempts.		

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray silty CLAY.	CL
No		5	Brown gravelly SAND.	SW
		6 7 8	Total core recovery 5 feet, 3 inches	

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SEDIMENT CORE LOG

Sample Station Number SH-21-WC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/2/08 09:10
Project number	06-03386-007	Date/Time Core Processed	10/2/08 09:50
Client	Ecology	Latitude / Longitude	47.208772 / -123.089710
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	6 feet, 11 inches
Photo number	022	Core Recovery (percent)	5 feet, 4 inches (77%)

Notes Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 20% wood chips 5% wood fibers	SH-21-WC-01	1	Dark brown to black, clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes 20% wood chips 5% wood fibers	SH-21-WC-12	2	Same as above.	
Yes 20% wood chips 20% wood fibers	SH-21-WC-23	3	Same as above.	
Yes 25% bark 15% wood chips 30% wood fibers	SH-21-WC-34	4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: SH-21-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 022
Date/Time Core Collected: 10/2/08 09:10
Date/Time Core Processed: 10/2/08 09:50
Latitude: 47.208772 Longitude: -123.089710
Core Penetration: 6 feet, 11 inches
Core Recovery (percent): 5 feet, 4 inches (77%)
Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 25% bark 15% wood chips 30% wood fibers		5	Dark brown to black, clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
		6 7 8	Total core recovery 5 feet, 4 inches.	

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SEDIMENT CORE LOG

Sample Station Number: SH-21-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 023 and 024
Notes: Second core of two attempts.

Date/Time Core Collected: 10/15/08 14:45
Date/Time Core Processed: 10/15/08 18:30
Latitude: 47.208754 Longitude: -123.089651
Core Penetration: 12 feet
Core Recovery (percent): 12 feet (100%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 25% bark		1	Dark brown to black clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes 25% bark		2	Same as above.	
Yes 25% bark		3	Same as above.	
Yes 20% bark		4	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: SH-21-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 023 and 024
Notes: Second core of two attempts.

Date/Time Core Collected: 10/15/08 14:45
Date/Time Core Processed: 10/15/08 18:30
Latitude: 47.208754 Longitude: -123.089651
Core Penetration: 12 feet
Core Recovery (percent): 12 feet (100%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 5% bark	SH-21-WC-45	5	Dark brown to black clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes Less than 5% bark	SH-21-WC-56	6	Same as above.	
Yes Less than 5% bark	SH-21-WC-67	7	Same as above.	
Yes 5% bark	SH-21-WC-78	8	Same as above.	

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SEDIMENT CORE LOG

Sample Station Number: SH-21-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Diana Phelan
Photo number: 023 and 024
Notes: Log represents second core of two attempts.

Date/Time Core Collected: 10/15/08 14:45
Date/Time Core Processed: 10/15/08 18:30
Latitude: 47.208754 Longitude: -123.089651
Core Penetration: 12 feet
Core Recovery (percent): 12 feet (100%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% bark	SH-21-WC-89	9	Dark brown to black clayey SILT, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes 2% bark	SH-21-WC-910	10	Same as above.	
Yes Less than 5% bark	SH-21-WC-1011	11	Same as above.	
Yes 1% bark	SH-21-WC-1112	12	Same as above.	
			Total core recovery 12 feet.	

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SEDIMENT CORE LOG

Sample Station Number: SH-22-WC

Sheet 1 of 1

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 025
Notes: First core of three attempts.

Date/Time Core Collected: 10/6/08 16:30
Date/Time Core Processed: 10/7/08 08:50
Latitude: 47.208042 Longitude: -123.086823
Core Penetration: 3 feet, 1 inch
Core Recovery (percent): 2 feet, 6 inches (81%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 20% bark	SH-22-WC-01	1	Very dark olive gray SILT, trace amounts of sand and clay. Hydrogen sulfide odor present.	ML
Yes 25% bark	SH-22-WC-12	2	Very dark olive gray sandy SILT, trace amounts of clay. Hydrogen sulfide odor present.	
Yes 40% bark Less than 1% wood chips	SH-22-WC-23		Dark olive gray clayey SILT, shell fragments, trace amounts of sand. Hydrogen sulfide odor present.	
		3 4	Total core recovery 2 feet, 6 inches.	

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SEDIMENT CORE LOG

Sample Station Number: SH-23-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 026
Date/Time Core Collected: 9/30/08 16:44
Date/Time Core Processed: 9/30/08 18:20
Latitude: 47.208292 Longitude: -123.084487
Core Penetration: 8 feet
Core Recovery (percent): 6 feet, 9 inches (84%)
Notes: Processed samples from one core attempt at this location.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes Less than 5% bark	SH-23-SC-01	1	Dark olive gray sandy SILT, trace amounts of clay, shell fragments. Hydrogen sulfide odor present.	ML
Yes 10% bark	SH-23-SC-12	2	Same as above.	
Yes 10% bark	SH-23-SC-23	3	Same as above.	
No	SH-23-SC-34	4	Dark olive gray clayey SILT, shell fragments.	ML

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SEDIMENT CORE LOG

Sample Station Number: SH-23-SC

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	9/30/08 16:44
Project number	06-03386-007	Date/Time Core Processed	9/30/08 18:20
Client	Ecology	Latitude 47.208292	Longitude -123.084487
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	026	Core Recovery (percent)	6 feet, 9 inches (84%)

Notes: Processed samples from one core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No		5	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present/	ML
No		6	Same as above.	
No			Same as above.	
		7 8	Total core recovery 6 feet, 9 inches.	

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SEDIMENT CORE LOG

Sample Station Number SH-26-WC

Project name Oakland Bay Sediment Characterization
Project number 06-03386-007
Client Ecology
HEC Samplers Bruce Carpenter/Gina Catarra
Photo number 027
Notes One core attempt at this location.

Date/Time Core Collected 10/6/08 12:40
Date/Time Core Processed 10/6/08 15:30
Latitude 47.211604 Longitude -123.089908
Core Penetration 6 feet, 10 inches
Core Recovery (percent) 4 feet, 8 inches (68%)

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-26-WC-01	1	Grayish brown coarse-grained SAND, trace amounts of silt and gravel, shell. fragments. Slight hydrogen sulfide odor present.	SP
No	SH-26-WC-12	2	Same as above, one twig present.	
No	SH-26-WC-23		Same as above.	
No		3	Very dark gray to black silty SAND. Slight hydrogen sulfide odor present.	SM
No	SH-26-WC-34		Same as above.	
No		4	Very dark gray to black clayey SILT, trace amounts of sand. Slight hydrogen sulfide odor present.	ML

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SEDIMENT CORE LOG

Sample Station Number: SH-26-WC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 027
Notes: One core attempt at this location.

Date/Time Core Collected: 10/6/08 12:40
Date/Time Core Processed: 10/6/08 15:30
Latitude: 47.211604 Longitude: -123.089908
Core Penetration: 6 feet, 10 inches
Core Recovery (percent): 4 feet, 8 inches (68%)

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Very dark gray to black clayey SILT, trace amounts of sand. Slight hydrogen sulfide odor present.	ML
		5	Total core recovery 4 feet, 8 inches.	
		6		
		7		
		8		

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SEDIMENT CORE LOG

Sample Station Number: SH-27-WC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/6/08 11:45
Project number	06-03386-007	Date/Time Core Processed	10/6/08 14:15
Client	Ecology	Latitude / Longitude	47.212037 / -123.087788
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet
Photo number	028	Core Recovery (percent)	6 feet, 3 inches (89%)
Notes	One core attempt at this location.		

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 10% bark 10% twigs	SH-27-WC-01	1	Dark gray to black SILT, trace amounts of sand and clay.	ML
Yes 5% wood chunks 5% twigs	SH-27-WC-12		Same as above. Hydrogen sulfide odor present.	
		2	Olive gray silty SAND, trace amounts of gravel.	SM
Yes 5% wood chunks	SH-27-WC-23	3	Olive gray gravelly SAND, trace amounts of silt. Hydrogen sulfide odor present.	SW
Yes Less than 1% wood chunks	SH-27-WC-34	4	Same as above, shell fragments.	

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SEDIMENT CORE LOG

Sample Station Number: SH-27-WC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/6/08 11:45
Project number	06-03386-007	Date/Time Core Processed	10/6/08 14:15
Client	Ecology	Latitude / Longitude	47.212037 / -123.087788
HEC Samplers	Bruce Carpenter/Gina Catarra	Core Penetration	7 feet
Photo number	028	Core Recovery (percent)	6 feet, 3 inches (89%)

Notes: One core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray poorly-graded SAND, trace amounts of gravel and silt, shell fragments. Hydrogen sulfide odor present.	SP
		5		
No			Same as above.	
		6		
			Total core recovery 6 feet, 3 inches.	
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: SH-28-SC

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Brady Hanson
Photo number: 029
Date/Time Core Collected: 9/30/08 15:04
Date/Time Core Processed: 9/30/08 19:00
Latitude: 47.210426 Longitude: -123.081994
Core Penetration: 8 feet
Core Recovery (percent): 6 feet, 7.5 inches (83%)
Notes: Processed samples from second core of two attempts.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 20% bark	SH-28-SC-01	1	Dark olive gray sandy SILT, trace amounts of shell fragments. Hydrogen sulfide odor present.	ML
Yes 10% bark	SH-28-SC-12	2	Same as above.	
Yes 10% bark	SH-28-SC-23	3	Dark olive gray clayey SILT, some shell fragments, trace amounts of sand. Hydrogen sulfide odor present.	ML
Yes Less than 5% bark	SH-28-SC-34	4	Same as above, abundant amounts of large shell fragments.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: SH-28-SC

Sheet 2 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	9/30/08 15:04
Project number	06-03386-007	Date/Time Core Processed	9/30/08 19:00
Client	Ecology	Latitude / Longitude	47.210426 / -123.081994
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	029	Core Recovery (percent)	6 feet, 7.5 inches (83%)

Notes: Processed samples from second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Dark olive gray clayey SILT, trace amounts of sand, abundant amounts of shell fragments. Hydrogen sulfide odor present.	ML
		5		
No			Same as above.	
		6		
No			Same as above.	
			Total core recovery 6 feet, 7.5 inches.	
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: SH-29-WC

Sheet 1 of 2

Project name: Oakland Bay Sediment Characterization
Project number: 06-03386-007
Client: Ecology
HEC Samplers: Bruce Carpenter/Gina Catarra
Photo number: 030
Date/Time Core Collected: 10/6/08 10:38
Date/Time Core Processed: 10/6/08 13:15
Latitude: 47.211880 Longitude: -123.078134
Core Penetration: 7 feet, 1 inch
Core Recovery (percent): 6 feet, 6 inches (92%)
Notes: Second core of two attempts. No samples processed from this core.

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No	SH-29-WC-01	1	Dark gray to black slightly silty fine- to medium-grained SAND, trace amounts of gravel, shell fragments.	SP-SM
Yes Less than 1% bark	SH-29-WC-12	2	Same as above.	
Yes Less than 5% bark	SH-29-WC-23	3	Same as above. Hydrogen sulfide odor present.	
No	SH-29-WC-34	4	Same as above. Hydrogen sulfide odor present.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: SH-29-WC

Sheet 2 of 2

Project name: Oakland Bay Sediment Characterization	Date/Time Core Collected: 10/6/08 10:38
Project number: 06-03386-007	Date/Time Core Processed: 10/6/08 13:15
Client: Ecology	Latitude: 47.211880 Longitude: -123.078134
HEC Samplers: Bruce Carpenter/Gina Catarra	Core Penetration: 7 feet, 1 inch
Photo number: 030	Core Recovery (percent): 6 feet, 6 inches (92%)

Notes: Second core of two attempts.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Dark gray to black fine- to medium-grained SAND, trace amounts of silt and gravel, shell fragments. Hydrogen sulfide odor present.	SP
		5		
Yes Less than 1% wood			Same as above.	
		6		
No			Same as above.	
			Total core recovery 6 feet, 6 inches.	
		7		
		8		

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: SH-30-WC

Sheet 1 of 2

Project name	Oakland Bay Sediment Characterization	Date/Time Core Collected	10/2/08 11:45
Project number	06-03386-007	Date/Time Core Processed	10/2/08 13:30
Client	Ecology	Latitude 47.214335	Longitude -123.083965
HEC Samplers	Bruce Carpenter/Brady Hanson	Core Penetration	8 feet
Photo number	031	Core Recovery (percent)	6 feet, 6 inches (83%)
Notes	One core attempt at this location.		

Wood (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
Yes 5% bark	SH-30-WC-01	1	Dark gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
No	SH-30-WC-12	2	Olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	
No	SH-30-WC-23	3	Same as above.	
No	SH-30-WC-34	4	Same as above.	

HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT CORE LOG

Sample Station Number: SH-30-WC

Sheet 2 of 2

Project name: Oakland Bay Sediment Characterization	Date/Time Core Collected: 10/2/08 11:45
Project number: 06-03386-007	Date/Time Core Processed: 10/2/08 13:30
Client: Ecology	Latitude: 47.214335 Longitude: -123.083965
HEC Samplers: Bruce Carpenter/Brady Hanson	Core Penetration: 8 feet
Photo number: 031	Core Recovery (percent): 6 feet, 6 inches (83%)

Notes: One core attempt at this location.

Wood chips (Y or N)/Percent	Sample ID and Interval	Depth (feet)	Soil Description / Comments	Sediment Core Log
No			Olive gray clayey SILT, trace amounts of sand, shell fragments. Hydrogen sulfide odor present.	ML
		5		
No			Same as above.	
		6		
No			Same as above.	
			Total core recovery 6 feet, 6 inches.	
		7		
		8		

APPENDIX C

Sample Summary Information

Table C-1. Samples collected and analyzed in Shelton Harbor.

Sample ID	Date Collected	Date Received by Lab				Analyses performed														
		ARI	Test America	NewFields	Axys	TOC	Grain Size	SVOCs	Resin Acids	Pesticides	PCBs	Dioxin	TPH	TBT	Metals	Sulfides	Ammonia	TVS	Pb210	Bioassay
SH-01-SS-00	9/29/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X		X	X	X	X	X	X	X	X			X
SH-01-SC-01	10/1/2008	10/6/2008	NA	NA	NA															
SH-01-SC-12	10/1/2008	10/6/2008	10/3/2008	NA	NA	X	X	X		X	X		X	X	X	X	X			
SH-01-SC-23	10/1/2008	10/6/2008	NA	NA	NA															
SH-01-SC-34	10/1/2008	10/6/2008	NA	NA	NA															
SH-02-SS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X		X	X	X	X	X	X	X	X			X
SH-02-SC-01	10/7/2008	10/8/2008	NA	NA	NA															
SH-02-SC-12	10/7/2008	10/8/2008	10/8/2008	NA	NA	X	X	X		X	X		X	X	X	X	X			
SH-02-SC-23	10/7/2008	10/8/2008	NA	NA	NA							X								
SH-02-SC-34	10/7/2008	10/8/2008	NA	NA	NA															
SH-03-SS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/14/2008	X	X	X		X	X	X			X	X	X			X
SH-04-SS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-04-SC-01	10/15/2008	10/17/2008	NA	NA	NA															
SH-04-SC-12	10/15/2008	10/17/2008	10/16/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-04-SC-23	10/15/2008	10/17/2008	NA	NA	NA							X								
SH-04-SC-34	10/15/2008	10/17/2008	NA	NA	NA															
SH-05-SS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X	X		X	X	X			X
SH-05-SC-01	10/15/2008	10/17/2008	NA	NA	NA															
SH-05-SC-12	10/15/2008	10/17/2008	10/16/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-07-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-07-SC-01	10/15/2008	10/17/2008	NA	NA	NA															
SH-07-SC-12	10/15/2008	10/17/2008	10/16/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-07-SC-23	10/15/2008	10/17/2008	NA	NA	NA															
SH-07-SC-34	10/15/2008	10/17/2008	NA	NA	NA															
SH-08-SC-01	10/6/2008	10/8/2008	NA	NA	NA															
SH-08-SC-12	10/6/2008	10/8/2008	10/8/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-08-SC-23	10/6/2008	10/8/2008	NA	NA	NA															
SH-08-SC-34	10/6/2008	10/8/2008	NA	NA	NA															
SH-09-SS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-09-SC-01	10/1/2008	10/6/2008	NA	NA	NA															
SH-09-SC-12	10/1/2008	10/6/2008	10/3/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-09-SC-23	10/1/2008	10/6/2008	NA	NA	NA							X								
SH-10-SS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-10-SC-01	9/30/2008	10/2/2008	NA	NA	NA															
SH-10-SC-12	9/30/2008	10/2/2008	10/1/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-10-SC-23	9/30/2008	10/2/2008	NA	NA	NA							X								
SH-10-SC-34	9/30/2008	10/2/2008	NA	NA	NA															
SH-11-SS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-11-SC-01	10/14/2008	10/15/2008	NA	NA	NA															
SH-11-SC-12	10/14/2008	10/15/2008	10/15/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-11-SC-23	10/14/2008	10/15/2008	NA	NA	NA															
SH-11-SC-34	10/14/2008	10/15/2008	NA	NA	NA															
SH-12-SS-00	10/2/2008	10/6/2008	10/13/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-12-SC-01	10/2/2008	10/6/2008	NA	NA	NA															
SH-12-SC-12	10/2/2008	10/6/2008	10/3/2008	NA	NA	X	X	X		X	X	X			X	X	X			
SH-12-SC-23	10/2/2008	10/6/2008	NA	NA	NA							X								
SH-12-SC-34	10/2/2008	10/6/2008	NA	NA	NA															
SH-12-SC-45	10/20/2008	10/21/2008	NA	NA	NA															
SH-12-SC-56	10/20/2008	10/21/2008	NA	NA	NA															

Table C-1 (continued). Samples collected and analyzed in Shelton Harbor.

Sample	Date	Date Received by Lab				Analyses performed														
ID	Collected	ARI	Test America	NewFields	Axys	TOC	Grain Size	SVOCs	Resin Acids	Pesticides	PCBs	Dioxin	TPH	TBT	Metals	Sulfides	Ammonia	TVS	Pb210	Bioassay
SH-12-SC-67	10/20/2008	10/21/2008	NA	NA	NA															
SH-12-SC-1011	10/20/2008	10/21/2008	NA	NA	NA															
SH-13-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-13-SC-01	10/15/2008	10/17/2008	NA	NA	NA															
SH-13-SC-12	10/15/2008	10/17/2008	10/16/2008	NA	NA	X	X	X		X	X	X			X	X	X			
SH-13-SC-23	10/15/2008	10/17/2008	NA	NA	NA							X								
SH-13-SC-34	10/15/2008	10/17/2008	NA	NA	NA															
SH-14-SS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-14-SC-01	9/30/2008	10/2/2008	NA	NA	NA															
SH-14-SC-12	9/30/2008	10/2/2008	10/1/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-14-SC-23	9/30/2008	10/2/2008	NA	NA	NA							X								
SH-14-SC-34	9/30/2008	10/2/2008	NA	NA	NA															
SH-15-SS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-15-SC-01	10/1/2008	10/6/2008	NA	NA	NA															
SH-15-SC-12	10/1/2008	10/6/2008	10/3/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-15-SC-23	10/1/2008	10/6/2008	NA	NA	NA															
SH-15-SC-34	10/1/2008	10/6/2008	NA	NA	NA															
SH-16-SS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
SH-16-SC-01	10/2/2008	10/6/2008	NA	NA	NA															
SH-16-SC-12	10/2/2008	10/6/2008	10/3/2008	NA	NA	X	X	X		X	X				X	X	X			
SH-17-RI-04	10/15/2008	NA	10/16/2008	NA	NA														X	
SH-18-WS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X	X		X	X	X	X		X
SH-18-WC-01	10/2/2008	10/6/2008	NA	NA	NA															
SH-18-WC-12	10/2/2008	10/6/2008	10/3/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-18-WC-23	10/2/2008	10/6/2008	NA	NA	NA															
SH-18-WC-34	10/2/2008	10/6/2008	NA	NA	NA															
SH-19-WS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-19-WC-01	10/14/2008	10/15/2008	NA	NA	NA															
SH-19-WC-12	10/14/2008	10/15/2008	10/15/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-19-WC-23	10/14/2008	10/15/2008	NA	NA	NA															
SH-19-WC-34	10/14/2008	10/15/2008	NA	NA	NA															
SH-20-WS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X	X		X	X	X	X		X
SH-20-WC-01	10/7/2008	10/8/2008	NA	NA	NA															
SH-20-WC-12	10/7/2008	10/8/2008	10/8/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-20-WC-23	10/7/2008	10/8/2008	NA	NA	NA															
SH-20-WC-34	10/7/2008	10/8/2008	NA	NA	NA															
SH-21-WS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-21-WC-01	10/2/2008	10/6/2008	NA	NA	NA															
SH-21-WC-12	10/2/2008	10/6/2008	10/3/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-21-WC-23	10/2/2008	10/6/2008	NA	NA	NA															
SH-21-WC-34	10/2/2008	10/6/2008	NA	NA	NA															
SH-21-WC-45	10/15/2008	10/17/2008	NA	NA	NA															
SH-21-WC-56	10/15/2008	10/17/2008	NA	NA	NA															
SH-21-WC-67	10/15/2008	10/17/2008	NA	NA	NA															
SH-21-WC-78	10/15/2008	10/17/2008	NA	NA	NA															
SH-21-WC-89	10/15/2008	10/17/2008	NA	NA	NA															
SH-21-WC-910	10/15/2008	10/17/2008	NA	NA	NA															

Table C-1 (continued). Samples collected and analyzed in Shelton Harbor.

Sample	Date	Date Received by Lab				Analyses performed														
ID	Collected	ARI	Test America	NewFields	Axys	TOC	Grain Size	SVOCs	Resin Acids	Pesticides	PCBs	Dioxin	TPH	TBT	Metals	Sulfides	Ammonia	TVS	Pb210	Bioassay
SH-21-WC-1011	10/15/2008	10/17/2008	NA	NA	NA															
SH-21-WC-1112	10/15/2008	10/17/2008	NA	NA	NA															
SH-22-WS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-22-WC-01	10/7/2008	10/8/2008	NA	NA	NA															
SH-22-WC-12	10/7/2008	10/8/2008	10/8/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-22-WC-23	10/7/2008	10/8/2008	NA	NA	NA															
SH-23-WS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-23-WC-01	9/30/2008	10/2/2008	NA	NA	NA															
SH-23-WC-12	9/30/2008	10/2/2008	10/1/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-23-WC-23	9/30/2008	10/2/2008	NA	NA	NA															
SH-23-WC-34	9/30/2008	10/2/2008	NA	NA	NA															
SH-24-WS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-25-WS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-26-WS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-26-WC-01	10/6/2008	10/8/2008	NA	NA	NA															
SH-26-WC-12	10/6/2008	10/8/2008	10/8/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-26-WC-23	10/6/2008	10/8/2008	NA	NA	NA															
SH-26-WC-34	10/6/2008	10/8/2008	NA	NA	NA															
SH-27-WS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-27-WC-01	10/6/2008	10/8/2008	NA	NA	NA															
SH-27-WC-12	10/6/2008	10/8/2008	10/8/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-27-WC-23	10/6/2008	10/8/2008	NA	NA	NA															
SH-27-WC-34	10/6/2008	10/8/2008	NA	NA	NA															
SH-28-WS-00	9/30/2008	10/2/2008	10/1/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-28-WC-01	9/30/2008	10/2/2008	NA	NA	NA															
SH-28-WC-12	9/30/2008	10/2/2008	10/1/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-28-WC-23	9/30/2008	10/2/2008	NA	NA	NA															
SH-28-WC-34	9/30/2008	10/2/2008	NA	NA	NA															
SH-29-WS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
SH-29-WC-01	10/6/2008	10/8/2008	NA	NA	NA															
SH-29-WC-12	10/6/2008	10/8/2008	10/8/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
SH-29-WC-23	10/6/2008	10/8/2008	NA	NA	NA															
SH-29-WC-34	10/6/2008	10/8/2008	NA	NA	NA															
SH-30-WS-00	10/1/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X		X	X	X	X	X		X
SH-30-WC-01	10/2/2008	10/6/2008	NA	NA	NA															
SH-30-WC-12	10/2/2008	10/6/2008	10/3/2008	NA	NA	X	X	X	X	X	X			X	X	X	X	X		
SH-30-WC-23	10/2/2008	10/6/2008	NA	NA	NA															
SH-30-WC-34	10/2/2008	10/6/2008	NA	NA	NA															

NA = samples not submitted for analysis or archive

Table C-2. Samples collected and analyzed in Oakland Bay

Sample	Date	Date Received by Lab				Analyses performed														
ID	Collected	ARI	Test America	NewFields	Axys	TOC	Grain Size	SVOCs	Resin Acids	Pesticides	PCBs	Dioxin	TPH	TBT	Metals	Sulfides	Ammonia	TVS	Pb210	Bioassay
OB-01-SS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X	X		X	X	X			X
OB-01-SC-01	10/3/2008	10/8/2008	NA	NA	NA															
OB-01-SC-12	10/3/2008	10/8/2008	10/6/2008	NA	NA	X	X									X	X			
OB-01-SC-23	10/3/2008	10/8/2008	NA	NA	NA															
OB-01-SC-34	10/3/2008	10/8/2008	NA	NA	NA															
OB-02-SS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X			X
OB-02-SC-01	10/3/2008	10/8/2008	NA	NA	NA															
OB-02-SC-12	10/3/2008	10/8/2008	10/6/2008	NA	NA	X	X									X	X			
OB-02-SC-23	10/3/2008	10/8/2008	NA	NA	NA															
OB-02-SC-34	10/3/2008	10/8/2008	NA	NA	NA															
OB-03-SS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-03-SC-01	10/3/2002	10/8/2008	NA	NA	NA															
OB-03-SC-12	10/3/2002	10/8/2008	10/6/2008	NA	NA	X	X					X				X	X			
OB-03-SC-23	10/3/2002	10/8/2008	NA	NA	NA															
OB-03-SC-34	10/3/2002	10/8/2008	NA	NA	NA															
OB-04-SS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-04-SC-01	10/4/2008	10/8/2008	NA	NA	NA															
OB-04-SC-12	10/4/2008	10/8/2008	10/6/2008	NA	NA	X	X									X	X			
OB-04-SC-23	10/4/2008	10/8/2008	NA	NA	NA															
OB-04-SC-34	10/4/2008	10/8/2008	NA	NA	NA															
OB-05-SS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X			X
OB-05-SC-01	10/4/2008	10/8/2008	NA	NA	NA															
OB-05-SC-12	10/4/2008	10/8/2008	10/6/2008	NA	NA	X	X									X	X			
OB-05-SC-23	10/4/2008	10/8/2008	NA	NA	NA															
OB-05-SC-34	10/4/2008	10/8/2008	NA	NA	NA															
OB-06-SS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X			X
OB-06-SC-01	10/5/2008	10/8/2008	NA	NA	NA															
OB-06-SC-12	10/5/2008	10/8/2008	10/6/2008	NA	NA	X	X					X				X	X			
OB-06-SC-23	10/5/2008	10/8/2008	NA	NA	NA															
OB-06-SC-34	10/5/2008	10/8/2008	NA	NA	NA															
OB-07-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-07-SC-01	10/16/2008	10/17/2008	NA	NA	NA															
OB-07-SC-12	10/16/2008	10/17/2008	10/17/2008	NA	NA	X	X									X	X			
OB-07-SC-23	10/16/2008	10/17/2008	NA	NA	NA															
OB-07-SC-34	10/16/2008	10/17/2008	NA	NA	NA															
OB-08-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-08-SC-01	10/16/2008	10/17/2008	NA	NA	NA															
OB-08-SC-12	10/16/2008	10/17/2008	10/17/2008	NA	NA	X	X									X	X			
OB-08-SC-23	10/16/2008	10/17/2008	NA	NA	NA															
OB-08-SC-34	10/16/2008	10/17/2008	NA	NA	NA															
OB-09-SS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-09-SC-01	10/5/2008	10/8/2008	NA	NA	NA															
OB-09-SC-12	10/5/2008	10/8/2008	10/6/2008	NA	NA	X	X					X				X	X			
OB-09-SC-23	10/5/2008	10/8/2008	NA	NA	NA															
OB-09-SC-34	10/5/2008	10/8/2008	NA	NA	NA															
OB-10-SS-00	10/4/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X			X
OB-10-SC-01	10/5/2008	10/8/2008	NA	NA	NA															
OB-10-SC-12	10/5/2008	10/8/2008	10/6/2008	NA	NA	X	X					X				X	X			
OB-10-SC-23	10/5/2008	10/8/2008	NA	NA	NA															
OB-10-SC-34	10/5/2008	10/8/2008	NA	NA	NA															
OB-11-SS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-11-SC-01	10/8/2008	10/10/2008	NA	NA	NA															

Table C-2 (continued). Samples collected and analyzed in Oakland Bay.

Sample	Date	Date Received by Lab				Analyses performed														
ID	Collected	ARI	Test America	NewFields	Axys	TOC	Grain Size	SVOCs	Resin Acids	Pesticides	PCBs	Dioxin	TPH	TBT	Metals	Sulfides	Ammonia	TVS	Pb210	Bioassay
OB-11-SC-12	10/8/2008	10/10/2008	10/13/2008	NA	NA	X	X									X	X			
OB-11-SC-23	10/8/2008	10/10/2008	NA	NA	NA															
OB-11-SC-34	10/8/2008	10/10/2008	NA	NA	NA															
OB-12-SS-00	10/4/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X	X		X	X	X			X
OB-12-SC-01	10/4/2008	10/8/2008	NA	NA	NA															
OB-12-SC-12	10/4/2008	10/8/2008	10/6/2008	NA	NA	X	X					X				X	X			
OB-12-SC-23	10/4/2008	10/8/2008	NA	NA	NA															
OB-12-SC-34	10/4/2008	10/8/2008	NA	NA	NA															
OB-12-SC-45	10/20/2008	10/21/2008	NA	NA	NA															
OB-12-SC-56	10/20/2008	10/21/2008	NA	NA	NA															
OB-12-SC-67	10/20/2008	10/21/2008	NA	NA	NA															
OB-13-SS-00	10/4/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X	X		X	X	X			X
OB-13-SC-01	10/8/2008	10/10/2008	NA	NA	NA															
OB-13-SC-12	10/8/2008	10/10/2008	10/9/2009	NA	NA	X	X									X	X			
OB-13-SC-23	10/8/2008	10/10/2008	NA	NA	NA															
OB-14-SS-00	10/4/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
OB-14-SC-01	10/7/2008	10/8/2008	NA	NA	NA															
OB-14-SC-12	10/7/2008	10/8/2008	10/8/2008	NA	NA	X	X									X	X			
OB-14-SC-23	10/7/2008	10/8/2008	NA	NA	NA															
OB-14-SC-34	10/7/2008	10/8/2008	NA	NA	NA															
OB-15-RI-04	10/16/2008	NA	10/17/2008	NA	NA														X	
OB-16-RI-04	10/20/2008	NA	10/23/2008	NA	NA														X	
OB-17-WS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
OB-17-WC-01	10/6/2008	10/8/2008	NA	NA	NA															
OB-17-WC-12	10/6/2008	10/8/2008	10/8/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
OB-17-WC-23	10/6/2008	10/8/2008	NA	NA	NA															
OB-17-WC-34	10/6/2008	10/8/2008	NA	NA	NA															
OB-18-WS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
OB-18-WC-01	10/5/2008	10/8/2008	NA	NA	NA															
OB-18-WC-12	10/5/2008	10/8/2008	10/6/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
OB-18-WC-23	10/5/2008	10/8/2008	NA	NA	NA															
OB-18-WC-34	10/5/2008	10/8/2008	NA	NA	NA															
OB-19-WS-00	10/4/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X	X		X
OB-19-WC-01	10/5/2008	10/10/2008	NA	NA	NA															
OB-19-WC-12	10/5/2008	10/10/2008	10/13/2008	NA	NA	X	X	X	X	X	X				X	X	X	X		
OB-19-WC-23	10/5/2008	10/10/2008	NA	NA	NA															
OB-19-WC-34	10/5/2008	10/10/2008	NA	NA	NA															

NA = samples not submitted for analysis or archive

Table C-3. Samples collected and analyzed in Hammersley Inlet.

Sample	Date	Date Received by Lab				Analyses performed														
ID	Collected	ARI	Test America	NewFields	Axys	TOC	Grain size	SVOCs	Resin Acids	Pesticides	PCBs	Dioxin	TPH	TBT	Metals	Sulfides	Ammonia	TVS	Pb210	Bioassay
HI-01-SC-01	10/16/2008	10/17/2008	NA	NA	NA															
HI-01-SC-12	10/16/2008	10/17/2008	10/17/2008	NA	NA	X	X									X	X			
HI-01-SC-23	10/16/2008	10/17/2008	NA	NA	NA															
HI-01-SC-34	10/16/2008	10/17/2008	NA	NA	NA															
HI-02-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X			X
HI-02-SC-01	10/15/2008	10/17/2008	NA	NA	NA															
HI-02-SC-12	10/15/2008	10/17/2008	10/16/2008	NA	NA	X	X									X	X			
HI-02-SC-23	10/15/2008	10/17/2008	NA	NA	NA															
HI-02-SC-34	10/15/2008	10/17/2008	NA	NA	NA															
HI-03-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
HI-03-SC-01	10/14/2008	10/15/2008	NA	NA	NA															
HI-03-SC-12	10/14/2008	10/15/2008	10/15/2008	NA	NA	X	X									X	X			
HI-03-SC-23	10/14/2008	10/15/2008	NA	NA	NA															
HI-03-SC-34	10/14/2008	10/15/2008	NA	NA	NA															
HI-04-SS-00	10/5/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X	X	X	X	X			X	X	X			X
HI-04-SC-01	10/14/2008	10/15/2008	NA	NA	NA															
HI-04-SC-12	10/14/2008	10/15/2008	10/15/2008	NA	NA	X	X									X	X			
HI-04-SC-23	10/14/2008	10/15/2008	NA	NA	NA															
HI-04-SC-34	10/14/2008	10/15/2008	NA	NA	NA															
HI-05-SS-00	10/2/2008	10/6/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
HI-06-SS-00	10/3/2008	10/8/2008	10/6/2008	10/6/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
HI-06-SC-01	10/6/2008	10/8/2008	NA	NA	NA															
HI-06-SC-12	10/6/2008	10/8/2008	10/8/2008	NA	NA	X	X									X	X			
HI-06-SC-23	10/6/2008	10/8/2008	NA	NA	NA															
HI-06-SC-34	10/6/2008	10/8/2008	NA	NA	NA															
HI-07-SS-00	10/2/2008	10/8/2008	10/3/2008	10/3/2008	10/8/2008	X	X	X		X	X	X			X	X	X			X
HI-07-SC-01	10/3/2008	10/8/2008	NA	NA	NA															
HI-07-SC-12	10/3/2008	10/8/2008	10/6/2008	NA	NA	X	X									X	X			
HI-07-SC-23	10/3/2008	10/8/2008	NA	NA	NA															
HI-07-SC-34	10/3/2008	10/8/2008	NA	NA	NA															

NA = samples not submitted for analysis or archive

APPENDIX D

Sediment Record Forms

2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

SEDIMENT SAMPLE RECORD

PROJECT NAME: **Oakland Bay Sediment Characterization Study / 06-03386-007** DATES: **9/29/08 – 10/7/08, 10/14/08 – 10/16/08, 10/20/08**

LOCATION: **Hammersley Inlet** CREW: **GC, BC, BH, GI, AS, KG, DP** GEAR: **Van Veen (surface sampling); Vibracore (subsurface sampling)**

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
HI-01	10/16/08	14:59	B	25.7	57	0-1	Olive gray sandy GRAVEL.
						1-2	Olive gray sandy GRAVEL to 1.3 feet. Olive gray silty CLAY from 1.3 to 2 feet.
						2-3	Olive gray silty CLAY.
						3-4	Olive gray silty CLAY.
HI-02	10/5/08	14:35	B	NR	NA	0-0.33	Light brown surface. Brown to gray silty SAND, with shell fragments. Brittle stars, crab, and shrimp on surface.
	10/14/08	13:50	B	20.2	70	0-1	Olive gray sandy SILT.
						1-2	Olive gray sandy SILT to 1.3 feet. Olive gray silty SAND, abundant shell fragments from 1.3 to 2 feet.
						2-3	Olive gray silty SAND, abundant shell fragments to 2.3 feet. Olive gray sandy GRAVEL, shell fragments from 2.3 to 3 feet.
						3-4	Olive gray sandy GRAVEL, shell fragments to 3.6 feet. Olive gray clayey SILT from 3.6 6o 4 feet.
HI-03	10/5/08	15:26	A	NR	NA	0-0.33	Brown sandy SILT surface layer. Greenish gray silty SAND to 0.01 feet. Greenish gray sandy CLAY to depth, shell fragments. Brittle stars on surface.
	10/14/08	14:35	A	9.4	97	0-1	Olive gray sandy SILT, abundant shell fragments. Less than 1% bark.
						1-2	Olive gray silty CLAY, shell fragments.
						2-3	Olive gray slightly silty CLAY.
						3-4	Olive gray slightly sandy CLAY, few shell fragments.
HI-04	10/5/08	16:11	A	NR	NA	0-0.33	Brown sandy SILT surface layer. Brown fine- to medium-grained SAND to 0.01 feet. Greenish gray medium-grained SAND to depth. 5% bark.
		16:25	B	NR	NA	0-0.33	Brown sandy SILT surface layer. Brown fine- to medium-grained SAND to 0.01 feet. Greenish gray medium-grained SAND to depth. 5% bark.
	10/14/08	15:20	A	8.8	64	0-1	Olive gray silty SAND. 5% bark. Slight hydrogen sulfide odor present.
						1-2	Olive gray silty SAND, few shell fragments. 1% bark. Slight hydrogen sulfide odor present.
						2-3	Olive gray silty SAND.
						3-4	Olive gray silty SAND, few shell fragments. Less than 1% wood chips.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
HI-05	10/2/08	13:24	A	NR	NA	0-0.33	Light brown surface. Gray gravelly SAND. Redox potential depth is 0.79 inches. Fish, shrimp, hermit crab, and gastropods present.
		13:40	B	NR	NA	0-0.33	Light brown surface. Gray gravelly SAND. Redox potential depth is 0.79 inches. Fish, shrimp, hermit crab, and gastropods present.
HI-06	10/3/08	08:48	A	NR	NA	0-0.33	Light brown surface. Brownish green to brownish gray silty SAND, shell fragments. Redox potential depth is 0.79 inches.
	10/5/08	15:45	A	15.9	75	0-1	Dark gray to black gravelly SAND, shell fragments. 5% bark. Slight hydrogen sulfide odor present.
						1-2	Dark olive gray sandy GRAVEL, with cobbles. 2% bark.
						2-3	Dark gray silty fine-grained, poorly-graded SAND.
						3-4	Dark gray silty fine-grained, poorly-graded SAND.
HI-07	10/2/08	08:48	C	NR	NA	0-0.33	Brown surface. Brownish gray to dark gray gravelly SAND, shell fragments. Redox potential depth is 0.79 inches. Shrimp, hermit crab, and sponges present.
		09:10	D	NR	NA	0-0.33	Brown surface. Brownish gray to dark gray gravelly SAND. Redox potential depth is 0.79 inches. Slight hydrogen sulfide odor present. Shrimp, hermit crab, and worms present.
	10/3/08	11:30	A	36.4	73	0-1	Dark gray poorly-graded medium-grained SAND, shell fragments.
						1-2	Dark gray poorly-graded medium-grained SAND, shell fragments. Less than 1% wood fibers.
						2-3	Dark gray poorly-graded medium-grained SAND, shell fragments.
						3-4	Dark gray poorly-graded medium-grained SAND, shell fragments to 3.6 feet. Dark olive gray silty CLAY from 3.6 to 4 feet. Hydrogen sulfide odor present.

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HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT SAMPLE RECORD

PROJECT NAME: **Oakland Bay Sediment Characterization Study / 06-03386-007** DATES: **9/29/08 – 10/7/08, 10/14/08 – 10/16/08, 10/20/08**

LOCATION: **Oakland Bay** CREW: **GC, BC, BH, GI, AS, KG, DP** GEAR: **Van Veen (surface sampling); Vibracore (subsurface sampling)**

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
OB-01	10/2/08	15:23	B	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black sandy GRAVEL. Redox potential depth to 0.98 inches. Shells, sea anemone, shrimp, sponges on surface.
		15:23	C	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black sandy GRAVEL, shell fragments. Redox potential depth to 0.98 inches. Shells, sea anemone, shrimp, sponges on surface.
	10/3/08	13:43	B	24.5	73	0-1	Dark gray sandy GRAVEL, shell fragments.
						1-2	Dark gray sandy GRAVEL, shell fragments.
						2-3	Dark gray sandy GRAVEL, shell fragments. Less than 1% bark.
						3-4	Dark gray sandy GRAVEL, shell fragments to 3.7 feet. Dark olive gray sandy SILT from 3.7 to 4 feet.
OB-02	10/2/08	14:30	A	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black clayey SILT, shell fragments. Brittle star, fish, algae on surface.
	10/3/08	11:01	A	26.5	91	0-1	Dark olive gray clayey SILT, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						3-4	Dark olive gray clayey SILT, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
OB-03	10/2/08	16:10	A	NR	NA	0-0.33	Light brown surface. Dark olive to black SILT, shell fragments. Redox potential depth to 0.20 inches. Slight hydrogen sulfide odor present.
	10/3/08	10:08	B	24.5	84	0-1	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						2-3	Dark olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
						3-4	Dark olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
OB-04	10/3/08	14:52	A	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black sandy SILT, shell fragments. Redox potential to 0.39 inches. 5% bark.
	10/4/08	10:20	A	21.2	72	0-1	Olive gray clayey SILT, shell fragments. 15% bark. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY. Hydrogen sulfide odor present.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
OB-05	10/3/08	11:55	A	NR	NA	0-0.33	Light brown surface. Dark olive to black SILT. Slight hydrogen sulfide odor present.
	10/4/08	12:20	C	26.4	71	0-1	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
OB-06	10/3/08	15:35	A	NR	NA	0-0.33	Light brown surface. Dark olive to black SILT, shell fragments. Redox potential to 0.20 inches. Less than 5% wood fibers. Slight sulfide odor present.
	10/6/08	13:47	A	18.2	94	0-1	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
OB-07	10/5/08	10:29	A	NR	NA	0-0.13	Brown surface. Brown sandy SILT to 0.13 feet. Brown medium-grained sandy GRAVEL to depth.
		10:40	B	NR	NA	0-0.26	Brown surface. Brown sandy SILT to 0.26 feet. Brown medium-grained sandy GRAVEL to depth.
		10:48	C	NR	NA	0-0.16	Brown sandy SILT to 0.16 feet, shell fragments. Pea gravel to depth.
		10:56	D	NR	NA	0-0.16	Brown sandy SILT to 0.16 feet, shell fragments. Pea gravel to depth.
	10/15/08	16:30	A	9.0	86	0-1	Olive gray slightly sandy SILT to 0.5 foot. Olive gray sandy SILT, abundant shell fragments from 0.5 to 1 foot.
						1-2	Olive gray sandy GRAVEL, abundant shell fragments.
						2-3	Olive gray sandy SILT, few shell fragments. Less than 1% bark.
						3-4	Olive gray sandy SILT, abundant shell fragments. 20% bark.
OB-08	10/5/08	11:22	A	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black silty CLAY. Less than 1% bark.
	10/15/08	17:10	A	6.5	87	0-1	Olive gray sandy SILT. Less than 1% bark.
						1-2	Olive gray silty CLAY.
						2-3	Mottled olive gray and brown silty CLAY.
						3-4	Mottled olive gray and brown silty CLAY.
OB-09	10/3/08	16:10	A	NR	NA	0-0.33	Light brown surface. Dark olive to black SILT. Redox potential depth to 0.20 inches.
	10/5/08	11:38	A	21.3	70	0-1	Dark olive gray clayey SILT. Hydrogen sulfide odor present.
						1-2	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
OB-10	10/4/08	09:51	A	NR	NA	0-0.33	Light brown surface. Dark olive to black SILT. Redox potential to 0.39 inches. Slight hydrogen sulfide odor present.
	10/5/08	10:55	B	24.0	72	0-1	Dark olive gray clayey SILT. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						2-3	Olive gray clayey SILT. Less than 1% bark. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
OB-11	10/3/08	09:40	B	NR	NA	0-0.33	Shellfish and shells on surface to 2 inches. Light brown to black SILT, shell fragments. Slight hydrogen sulfide odor present.
		10:00	C	NR	NA	0-0.33	Shellfish and shells on surface to 2 inches. Light brown to black SILT, shell fragments. Slight hydrogen sulfide odor present.
		10:25	D	NR	NA	0-0.33	Shellfish and shells on surface to 2 inches. Light brown to black SILT, shell fragments. Moderate hydrogen sulfide odor present.
	10/7/08	14:45	B	22.6	66	0-1	Dark olive gray slightly silty, gravelly SAND, abundant shell fragments.
						1-2	Dark olive gray slightly silty, gravelly SAND, abundant shell fragments. Less than 1% bark.
						2-3	Dark olive gray slightly silty, gravelly SAND, abundant shell fragments.
						3-4	Dark olive gray slightly silty, gravelly SAND, abundant shell fragments. Hydrogen sulfide odor present.
OB-12	10/4/08	10:34	A	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black clayey SILT. Redox potential to 0.39 inches.
	10/4/08	14:35	A	4.5	71	0-1	Olive gray clayey SILT. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY.
						3-4	Olive gray silty CLAY to 3.25 feet. Olive gray silty CLAY from 3.25 to 4 feet. 75% sawdust.
	10/20/08	13:55	B	7.5	78	0-1	Olive gray silty CLAY. Hydrogen sulfide odor present. No samples submitted.
						1-2	Olive gray silty CLAY. 5% bark. Hydrogen sulfide odor present. No samples submitted.
						2-3	Olive gray silty CLAY. Hydrogen sulfide odor present. No samples submitted.
						3-4	Olive gray silty CLAY. Hydrogen sulfide odor present. No samples submitted.
						4-5	Olive gray silty CLAY. 50% sawdust.
						5-6	Olive gray silty CLAY. 75% sawdust.
						6-7	Olive gray silty CLAY. 90% sawdust.
						7-8	100% sawdust. No samples submitted.
						8-9	100% sawdust. No samples submitted.
						9-10	100% sawdust to 9.2 feet. No samples submitted.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
OB-13	10/4/08	11:24	B	NR	NA	0-0.23	Light brown surface. Dark olive to dark gray SILT to 0.23 feet. Gravel layer below.
		11:50	C	NR	NA	0-0.23	Light brown surface. Dark olive to dark gray SILT to 0.23 feet. Gravel layer below.
	10/7/08	16:15	C	7.2	62	0-1	Very dark olive gray to black slighty clayey, gravelly SILT to 0.7 foot. Olive gray clayey SILT, shell fragments from 0.7 to 1.0 foot.
						1-2	Olive gray clayey SILT, shell fragments. Less than 1% bark.
						2-3	Olive gray clayey SILT, shell fragments to 2.8 feet. Slight hydrogen sulfide odor present.
OB-14	10/4/08	13:25	A	NR	NA	0-0.33	Light brown surface. Dark olive SILT to 0.1 feet. Pea gravel layer to 0.16 feet. Dark olive gray coarse-grained SAND to 0.26 feet. Olive gray silty CLAY to depth. Redox potential depth to 0.39 inches.
	10/7/08	14:00	B	11.0	68	0-1	Olive gray clayey SILT.
						1-2	Olive gray clayey SILT to 1.3 feet. Olive gray silty SAND from 1.3 to 2 feet. Less than 1% bark.
						2-3	Olive gray silty SAND to 2.25 feet. Olive gray silty CLAY from 2.25 to 2.6 feet. Olive gray fine- to coarse-grained SAND from 2.6 to 3 feet.
						3-4	Olive gray fine- to coarse-grained SAND to 3.3 feet. Olive gray gravelly SAND, shell fragments from 3.3 to 4 feet.
OB-15	10/16/08	10:04	A	20.2	92	0-4	Olive gray silty CLAY. Hydrogen sulfide odor present from 2 to 4 feet.
OB-16	10/20/08	10:50	B	21.1	88	0-4	Olive gray silty CLAY, few shell fragments. Hydrogen sulfide odor present from 2 to 4 feet.
OB-17	10/3/08	13:04	B	NR	NA	0-0.33	Light brown surface. Dark olive to dark gray silty SAND. Less than 5% bark. Slight hydrogen sulfide odor present.
		13:04	C	NR	NA	0-0.33	Light brown surface. Dark olive to dark gray clayey SAND. Redox potential depth to 0.20 inches. Slight/moderate hydrogen sulfide odor present.
	10/5/08	15:12	A	37.5	92	0-1	Dark olive gray clayey SILT. 15% bark. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present.
OB-18	10/3/08	13:50	A	NR	NA	0-0.33	Light brown surface. Dark olive to black SILT, shell fragments. Redox potential to 0.20 inches. Moderate hydrogen sulfide odor present.
	10/5/08	14:35	A	25.9	79	0-1	Dark olive gray clayey SILT, shell fragments. 10% bark. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY, shell fragments. 10% bark, 1% wood fibers. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments. Hydrogen sulfide odor present. No samples submitted.
OB-19	10/4/08	09:13	A	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black clayey SILT. Redox potential to 0.20 inches.
	10/5/08	12:23	A	21.0	72	0-1	Dark olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT, shell fragments. 5% bark. Hydrogen sulfide odor present.
						2-3	Olive gray silty CLAY, shell fragments. Less than 1% bark. Hydrogen sulfide odor present.
						3-4	Olive gray silty CLAY, shell fragments to 4.1 feet. Hydrogen sulfide odor present.

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HERRERA ENVIRONMENTAL CONSULTANTS

SEDIMENT SAMPLE RECORD

PROJECT NAME: **Oakland Bay Sediment Characterization Study / 06-03386-007** DATES: **9/29/08 – 10/7/08, 10/14/08 – 10/16/08, 10/20/08**

LOCATION: **Shelton Harbor** CREW: **GC, BC, BH, GI, AS, KG, DP** GEAR: **Van Veen (surface sampling); Vibracore (subsurface sampling)**

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-01	9/29/08	18:05	A	NR	NA	0-0.33	Dark gray brown clayey SAND. Some small shell pieces.
		18:34	B	NR	NA	0-0.33	Dark gray brown clayey SAND. Two half shells on surface.
	10/1/08	11:55	C	NR	92	0-1	Dark olive gray sandy SILT. 10% bark.
						1-2	Light olive gray sandy, clayey SILT, with shell fragments. Hydrogen sulfide odor present.
						2-3	Light olive gray sandy, clayey SILT, with shell fragments.
						3-4	Light olive gray sandy, clayey SILT, with abundant shell fragments.
SH-02	9/30/08	10:40	D	NR	NA	0-0.33	Dark grayish brown sandy SILT. Moderate hydrogen sulfide odor present. Large piece of wood (5 inches), 5% wood chunks.
		10:45	E	NR	NA	0-0.33	Dark grayish brown sandy SILT. Moderate hydrogen sulfide odor present. 5% wood chunks, less than 5% wood fibers.
	10/6/08	15:50	A	8.3	86	0-1	Dark olive gray, slightly sandy, clayey SILT. 15% bark. Hydrogen sulfide and petroleum-like odor present.
						1-2	Dark olive gray clayey SILT, with few shell fragments. 5% bark, less than 1% wood chips. Hydrogen sulfide and slight petroleum-like odor present.
						2-3	Dark olive gray clayey SILT, with some shell fragments. 5% bark. Hydrogen sulfide and slight petroleum-like odor present.
						3-4	Dark olive gray clayey SILT, with some shell fragments to 3.6 feet. Dark olive gray, silty SAND, with shell fragments from 3.6 to 4 feet. Hydrogen sulfide odor present.
SH-03	10/1/08	10:20	A	NR	NA	0-0.33	Light brown surface. Olive gray clayey SILT. Redox potential depth to 0.79 inches. Slight hydrogen sulfide odor present. 5% wood fibers.
SH-04	10/1/08	09:50	A	NR	NA	0-0.33	Light brown surface. Olive gray SILT with trace sand. Redox potential depth to 0.39 inches. Slight hydrogen sulfide odor present. 5% wood fibers.
	10/15/08	09:39	B	17.8	76	0-1	Dark olive gray, clayey SILT. Hydrogen sulfide odor present.
						1-2	Dark olive gray, clayey SILT. 10% sawdust, 1 inch distinct lense. Hydrogen sulfide odor present.
						2-3	Dark olive gray, clayey SILT. 75% sawdust, less than 5% bark. Hydrogen sulfide and petroleum-like odor present.
						3-4	Dark olive gray, clayey SILT. 75% sawdust, less than 5% bark. Petroleum-like odor present.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-05	10/01/08	09:11	A	NR	NA	0-0.33	Light brown surface. Grayish brown gravelly SILT to 0.26 feet. Grayish brown sandy GRAVEL below. Black organic matter layer at 0.8 inches. Redox potential depth is 0.59 inches. 5% wood fibers.
	10/01/08	09:25	B	NR	NA	0-0.33	Light brown surface. Grayish brown gravelly SILT to 0.16 feet. Grayish brown sandy GRAVEL below. Black organic matter layer at 0.8 inches. Redox potential depth is 0.59 inches. 5% wood fibers.
	10/14/08	17:40	C	13	42	0-1	Grayish brown sandy GRAVEL.
						1-2	Grayish brown sandy GRAVEL to 1.2 feet. Grayish black, gravelly SAND, well-graded from 1.2 to 2.1 feet.
SH-07	10/5/08	12:21	D	NR	NA	0-0.33	Dark olive brown silty SAND to 0.16 feet, with leaves and twigs. Dark olive to dark grayish black sandy CLAY to depth, with rust colored inclusions. Less than 1% wood chunks at surface.
	10/15/08	10:45	B	3.5	67	0-1	Dark olive gray, clayey SILT.
						1-2	Dark brown silty SAND, with shell fragments, occasional gravel, black stained sand.
						2-3	Gray brown sandy GRAVEL.
						3-4	Gray brown sandy GRAVEL to 3.2 feet. Grayish brown gravelly SAND from 3.2 to 3.75 feet.
SH-08	10/6/08	14:45	A	11.5	65	0-1	Very dark olive gray, sandy GRAVEL with cobbles to 0.5 feet. Very dark olive gray clayey SILT from 0.5 to 1.0 foot. Slight hydrogen sulfide odor present.
						1-2	Very dark olive gray clayey SILT, with shell fragments. Slight hydrogen sulfide odor present.
						2-3	Very dark olive gray clayey SILT, with shell fragments. Slight hydrogen sulfide odor present.
						3-4	Very dark olive gray clayey SILT, with shell fragments to 3.25 feet. Very dark olive gray gravelly SAND, shell fragments from 3.25 to 4 feet. Slight hydrogen sulfide odor present.
SH-09	10/01/08	11:21	A	NR	NA	0-0.33	Light brown surface. Dark olive to dark greenish gray sandy SILT. Redox potential depth is 0.59 inches. Some shells on surface.
	10/1/08	13:50	B	4.9	77	0-1	Dark olive gray silty SAND. 1% wood chips.
						1-2	Dark olive gray sandy GRAVEL with silt, cobble layer at 1.4 feet. 2-inch thick layer of leaves and twigs at 1.5 feet.
						2-3	Dark olive gray sandy GRAVEL with silt.
SH-10	9/30/08	13:40	A	NR	NA	0-0.33	Light brown surface. Dark olive sandy SILT. Redox potential depth is 0.79 inches. Less than 5% wood fibers. Some shell fragments, shrimp, and algae.
	9/30/08	13:30	A	12.9	72	0-1	Dark olive gray, clayey SAND, shell fragments. Hydrogen sulfide odor present.
						1-2	Dark olive gray sandy SILT, shell fragments. 20% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray sandy SILT, shell fragments. 20% bark. Hydrogen sulfide odor present.
						3-4	Dark olive gray sandy SILT, shell fragments. 10% bark.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-11	10/2/08	10:32	A	NR	NA	0-0.33	Black/brown to dark olive SILT. Redox potential depth is 0.20 inches. 10% wood chips. Moderate hydrogen sulfide odor present. Wood debris layer at 0.16 feet, increase in wood at bottom of sample.
	10/14/07	11:17	B	16.6	69	0-1	Dark olive gray SILT. Less than 5% wood chips. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT. Less than 5% wood chips. Hydrogen sulfide odor present.
						2-3	Olive gray clayey SILT to 2.33 feet. Less than 5% wood chips. Dark brown sandy GRAVEL with cobbles from 2.33 to 3 feet. Hydrogen sulfide odor present.
						3-4	Dark brown SILT to 3.33 feet. Less than 1% bark. Dark brown sandy GRAVEL with cobbles from 3.33 to 4 feet.
SH-12	10/2/08	09:40	A	NR	NA	0-0.33	Gray/black surface. Dark olive to black clayey SILT. Redox potential depth is 0.20 inches. 5% wood chips. Moderate hydrogen sulfide odor present.
		09:55	B	NR	NA	0-0.33	Light brown surface. Dark olive to black clayey SILT. Redox potential depth is 0.20 inches. 5% wood chips. Moderate hydrogen sulfide odor present.
	10/2/08	13:20	C	6.2	77	0-1	Olive gray clayey SILT. 10% wood fibers, less than 5% wood chips. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT. 10% wood fibers, less than 5% wood chips, less than 1% bark. Hydrogen sulfide odor present.
						2-3	Olive gray clayey SILT. 10% wood fibers, less than 5% wood chips. Hydrogen sulfide odor present.
						3-4	Olive gray clayey SILT. 10% wood fibers. Hydrogen sulfide odor present.
	10/20/08	16:05	A	8.5	94	0-1	Olive gray clayey SILT. Less than 5% wood fibers.
						1-2	Olive gray clayey SILT. Less than 5% wood fibers.
						2-3	Olive gray clayey SILT. Less than 5% wood fibers.
						3-4	Olive gray clayey SILT. Less than 5% wood fibers.
						4-5	Olive gray clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						5-6	Olive gray clayey SILT. 5% bark, 10% wood fibers. Hydrogen sulfide odor present.
						6-7	Olive gray clayey SILT. 75% sawdust. Hydrogen sulfide odor present. No samples submitted.
						7-8	100% sawdust. No samples submitted.
						8-9	100% sawdust. No samples submitted.
						9-10	100% sawdust. No samples submitted.
						10-11	Olive gray clayey SILT to 10.4 feet. 85% sawdust.
SH-13	10/5/08	13:21	D	NR	NA	0-0.33	Light brown surface layer. Dark olive to dark greenish black sandy SILT. Redox potential depth to 0.20 inches. Less than 1% fibers. Moderate/strong hydrogen sulfide odor present.
	10/14/08	16:20	A	9.1	85	0-1	Olive gray sandy SILT to 0.8 foot. Less than 1% wood fibers. Olive gray sandy GRAVEL with cobbles, few shell fragments from 0.8 to 1.0 foot. Slight hydrogen sulfide odor present.
						1-2	Olive gray sandy GRAVEL with cobbles, few shell fragments to 1.7 feet. Less than 1% wood fibers. Olive gray clayey SILT from 1.7 to 2 feet. Less than 1% wood chips. Hydrogen sulfide odor present.
						2-3	Olive gray clayey SILT to 2.7 feet. Less than 1% wood chips. Olive gray sandy GRAVEL from 2.7 to 3 feet. Less than 5% wood fibers, less than 5% bark. Hydrogen sulfide odor present.
						3-4	Olive gray sandy GRAVEL to 3.25 feet. Less than 5% wood fibers, less than 5% bark. Olive gray clayey SILT from 3.25 to 4 feet. 5% wood fibers.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-14	9/30/08	15:05	A	NR	NA	0-0.33	Light brown surface. Dark olive sandy SILT. Redox potential depth is 0.79 inches. 5% bark and 5% chunks of wood. Slight/moderate hydrogen sulfide odor present. Some shells and algae on surface.
	9/30/08	16:08	B	20.9	84	0-1	Dark olive gray sandy SILT, shell fragments. 10% bark. Hydrogen sulfide odor present.
						1-2	Dark olive gray sandy SILT, shell fragments. 10% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray clayey SILT, shell fragments. 10% bark. Hydrogen sulfide odor present.
						3-4	Light olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
SH-15	10/1/08	15:44	A	NR	NA	0-0.33	Light brown surface. Dark olive gray fine-grained SAND. Redox potential depth is 0.79 inches.
	10/1/08	14:31	A	20.4	78	0-1	Dark olive gray to gray, fine-grained SAND.
						1-2	Dark olive gray to gray, fine-grained SAND, trace amount of shell fragments.
						2-3	Dark olive gray to gray, fine-grained SAND, trace amount of shell fragments.
						3-4	Dark olive gray to gray, fine-grained SAND, trace amount of shell fragments.
SH-16	10/1/08	16:54	A	NR	NA	0-0.33	Light brown surface. Brown to dark gray medium- to coarse-grained SAND. Redox potential depth is 0.59 inches. Surface layer of shells.
	10/2/08	10:05	A	41.4	58	0-1	Tan medium- to coarse-grained SAND, shell fragments to 0.5 foot. Black medium- to coarse-grained SAND, shell fragments from 0.5 to 1.0 foot.
						1-2	Black medium- to coarse-grained SAND, shell fragments.
						2-3	Black medium- to coarse-grained SAND, shell fragments to 2.7 feet.
SH-17	10/15/08	12:50	B	4.9	68	0-4	Dark olive gray clayey SILT to 1.33 feet. Less than 5% wood chips. Dark olive gray gravelly SAND from 1.33 to 2 feet. Dark olive gray sandy GRAVEL from 2 to 2.6 feet. Dark olive gray sandy SILT from 2.6 to 4 feet. 5% bark.
SH-18	10/2/08	11:15	A	NR	NA	0-0.33	Dark olive to grayish black SILT. Redox potential depth is 0.20 inches.
	10/2/08	13:57	A	14.5	68	0-1	Dark olive gray clayey SILT. 10% wood fibers, 5% bark, 5% wood chips. Hydrogen sulfide odor present.
						1-2	Dark olive gray clayey SILT. 10% wood fibers, 5% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray clayey SILT. 25% wood fibers, 5% bark. Hydrogen sulfide odor present.
						3-4	Dark olive gray clayey SILT. 20% wood fibers, 5% bark. Hydrogen sulfide odor present.
SH-19	10/01/08	13:00	A	NR	NA	0-0.33	Light brown surface. Dark olive to dark grayish green SILT. Redox potential depth is 0.79 inches. Less than 5% bark and 5% wood chips. Slight hydrogen sulfide odor present.
	10/14/08	13:05	B	9.5	77	0-1	Olive gray SILT. Less than 1% wood chips.
						1-2	Olive gray SILT. Less than 1% wood chips.
						2-3	Olive gray SILT to 2.25 feet. Brown SILT from 2.25 to 2.5 feet. Grayish brown sandy GRAVEL with cobbles from 2.5 to 3 feet.
						3-4	Grayish brown sandy GRAVEL with cobbles to 4.1 feet.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-20	10/01/08	12:28	A	NR	NA	0-0.33	Light brown surface. Dark olive to dark grayish green SILT. Redox potential depth is 0.79 inches. 5% wood fibers. Large crab on surface.
	10/7/08	10:30	B	13.9	76	0-1	Dark olive gray slightly clayey SILT, few shell fragments. Hydrogen sulfide odor present.
						1-2	Dark olive gray slightly clayey SILT, few shell fragments. 5% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray clayey SILT. Less than 1% bark.
						3-4	Dark olive gray clayey SILT to 3.6 feet. Dark olive gray gravelly SAND from 3.6 to 4 feet.
SH-21	10/01/08	11:45	A	NR	NA	0-0.33	Light brown surface. Dark olive to black clayey SILT. Redox potential depth is 0.20 inches. 5% wood fibers. Slight hydrogen sulfide odor present.
	10/2/08	09:10	A	16.5	77	0-1	Dark brown to black, clayey SILT. 20% wood chips, 5% wood fibers. Hydrogen sulfide odor present.
						1-2	Dark brown to black, clayey SILT. 20% wood chips, 5% wood fibers. Hydrogen sulfide odor present.
						2-3	Dark brown to black, clayey SILT. 20% wood chips, 20% wood fibers. Hydrogen sulfide odor present.
						3-4	Dark brown to black, clayey SILT. 15% wood chips, 30% wood fibers, 25% bark. Hydrogen sulfide odor present.
	10/15/08	14:45	B	7.0	100	0-1	Dark brown to black clayey SILT. 25% bark. Hydrogen sulfide odor present. No samples submitted.
						1-2	Dark brown to black clayey SILT. 25% bark. Hydrogen sulfide odor present. No samples submitted.
						2-3	Dark brown to black clayey SILT. 25% bark. Hydrogen sulfide odor present. No samples submitted.
						3-4	Dark brown to black clayey SILT. 20% bark. Hydrogen sulfide odor present. No samples submitted.
						4-5	Dark brown to black clayey SILT. 5% bark. Hydrogen sulfide odor present.
						5-6	Dark brown to black clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						6-7	Dark brown to black clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						7-8	Dark brown to black clayey SILT. 5% bark. Hydrogen sulfide odor present.
						8-9	Dark brown to black clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						9-10	Dark brown to black clayey SILT. 2% bark. Hydrogen sulfide odor present.
						10-11	Dark brown to black clayey SILT. Less than 5% bark. Hydrogen sulfide odor present.
						11-12	Dark brown to black clayey SILT. 1% bark. Hydrogen sulfide odor present.
SH-22	9/30/08	16:48	A	NR	NA	0-0.33	Light brown surface. Dark olive SILT. Redox potential depth is 0.20 inches. 50% bark. Moderate/strong hydrogen sulfide odor present.
		17:00	B	NR	NA	0-0.33	Light brown surface. Dark olive SILT. Redox potential depth is 0.20 inches. 50% bark. Moderate hydrogen sulfide odor present.
	10/6/08	16:30	A	7.0	81	0-1	Very dark olive gray SILT. 20% bark. Hydrogen sulfide odor present.
						1-2	Very dark olive gray sandy SILT. 25% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray clayey SILT, shell fragments to 2.5 feet. 40% bark, less than 1% wood chips. Hydrogen sulfide odor present.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-23	9/30/08	15:43	A	NR	NA	0-0.33	Light brown surface. Dark gray to black sandy SILT. Redox potential depth is 0.20 inches. Less than 5% bark. Slight hydrogen sulfide odor present.
	9/30/08	09:30	A	14.2	84	0-1	Dark olive gray sandy SILT, shell fragments. Less than 5% bark. Hydrogen sulfide odor present.
						1-2	Dark olive gray sandy SILT, shell fragments. 10% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray sandy SILT, shell fragments. 10% bark. Hydrogen sulfide odor present.
						3-4	Dark olive gray clayey SILT, shell fragments.
SH-24	10/1/08	13:32	A	NR	NA	0-0.33	Light brown surface. Dark olive gray clayey SILT. 50% bark. Slight/moderate hydrogen sulfide odor present.
		13:54	B	NR	NA	0-0.33	Light brown surface. Dark olive gray clayey SILT. 50% bark. Slight/moderate hydrogen sulfide odor present.
		14:54	C	NR	NA	0-0.33	Light brown surface. Dark olive gray clayey SILT. 50% bark. Slight/moderate hydrogen sulfide odor present.
SH-25	10/2/08	12:05	A	NR	NA	0-0.33	Light brown surface. Dark olive to grayish black sandy SILT, shell fragments. Redox potential depth is 0.20 inches. Moderate hydrogen sulfide odor present.
SH-26	9/30/08	12:50	A	NR	NA	0-0.33	Light brown surface. Dark gray sandy SILT. Redox potential depth is 0.39 in. Some shell fragments and twigs.
		13:08	B	NR	NA	0-0.33	Light brown surface. Grayish brown sandy SILT. Dark gray/black layer at 0.08 feet. Grayish brown gravelly SAND below layer. Redox potential depth is 0.39 in. Some shell fragments and twigs.
	10/6/08	12:40	A	13.5	68	0-1	Grayish brown coarse-grained SAND, shell fragments. Slight hydrogen sulfide odor present.
						1-2	Grayish brown coarse-grained SAND, shell fragments. Slight hydrogen sulfide odor present.
						2-3	Grayish brown coarse-grained SAND, shell fragments to 2.5 feet. Very dark gray to black silty SAND from 2.5 to 3 feet. Slight hydrogen sulfide odor present.
						3-4	Very dark gray to black silty SAND to 3.5 feet. Very dark gray to black clayey SILT from 3.5 to 4 feet. Slight hydrogen sulfide odor present.
SH-27	9/30/08	11:55	A	NR	NA	0-0.33	Light brown surface. Dark gray sandy SILT. 5% wood chunks. 20% shell fragments and twigs.
		12:10	B	NR	NA	0-0.33	Light brown surface. Dark gray sandy SILT. 5% wood chunks. 20% shell fragments and twigs.
	10/6/08	11:45	A	13.6	89	0-1	Dark gray to black SILT. 10% bark, 10% twigs.
						1-2	Dark gray to black SILT to 1.6 feet. Olive gray silty SAND from 1.6 to 2 feet. 5% wood chunks, 5% twigs. Hydrogen sulfide odor present.
						2-3	Olive gray gravelly SAND. 5% wood chunks. Hydrogen sulfide odor present.
						3-4	Olive gray gravelly SAND, shell fragments. Less than 1% wood chunks. Hydrogen sulfide odor present.
SH-28	9/30/08	14:29	A	NR	NA	0-0.33	Light brown surface. Dark grayish green sandy SILT. Redox potential depth is 0.79 inches.
	9/30/08	15:04	B	13.9	83	0-1	Dark olive gray sandy SILT. 20% bark. Hydrogen sulfide odor present.
						1-2	Dark olive gray sandy SILT. 10% bark. Hydrogen sulfide odor present.
						2-3	Dark olive gray clayey SILT, some shell fragments. 10% bark. Hydrogen sulfide odor present.
						3-4	Dark olive gray clayey SILT, abundant amount of shell fragments. Less than 5% bark.

STATION LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (ft)	% REC	SAMPLE INTERVAL [a] (ft)	CHARACTERISTICS (COLOR, TYPE, DEBRIS, ODOR)
SH-29	10/1/08	16:19	B	NR	NA	0-0.33	Light brown surface. Brown to dark gray fine- to medium-grained SAND. Redox potential depth is 0.98 inches. Surface layer of shells.
	10/6/08	10:38	B	37.4	92	0-1	Dark gray to black slightly silty fine- to medium-grained SAND, shell fragments. No samples submitted.
						1-2	Dark gray to black slightly silty fine- to medium-grained SAND, shell fragments. Less than 1% bark.
						2-3	Dark gray to black slightly silty fine- to medium-grained SAND, shell fragments. Less than 5% bark. Hydrogen sulfide odor present.
						3-4	Dark gray to black slightly silty fine- to medium-grained SAND, shell fragments. Hydrogen sulfide odor present.
SH-30	10/1/08	17:15	A	NR	NA	0-0.33	Light brown surface. Dark olive gray to dark gray clayey SILT. Redox potential depth is 0.59 inches. Slight hydrogen sulfide odor present. Shrimp, hermit crab, and worms present.
	10/2/08	11:45	A	26.1	83	0-1	Dark gray clayey SILT, shell fragments. 5% bark. Hydrogen sulfide odor present.
						1-2	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						2-3	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.
						3-4	Olive gray clayey SILT, shell fragments. Hydrogen sulfide odor present.

APPENDIX E

Geomorphic Assessment Report

TECHNICAL MEMORANDUM

Oakland Bay Geomorphic Assessment
Mason County

Prepared for

Washington Department of Ecology
Toxics Cleanup Program
Southwest Regional Office

March 2009

Note:
Some pages in this document have been purposefully skipped or blank pages inserted so that this document will copy correctly when duplexed.

TECHNICAL MEMORANDUM

Oakland Bay Geomorphic Assessment
Mason County

Prepared for

Washington Department of Ecology
Toxics Cleanup Program
Southwest Regional Office
300 Desmond Drive SE
Lacey, Washington 98503

Prepared by

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March 16, 2009

Contents

Tables

Figures

Glossary

Anastomosing. The characteristic of a stream with many branches that intermingle.

(Marine) bedforms. Sediment shapes on the sea bed produced by tides and currents that may take the form of ripples, dunes, and anti-dunes.

Bedload. Sediment load transported near the bed; generally only sediment coarser than sand (i.e., gravel and cobble) can be transported as bedload.

Delta. An area defined by the accumulation of sediment at the mouth of a stream or river.

Drogue. An instrument designed to float along a given density interface in order to measure currents at mid-depths in the ocean.

Fetch. The distance over the water that the wind blows to create waves.

Glaciomarine drift. Generally fine-grained material, occasionally with outsized sediment, deposited in seawater near the edge of a glacier.

Hydrograph. Referring to the physical processes responsible for transport of water and solids in a marine setting.

Lapse rate. The rate of decrease of temperature with elevation above sea level.

Outwash. Sediment discharged in front of a glacier, typically composed of clean gravels and sand released from erosion underneath the glacier.

Picocuries/gram. A common unit of measurement of the activity of different radioisotopes present in a given sediment sample.

Suspended load. The load of sediment transported in the water column. Generally only silt and clay are transported, although sand can be suspended in nearshore areas or other areas where flow is concentrated (e.g., streams).

Swell. Waves originating from the open ocean, swell has a much longer period than locally generated wind waves.

Till. Poorly sorted (wide range of grain sizes) sediment, generally highly compacted by overlying glacial pressure.

T-sheet. A series topographic maps produced by US Coast Survey in the late eighteenth century illustrating the coast of the US. T-sheets are often used to determine historical shoreline changes.

Wave period. The average time between wave crests.

Executive Summary

Oakland Bay is a shallow embayment located in south Puget Sound, with the town of Shelton and its industrial waterfront and harbor located at the southwest corner. It is connected to Puget Sound by Hammersley Inlet, an approximately 8-mile-long tidal channel. This study addresses the pathways of sediment input (broadly defined as any negatively buoyant solid material, including wood waste), transport, and deposition that occur in Oakland Bay and the western half of Hammersley Inlet.

Modern sediment input to Oakland Bay is limited to several creeks, the most notable of which is Goldsborough Creek, which discharges to Shelton Harbor. All of the creeks have extensive deltas at their mouths. The Goldsborough Creek delta is exceptionally large and coarse grained, most likely a result of extensive channelization and fill of formerly intertidal marshes.

Geophysical and bathymetric surveys conducted across the study area identified a distinct layer of recent sedimentation ranging from 1 to 8 feet in depth across all of Oakland Bay. While there are a few areas with large woody debris present, most of this layer is featureless. Hammersley Inlet does not possess an extensive surficial layer of sediment, but rather has a predominantly hard-bottom, with a few localized bedforms where sediment has accumulated. This limited surface sediment moves into Oakland Bay from Hammersley Inlet, as interpreted from bedform orientations. Freshwater exits primarily near the bay surface, causing most of the (denser) sediment originating in Oakland Bay to remain there.

A sediment budget was developed by estimating accumulation rates determined from sediment core dating and a common sediment production model. The budget confirms that nearly all sediment deposited within the study area stays within the confines of greater Oakland Bay (including Shelton Harbor and Chapman Cove). While there is some transport of fine-grained sediment (silt and clay) from Shelton Harbor to central Oakland Bay, most sediment discharged to the bay remains close to where it first enters marine waters.

1.0 Introduction

Oakland Bay is a shallow embayment located in south Puget Sound, with the town of Shelton and its industrial waterfront and harbor located at the southwest corner (Figure 1). Oakland Bay is defined by all marine waters north and west of Eagle Point and Munson Point, including Chapman Cove and Shelton Harbor. The Washington State Department of Ecology (Ecology) is directing sediment investigations and a sediment transport study of Oakland Bay and its surroundings, focusing on the marine environment associated with terrestrial and aquatic sediment sources. The study area boundaries follow the upper creek basin boundaries that contribute to Oakland Bay and the western half of Hammersley Inlet.

Oakland Bay, like most marine basins, is filling with sediment (broadly defined as any solid material denser than water, including woody debris) from sources on land. Sediment transport is a complicated physical process that cannot be easily measured directly, so several different techniques and analyses are used to build a coherent, qualitative picture of transport and fate mechanisms. Understanding of each analysis and the assumptions made is essential to develop a complete picture of sediment transport across the bay.

The purpose of this assessment is to describe the existing geomorphic conditions of the shoreline and marine waters of the study area, perform a geophysical survey and interpret the results from it, and perform a simple sediment budget of the study area based upon estimated sediment inputs and sediment accumulation rates found using radioisotopic measurements and other sedimentological characteristics. This report describes the geomorphic ramifications of the human activities cataloged in the *Summary of Existing Information and Identification of Data Gaps Technical Memorandum* (Herrera 2008).

The assessment uses a process-based approach to describe sediment transport, with three primary physical processes responsible for sediment transport (treated in order from source to sink):

- Sediment input from creeks
- Geomorphic transport environments
- Sediment accumulation by deposition.

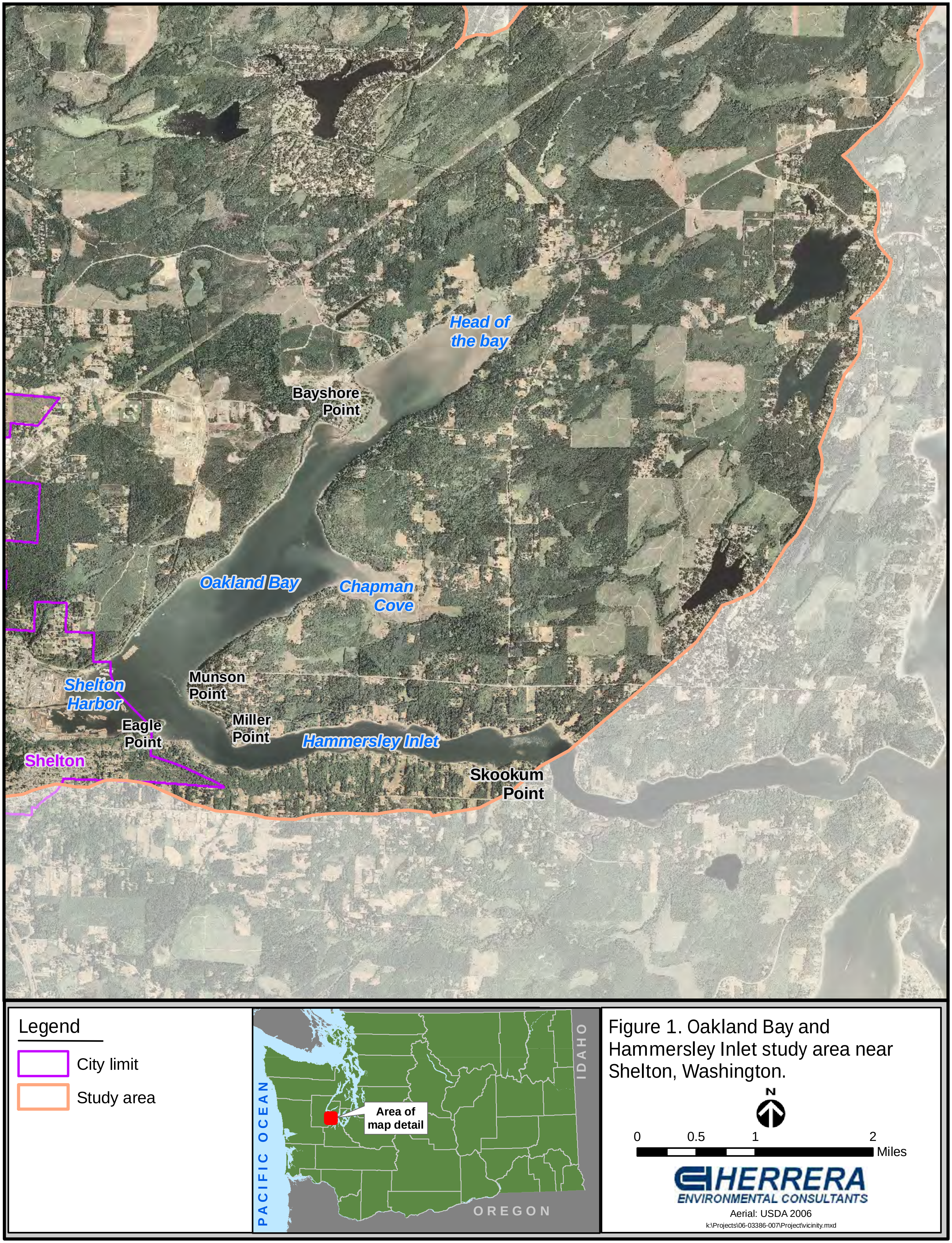


Figure 1. Oakland Bay and Hammersley Inlet study area near Shelton, Washington.

2.0 Methodology

In order to understand the fate and transport of sediment in the study area, it is necessary to quantify sediment inputs, describe the pathways by which sediment is transported, and measure the sediment accumulation rate. Each of these analyses is described in that order.

2.1 Sediment Input

Total sediment input to Oakland Bay was estimated using a method that calculates general sediment input from unmonitored basins (Syvitski et al. 2005), hereafter referred to as the Syvitski model. The Syvitski model has been shown to be appropriate for temperate basins in the northern hemisphere, such as the Oakland Bay basin. The model is purely empirical and therefore does preserve unit dimensions. The governing equation of the model is the following:

$$Q_s = 6.15 \times 10^{-5} A^{0.55} R^{1.12} e^{0.07T} \qquad (1)$$

Where: Q_s is the long-term average sediment input (kilograms per second)

A is the basin area (square kilometers)

R is the maximum relief in the basin (meters)

e is the base of the natural logarithm, approximately equal to 2.718

T is the *calculated* average annual temperature throughout each subbasin (degrees Celsius).

The average annual temperature *T* is frequently not known for sediment contributing subbasins, and therefore must be estimated from an elevation based equation:

$$T = T_0 - LH \qquad (2)$$

Where: *L* is the lapse rate of the atmosphere (i.e., the decrease in temperature with elevation above sea level [calculated to be 7.22°C/km for Oakland Bay])

T_0 is the measured average annual temperature, for the purposes of this analysis, the average annual temperature at a NOAA's Cooperative Observer Program (COOP) weather station in Shelton, Washington (station 457584) was used as the average annual temperature, which is 10.7°C (WRCC 2008).

H is the average basin elevation (kilometers).

Geographic information system (GIS) spatial analyst tools were used to delineate subbasins that drain to the study area from a U.S. Geological Survey 10-meter digital elevation model for the water resource inventory area watersheds draining to the study area (Figure 2). Subbasins within the study area were delineated by hand from digital elevation models. The size of the drainage basins and their maximum elevations were used in the Syvitski model calculations.

Areas immediately adjacent to Oakland Bay not identified as part of a subbasin may be sources of sediment in the bay (especially bare, unstable slopes). These potential sediment inputs have not been calculated and are assumed to be negligible in comparison to the total estimates of sediment yield to Oakland Bay. Support for this assumption comes from the disconnection of many bluff areas from the shoreline due to development, which is detailed in the following section.

2.2 Geomorphic Environments

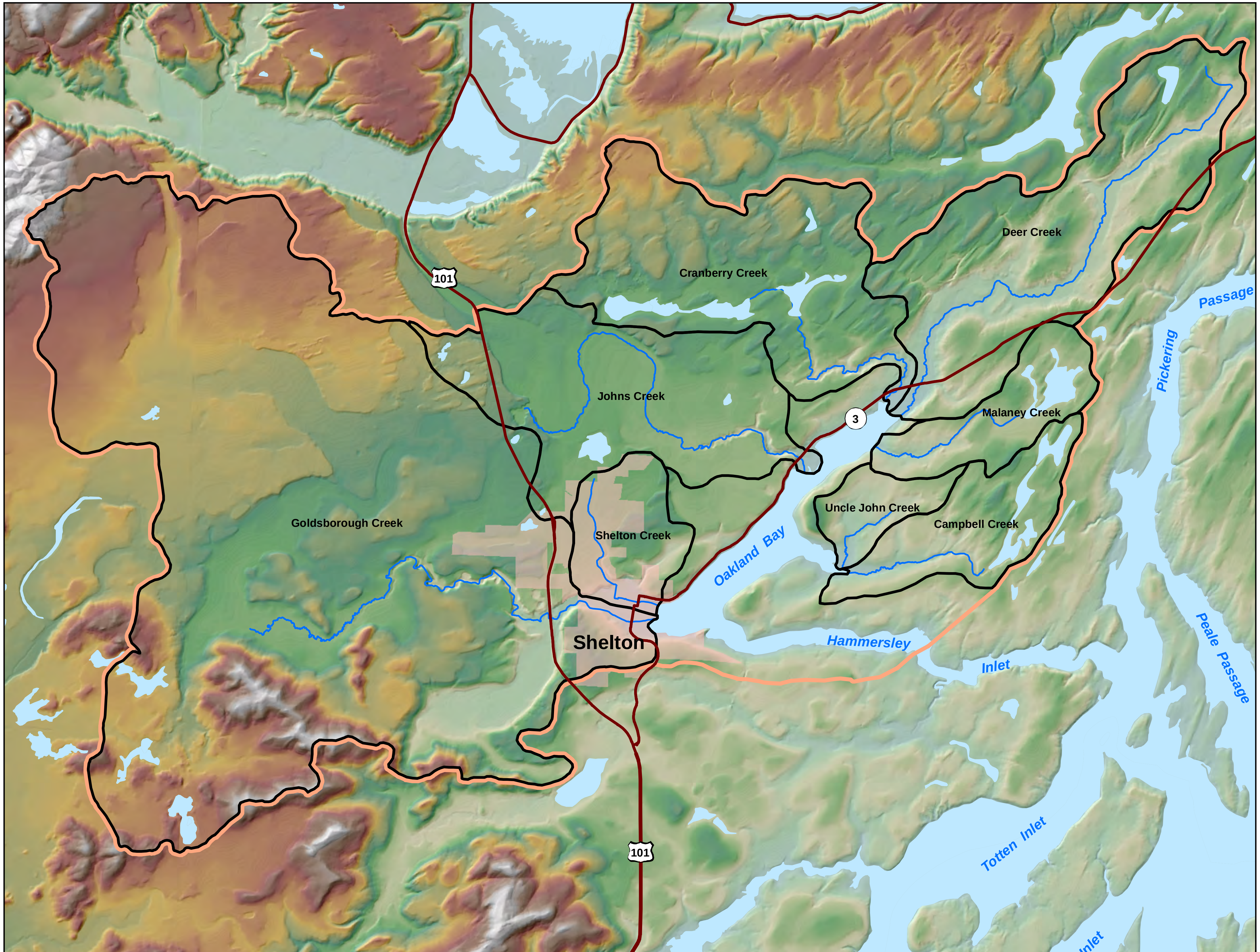
The delineation of geomorphic environments, distinct areas where sediment transport processes are similar, arose from a variety of existing resources describing the topography and geology of the study area. The Shelton geologic map was used to identify bedrock areas and the extents of different substrate types (Schasse et al. 2003). Historical maps and aerial photographs enabledthe delineation of fringing beaches and tidal flats (NOAA 1878, DNR 1942). GIS slope and shoreline data (Ecology 1978-1980) of Oakland Bay defined areas of extensive shoreline development. These data were manually digitized into GIS shape files.

Shoreline development and evolution was investigated by using several different historical resources. A topographic sheet representing conditions in 1878 (NOAA 1878; provided in Appendix A), oblique aerial photographs taken by the U.S. Coastal Survey (Ecology 1977, 1992, 2001, and 2006; provided in Appendix B), and historical aerial orthophotographs of Oakland Bay (DNR 1942, 1957, 1965, 1980, and 2003; provided in Appendix C) were used to delineate creek deltas and describe shoreline development and historical changes to subbasin creek estuaries.

A geophysical survey conducted by Global Geophysics mapped the bathymetric and subbottom features of Oakland Bay south of Bayshore Point and the western portion of Hammersley Inlet. The geophysical survey was conducted between June 25 and 27, 2008. Bathymetric data were collected with a Reson precision echosounder using a 300-kilohertz (kHz) transducer. Point data acquired from the bathymetric survey were interpolated to create polygons indicating areas of similar depth within a 5 foot lateral range. Analyzing the bathymetric survey data in GIS, a continuous line of spatially low polygons was delineated as a subglacial channel.

Global Geophysics also collected subsurface (acoustic) reflection data using an EdgeTech Chirp system. A high-frequency (4- to 24-kHz) signal was discharged three times per second and the resulting subsurface reflection data recorded. Subsurface data were viewed and analyzed using EdgeTech software (Discover SB 3200-XS). While in the field, a Herrera geomorphologist noted bedform features southeast of Shelton Harbor on a real-time digital display aboard the data collection vessel. Locations of the bedform features were mapped in GIS and the direction of travel noted. In reviewing the subsurface data, screenshots were taken of the EdgeTech digital display record and bedform geometry was noted. Side-scan sonar data were also collected with a Lowrance Sonar/M1 Side Scan Sonar device (300 kHz), providing a digital image of the sea bottom. Electrical resistivity was also collected, but it was found that it was strongly biased by

Figure 2.
Subbasin delineations, Oakland Bay.



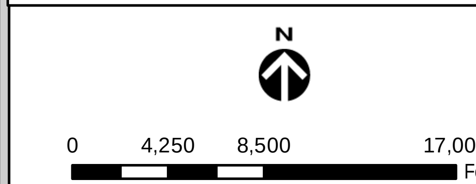
Legend

- Highway
- Basin
- Study area
- Water Body
- Creek
- City of Shelton

Elevation

High : 928.1

Low : 0



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bed surface abnormalities and not useful for description of geomorphic features or the presence of wood waste.

2.3 Sediment Accumulation

Three sediment cores from Oakland Bay and Shelton Harbor (SH-17, OB-15, and OB-16) were sampled for the presence and concentration of the isotopes cesium-137 (^{137}Cs) and lead-210 (^{210}Pb). Core locations (shown in Figure 5) were specifically selected to avoid areas of known disturbance identified by local shellfish growers. Radioisotopic analysis was performed on sediment samples collected every 10 centimeters (approximately 4 inches) apart. The samples included 2 centimeters (cm) of core, with mean depth of the sample reported as the depth in this analysis. ^{210}Pb and ^{137}Cs analyses are complementary, and when taken together, can provide an estimate of the sediment accumulation rate at a particular location.

^{210}Pb is a radioactive form of lead, having an atomic weight of 210. It is one of the last elements created by the radioactive decay of the isotope uranium-238 (^{238}U). ^{210}Pb forms naturally in sediments and rocks that contain ^{238}U, as well as in the atmosphere, a by-product of radon gas. Within 10 days of its creation from radon, ^{210}Pb falls out of the atmosphere. It accumulates on the surface of the earth where it is stored in soils, lake and ocean sediments, and glacial ice. The ^{210}Pb eventually decays into a non-radioactive form of lead. ^{210}Pb has a half-life of 22.3 years, which means that after 22.3 years, only half of the original amount is undecayed. If the sediment layers are undisturbed, then as the sediment ages it slowly loses its radioactivity. We can determine how old a sediment layer is by how much ^{210}Pb it contains. It takes about 7 half-lives, or 150 years, for the ^{210}Pb in a sample to reach near-zero radioactivity. In addition, net accumulation rates can be determined from age and depth of ^{210}Pb samples.

^{137}Cs, with a half-life of 30.3 years, is a radioactive form of cesium and a thermonuclear byproduct. Its presence is directly related to the atmospheric testing of nuclear devices during the latter half of the 1950s and early 1960s. Because it was not present in the atmosphere or on the Earth's surface prior to 1945 (63 years since the cores were taken), it is an independent check on the results of ^{210}Pb analysis. ^{137}Cs analytical results are evaluated for presence-absence, so the test is performed following analysis of ^{210}Pb results for portions of the core estimated to be 50 to 60 years old.

In order to determine the amount of sediment that leaves the study area, accumulation rates were compared to sediment input estimated using the Syvitski model. To properly compare accumulation rates of fine (suspended) sediment with estimates of total sediment loading, an assumption must be made about the relative volume of bedload (deposited on the delta) to suspended load (transported farther into the bay). The Syvitski model assumes that 15 percent of the total volume of sediment in transport is bedload (i.e., sediment load transported near the bed), which was applied to each of the Oakland Bay creek basins.

3.0 Study Area Background

Oakland Bay is located at the southwest end of the Puget Lowland, which occupies a basin bounded on the west by the Olympic Mountains and on the east by the Cascade Mountains. Oakland Bay, which includes Shelton Harbor and Chapman Cove, covers 1,856 acres, with 8 creeks flowing to it, and a contributing area equal to roughly 83,000 acres, including numerous small unnamed coastal drainages. Land use in the basin has historically been dominated by commercial logging and lumber production, which began in the 1850s. The Johns Creek basin, and the Shelton waterfront and harbor, have been historically and are currently used by a number of timber and wood product manufacturing industries, including saw mills and plywood manufacturing, pulp and paper production, and insulation board and fiber board manufacturing. The waters of Oakland Bay also became a center for economic production, as by 1902, hundreds of acres were under oyster and shellfish cultivation. Today, there are 21 shellfish growers in Oakland Bay, in addition to the Squaxin Island Tribe, as well as some recreational shellfish harvesting on public and private beaches.

3.1 Geology

Oakland Bay topography and geology is primarily influenced by glacial advance and retreat. The exception to this is in the heavily developed areas west of Shelton Harbor, where nonglacial deposits, including fill, have been placed by man. This area has been filled by clay, silt, sand, gravel, organic matter, riprap, and debris to elevate the land surface and reshape the surface morphology.

Throughout the last million years, the Puget Lowland was inundated by a continental ice sheet, which laid down a predictable sequence of glacial sedimentary deposits. As many as six distinct glacial advances filled the lowland with sediment to an elevation of more than 400 feet above present sea level (Booth 1994). Sediments of the last advance, the Vashon Stade, remain the dominant material exposed in the study area and are discussed in depth below. Some pre-Vashon glacial deposits (from earlier glacial occupations) also have been mapped in the area (Schasse et al. 2003). These deposits have been cemented and are well compacted. They are found on steep slopes between the till and recessional deposits, particularly north and south of fill material in Shelton Harbor and along the eastern slopes of Oakland Bay. Typically, the unconsolidated deposits are underlain by volcanic basalt bedrock in this area.

The Vashon Stade, and the sediment laid down during that time, began with an ice dam forming in Admiralty Inlet from the Cordilleran Ice Sheet advancing southward from the Fraser River valley in Canada approximately 20,000 years ago. The dam cut southern Puget Sound off from marine influence and caused the accumulation of silt and clay, sometimes called the Lawton Clay. These materials are relatively impermeable. Exposure is relatively limited in the study area, the materials likely underlie many of the more recent sediments.

As the glacier advanced toward the study area, it delivered outwash sand and gravel to areas in front of it. The advance outwash is commonly exposed where topography is steep and the overlying till has been removed by erosion. It is found along the northwest shoreline of the bay, on the shoreline and slopes north of Chapman Cove, and near Eagle and Miller Points. Advance outwash may contain prolific water-bearing zones.

Glacial till, consisting of a highly compacted mixture of clay, silt, sand, and gravel deposited directly by glacial ice, was the last type of material laid down in front of the advancing glacier. Even though ice remained over the study area for only a few hundred years, till is widespread. It flanks Shelton Harbor to the north and south and also is found in the upland areas above the steep slopes of the eastern shoreline. Typically, glacial till has a low infiltration rate and does not yield much water due to its compact nature and clay and silt content.

The study area has an extensive record of sedimentation from times following the Vashon glacier collapse, approximately 17,000 years ago (i.e., recessional deposits). Vashon recessional outwash and pre-glacial stratified sand and gravel, with variable amounts of silt, were deposited as the glacial ice was receding. These deposits occur west of Shelton Harbor and continue toward the northwest; they also occur about 2 miles northeast of Shelton on the western shoreline continuing to the north end of the bay. Clay-richlake deposits from the receding Vashon Stade of glaciation occur in Chapman Cove.

As a result of the unloading of glacial ice, south Puget Sound experienced drastic sea level fluctuations from 17,000 years ago until approximately 6,000 years ago. Relative sea levels during this time were much lower in the south Puget Sound than the current elevation. Streams draining upland areas sharply eroded their valleys in an effort to reach the sea. This gave rise to postglacial alluvial deposits of silt, sand, gravel, and peat in deltas where creeks flow into the Oakland Bay system. Major alluvial deposits are found in two areas within Oakland Bay: a large prominent deposit that extends along the west shoreline at the outlet of Johns Creek (Bayshore Point) and deposits at the head of the bay. Sea level rise associated with deglaciation drowned these carved river valleys, forming narrow inlets and embayments (Shipman 2008). Oakland Bay and Hammersley Inlet is one such drowned river valley that likely occupied a former subglacial channel.

By approximately 6,000 years ago, most of the sea level rise to current levels had already occurred, although slow sea level rise persists today at approximately 0.06 inches per year. As sea level rose to its present level, bluffs along the modern-day shoreline of the harbor began eroding and left the landscape in the conditions found at the time of European settlement, as reflected in the topographic sheet (T-sheet) of the area (NOAA 1878).

3.2 Hydrology (Surface Water, Stormwater Runoff, and Wetlands)

The study area is located within WRIA 14, often called the Kennedy-Goldsborough watershed. The Kennedy subbasin drains the Black Hills to the south of Oakland Bay and lies outside of the assessment extents of this report. The Goldsborough subbasin consists of the southeast one-third of Mason County and a small northwest portion of Thurston County. The Goldsborough subbasin includes all of Oakland Bay and Hammersley Inlet, including Shelton Harbor, Chapman Cove and numerous small, unnamed coastal drainages.

The study area features an extensive network of low-elevation streams that issue from springs, wetlands, small lakes, and surface water drainages. Principal streams that discharge into Oakland Bay include Goldsborough, Shelton, Johns, Cranberry, Deer, Malaney, Uncle John, and Campbell creeks (Figure 2). Despite its abundance of creeks, WRIA 14 has no major rivers.

Because of its low elevation, the study area includes no high-elevation ice packs or snow fields to sustain streamflows; streams within this watershed depend upon direct precipitation and groundwater inflow to maintain flow levels. Streamflow volumes reflect seasonal variations in precipitation. Direct precipitation either becomes runoff that flows overland into streams and other water bodies or percolates into the ground to recharge the groundwater aquifer system, which supports baseflow to streams depending upon availability.

Peak runoff in these streams occurs during the winter and early spring months during high precipitation. As precipitation subsides in late spring and early summer, streamflow decreases such that by August, the streams have reached their lowest levels. Streamflow then increases as precipitation increases in the fall.

Surface water within the study area is used for a variety of purposes. Shelton Springs, the headwaters of Shelton Creek, is the source of the municipal water supply for Shelton. Much of the creek is conveyed in concrete conduits beneath the city. Goldsborough Creek is used by Simpson Timber Company for industrial water supply.

3.3 Wind and Waves

As southern Puget Sound is isolated from the Pacific Ocean by the Olympic peninsula, waves in Puget Sound are generated locally by wind blowing over the basins, rather than by swell from the eastern Pacific. The consequences of this are that (1) the waves are fetch-limited and low energy compared to incident waves on the Pacific coast, and (2) the wave climate is tightly coupled to local wind patterns (Finlayson 2006). Predominant winds in Puget Sound are from the south or southwest during the winter and from the north or northwest during the summer (Overland and Walter 1983).

3.4 Hydrography

Modern-day Oakland Bay functions like an estuary. In estuarine environments with limited fetch length and low-energy wave climates like that of Oakland Bay, tides and freshwater input from uplands are the dominant drivers for fluid motion and sediment transport. The observed tidal range in Oakland Bay and Hammersley Inlet is one of the greatest in the Puget Sound, at 4.5 meters (14.8 feet) (Finlayson 2006). Estuarine circulation of fresh water from the creeks and seawater from the sound ensures that denser seawater flows into the bay along the bottom of the water column, possibly capable of transporting sediment; fresh water flows out of the bay on the surface, not capable of transporting sediment because flow is concentrated at the water surface (Fischer et al. 1979).

Oakland Bay is a high-refluxing and low-flushing estuary (Albertson 2004). This means that a significant amount of fluid is exchanged between Oakland Bay and greater Puget Sound over the tidal cycle, but the water in the bay has a long residence time. This is because most of the exchange occurs in the dense (saltier) bottom layer. Estimates of residence time in the bay vary from 2 to 5 days, based on evaluating tide gauges, conducting tidal simulations with the Hammersley Oakland Bay Oceanographic (HOBO) model, and observing movement across portions of the system (Albertson 2004). This study evaluated only fate and transport of suspended aqueous material and not sediment transport. Sediments are negatively buoyant and less mobile than suspended aqueous material, and they will not remain suspended in the water column for a long period. In such a naturally low-flushing environment, sediment is likely to remain undisturbed from the location in which it settled. Observations made herein were needed to fully understand the hydrodynamics of the seabed and sediment transport in the bay.

4.0 Results

Results of the geomorphic assessment are arranged in order from source to sink; final sediment budget calculations are provided in the Sediment Accumulation section.

4.1 Sediment Input

Sediment input to the study area comes from four primary sources: the head of the bay (including Cranberry, Deer, and Malaney Creeks), Chapman Cove (including Uncle John and Campbell Creeks), Shelton Harbor (including Goldsborough and Shelton Creeks) and Johns Creek. Creek basin characteristics are summarized in Table 1.

Within the head of the bay, the upper Cranberry Creek drainage area extends northwest toward Annas Bay and the Skokomish River basin, the Deer Creek and Malaney Creek basins drain the lowland areas northeast of Oakland Bay. Johns Creek drains land northwest of the central portion of Oakland Bay. The small basins of Uncle John Creek and Campbell Creek drain land northeast of Chapman Cove. The largest drainage basin is that of Goldsborough Creek, which drains areas directly west in the foothills of the Olympic Mountains. The Shelton Creek drainage basin is one of the smallest in the watershed, with a drainage area directly west of Oakland Bay.

Table 1. Characteristics of creek basins in Oakland Bay.

Creek	Maximum Elevation in Watershed (feet)	Size of Drainage Basin (acres)
Johns Creek	420	7,833
Malaney Creek	266	2,459
Shelton Creek	295	2,269
Goldsborough Creek	1,375	38,621
Campbell Creek	295	3,097
Cranberry Creek	502	8,235
Deer Creek	390	9,291
Uncle John Creek	279	1,214

Using the basin areas found in Table 1, sediment input was estimated using the Syvitski model for each Oakland Bay creek (Table 2). Goldsborough Creek drains the largest area by an order of magnitude and has a maximum elevation more than twice that of the other Oakland Bay subbasins, resulting in the largest estimated sediment contribution to Oakland Bay (67 percent). The estimated total sediment input to Oakland Bay is 9,622 tons/km^2/year.

Table 2. Volumetric estimates of sediment input to Oakland Bay from contributing creeks.

Creek	Total Average Annual Sediment Input (tons/year)	Total Average Annual Bedload Sediment Input (tons/year)	Total Average Annual Suspended Sediment Input (tons/year)	Sediment Input to Oakland Bay ($tons/km^2/year$) [b]	Average Potential Accumulation Rate [a] (cm/year)
Goldsborough Creek	56,633	8,495	48,138	6,406	0.377
Cranberry Creek	7,832	1,175	6,657	886	0.052
Deer Creek	6,316	947	5,369	713	0.042
Johns Creek	6,240	936	5,304	706	0.042
Campbell Creek	2,525	379	2,146	286	0.017
Shelton Creek	2,128	319	1,809	241	0.014
Malaney Creek	1,976	296	1,680	224	0.013
Uncle John Creek	1,415	212	1,203	160	0.009
Total	85,065	12,759	72,306	9,622	0.566

Note: Assumes sediment density of 1.7 $tons/m^3$ and a uniform deposition throughout Oakland Bay.
[a] The average potential accumulation rate assumes that all sediment discharged by the creeks is retained in the bay.
[b] Assumes suspended sediment is the sole source of sediment inputs in Oakland Bay.

In order to verify modeled sediment input results for Oakland Bay, a comparison to observations made at nearby creeks and rivers is necessary. Based on the Skokomish, Hamma Hamma, Duckabush, Dosewalips, and Quilcene Rivers on Hood Canal, the Goldsborough Creek basin falls in the midrange of estimated average sediment yield (Downing 1983; Wise et al. 2007), despite its being somewhat smaller and lower in peak elevation (Table 3). Sediment flux results for Goldsborough Creek appear to be within an acceptable range of values for local rivers, but likely represent an upper limit of the sediment contributed to the bay.

Table 3. Comparison of calculated sediment yield from Goldsborough Creek basin and other Hood Canal river basins.

Creek/River Basin	Average Sediment Production in River Basins ($tons/km^2/year$)
Goldsborough Creek	431
Hood Canal rivers [a]	193
Hood Canal rivers [b]	610

[a] Source: Downing (1983).
[b] Source: Wise et al. (2007).

Sediment input provided in Table 2 compares the sediment input across the bay area (km^2) and potential accumulation rate contributions by creek, whereas Table 3 compares the average sediment yield across basin areas (km^2) resulting from erosional processes among basins in southern Puget Sound. Sediment input is notoriously difficult to characterize, but the Syvitski model is bounded by two independent observations of sediment production in similar areas.

4.2 Geomorphic Environments

Oakland Bay is a shallow embayment approximately 4 miles long and 3/4 of a mile wide, with water depths generally ranging to 35 feet below mean lower low water (depths described hereafter are all with respect to mean lower low water). Areas up to 85 feet deep stretch from the southwest shore of Hammersley Inlet into Oakland Bay and along the western shoreline north of Shelton Harbor, as far as the midway point between Shelton Harbor and Johns Creek (Figure 3). A deep water area covering 1,000 feet by 500 feet varies in depth from 45 to 80 feet at the juncture of Oakland Bay and Hammersley Inlet. Shallow tidal flats up to 10 feet deep dominate most of central Oakland Bay, Chapman Cove, and the head of the bay. Much of Shelton Harbor is dominated by shallow areas ranging up to 15 feet deep.

Localized geomorphic features help to describe the sedimentology of Oakland Bay (Figure 4). Between 1977 and 2006, a range of tides is visible in the oblique aerial photographs available from the Coastal Atlas (Ecology 1977, 1992, 2001, 2006). These photographs help to delineate tidal areas (subject to wetting and drying associated with tides) and foreshore areas (influenced by waves). The descriptions rely heavily on the Coastal Atlas oblique aerial photographs (Appendix B) and the aerial orthophotographs (Appendix C).

Broadly speaking, marine portions of the study area can be divided into two broad categories: creek deltas and their associated embayments and deeper portions of Oakland Bay and Hammersley Inlet. Creek deltas are shallow areas influenced by small local waves and drainage from creeks. Deep water portions of Oakland Bay and Hammersley Inlet are dominated by tidal exchange and only influenced by waves on their periphery. The following subsections summarize shoreline modifications and their impacts on sediment supply and storage based on the available data. For shoreline features, typology and terminology proposed by Terich (1987) is used.

4.2.1 Creek Deltas and Associated Embayments

There are four regions within the study area where sediment accretion (accumulation) is rapid and water depths are shallow. Because these regions have the same physical processes acting on them, they are addressed collectively below.

4.2.1.1 Shelton Harbor

Shelton Harbor is an area of extensive development associated with the town of Shelton. The erosion of large areas of unstable bluffs surrounding Shelton Harbor might have once been an important sediment source in Shelton Harbor; however, extensive armoring of the shoreline and development between the bluffs and the shoreline have completely cut off the bluffs as a source of sediment.

The 1878 T-sheets (topographic maps) indicate that the harbor shoreline had been hardened, but Goldsborough Creek and Shelton Creek had not yet been channelized (Appendix A). By 1942, Goldsborough Creek and Shelton Creek had been channelized through Shelton and into the harbor. Shelton was well developed and a large portion of the Shelton Creek basin consisted of impervious surface (i.e., constructed surfaces that water is unable to penetrate). Intensive logging also was occurring along Goldsborough and Shelton Creeks (intensive logging is visible on the northwest shore and inland of Oakland Bay). Extensive log rafts are visible in photographs from all the years (Appendix C). Goldsborough Creek was dammed in 1885, but the dam was small and the reservoir filled quickly. The dam was removed in 2001 and likely has produced more sediment in recent years than in years previous; however, this increase in sediment transport has been negligible compared to the background sediment transport rate in the creek (US Army Corps of Engineers 1999).

By 1957, new vegetation and development in the hills surrounding Goldsborough Creek and Shelton Creek is visible and U.S. Route 101 (US 101) is visible west of the harbor. Aerial photographs from 1965 show an active quarry on Goldsborough Creek west of US 101 (west of the extents in the aerial photograph shown in Figure C-3, Appendix C), which appears to have operated through 2006. Goldsborough Creek is heavily channelized in all of the Coastal Atlas aerial photographs for the years 1977 through 2006 (Figures B-7 through B-10, Appendix B). Shelton Creek is piped or channeled through the city, with the lower portion open to the surface.

Both Goldsborough Creek and Shelton Creek discharge to the north side of Shelton Harbor, with Goldsborough Creek directed northward by a constructed berm on the south bank. The resulting delta extends primarily north from the creek mouth, with a portion wrapping around the berm to the south and west. The 1965 aerial photographs show a small delta from Goldsborough and Shelton creeks during high tide. Both of the 1980 and the 1992 aerial photographs were taken during low tide and expansion of the Shelton Harbor delta system is clearly visible between those years.

Goldsborough Creek represents two-thirds of the total sediment input to Oakland Bay. Even though the Goldsborough Creek delta expansion is visible throughout the photographic record, accumulated sediment volumes cannot be estimated reliably because of the possibility of significant human alterations of these expanded areas.

4.2.1.2 Chapman Cove

Chapman Cove is similar to Shelton Harbor, but much less developed. Historical oblique aerial photographs of Chapman Cove from 1977, 1992, 2001, and 2006 show a large horizontal and vertical area under the influence of tides. Between 1977 and 2006, Uncle John Creek and Campbell Creek changed very little. The lower reaches of the creeks wind through narrow riparian (vegetated) corridors flanked by residential property and cleared land.

4.2.1.3 Johns Creek Delta

Historically, the Johns Creek delta was a large estuarine marsh before it was filled and drained in order to accommodate the golf course at the Bayshore Golf Club (see Appendix A). The 1977 aerial photographs show an active quarry southwest of the Johns Creek outfall (Figure B-1, Appendix B). The 1977 aerial photographs also show a more forested and less residential basin than visible in 1992. An anastomosing (branching) channel through the lower reaches of Johns

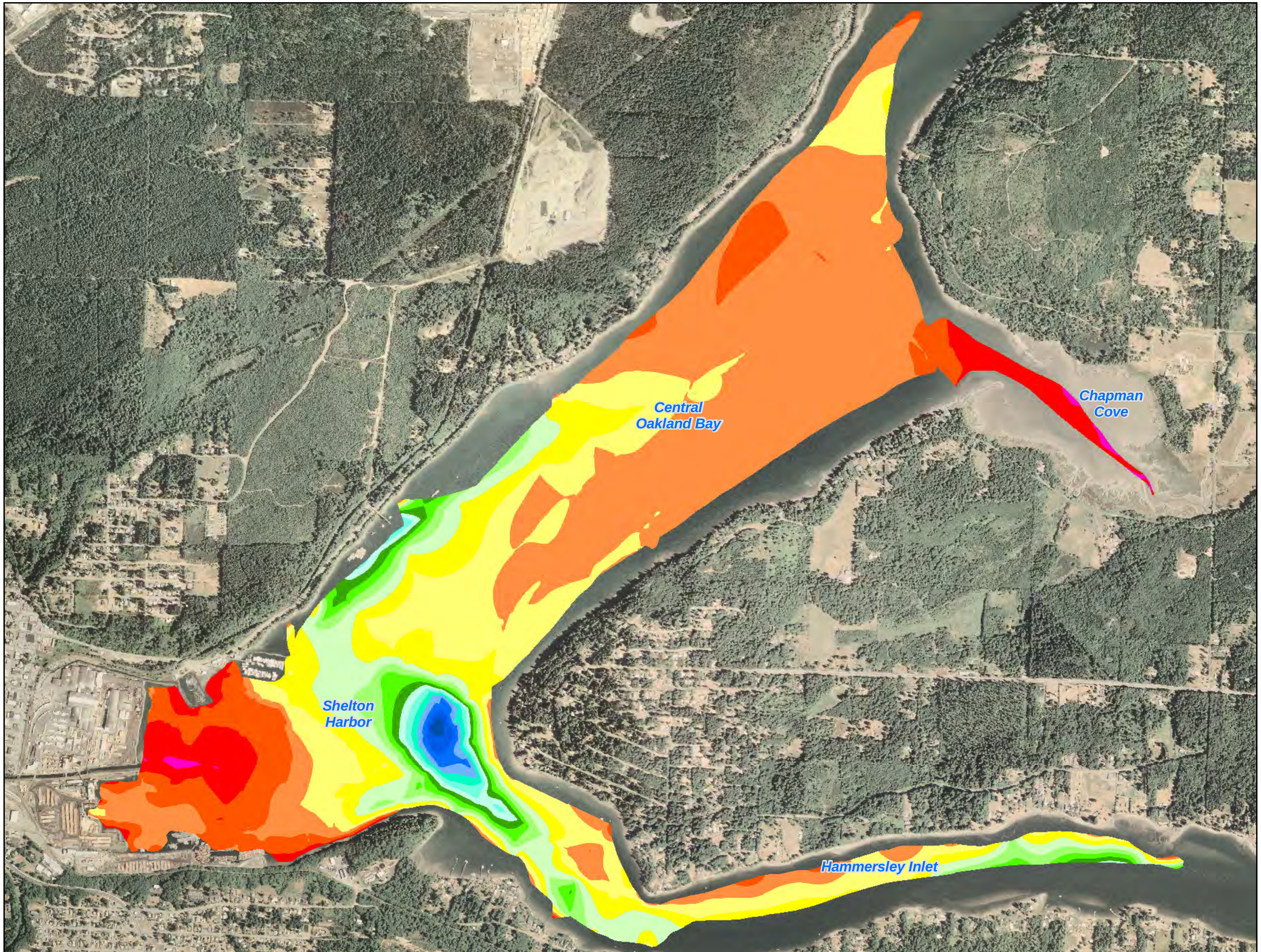

Figure 3.
Bathymetric data from geophysical survey in Oakland Bay and Hammersley Inlet.

Legend

Bathymetry

(feet below mean low water)

- -20 - -15
- -15 - -10
- -10 - -5
- -5 -0
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85

N

0 750 1,500 3,000 Feet

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Aerial: USDA 2006

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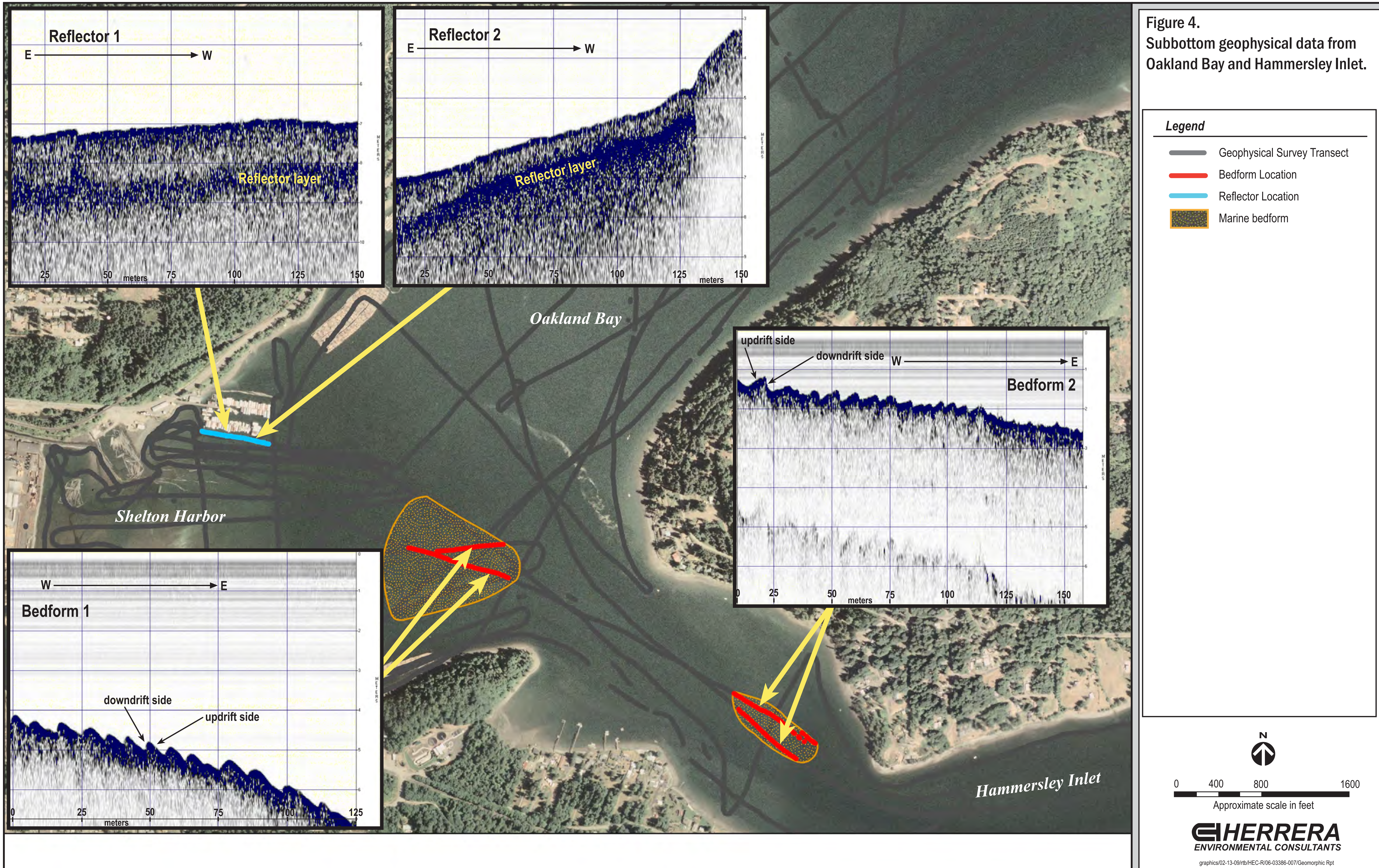

Figure 4.
Subbottom geophysical data from Oakland Bay and Hammersley Inlet.

Creek is visible in the 1977 aerial photographs. By 1992, Johns Creek appears to have a natural or constructed levy extending into Oakland Bay (Figure B-2, Appendix B). The photographs indicate few or no changes to the channel between 1992 and 2006 (Figures B-2 through B-4, Appendix B); only the areas near the golf course have experienced an increase in residential construction.

4.2.1.4 Head of the Bay

The head of the bay is characterized by a tidal flat exposed during low tides. This intertidal zone consists predominantly of mud flats with narrow deep channels associated with Deer, Cranberry and Malaney Creeks.

Deer Creek has a stable, single threaded channel that has maintained its sinuous form and vegetated coverage during the photographic record, from 1977 to 2006. Cranberry Creek appears well vegetated inland of the creek mouth. The 1977 oblique aerial photograph shows a mildly anastomosing lower Cranberry Creek (Figure B-15, Appendix B), which has become more channelized by 2006 (Figure B-19, Appendix B). The smooth, low-sloping topography between Cranberry and Deer creeks is a relic of the Vashon glacial advance. Fluted landscape features associated with glacial scour are most pronounced along the upper basins of Cranberry and Deer creeks. All the photographs of Malaney Creek show a braided creek mouth with limited lateral migration over time. The only lateral migration is evident between the 1977 and 1992 aerial photographs (Figures B-5 and B-6, Appendix B), when the channel had migrated into the right bank just before it met the bay. Adjacent to the creek is an area of land that was once cleared, but all of the recent aerial photographs show dense trees surrounding the creek channel, most likely supporting a stable channel alignment.

4.2.2 Central Oakland Bay and Hammersley Inlet

Central Oakland Bay and the western half of Hammersley Inlet include a relatively deep basin beneath the influence of wave action, bounded by steep shorelines. The erosion of unstable slopes along the adjacent shorelines was likely an important source of sediment to the area before European settlement. More recently, shoreline armoring and the construction of roadways between the bluffs and shoreline have limited the contribution of sediment from overland flow and landsliding; however, one identified unstable slope has experienced a recent slide on the southwest shoreline of Oakland Bay (Figure 5). The shoreline near the slide has had minimal modifications. It is possible that the slide is a small, but ongoing, source of sediment to Oakland Bay.

Hardpoint bedrock outcroppings are common in the area, typified by Vashon advance outwash found at the interface between Hammersley Inlet and Oakland Bay. This is evident from the subbottom profiles identified during the geophysical survey. The hardpoints at the interface of Oakland Bay and Hammersley Inlet effectively constrict tidal flow through a narrow and deep subglacial channel.

Central Oakland Bay and Hammersley Inlet are most probably the remnants of a subglacial channel formed during glacial retreat. That channel extends from Hammersley Inlet across Oakland Bay in front of Shelton Harbor, and then along the western shore north of the harbor to

Bayshore Point. The deep-water area in Oakland Bay, just to the west of Hammersley Inlet, is likely a result of energetic tidal exchange around Munson and Miller Points. Bedforms located to the east and west of the deep water area demonstrate that tidal flow preferentially transports sediment into the bay at depth (Figure 5). The return flow at the water surface does not export sediment out of the bay because of the deep (erosional) hole at the junction of Oakland Bay and Hammersley Inlet.

The bathymetric survey indicates a smooth surfaced, undulating seabed through most of the bay, broken in places by the presence of marine bedforms. Seismic reflection data indicate two distinct bedform fields (a group of similarly oriented marine bedforms): Bedform 1 is located at the southwest side of the entrance to Oakland Bay from Hammersley Inlet and Bedform 2 is located in the center of the lower (eastern) portion of Hammersley Inlet, just before it transitions into Oakland Bay (Figure 5). The marine bedforms are steeper on the west and have shallower slopes on the east. Bedform 1 is located in the deep-water region of the bay (13 to 40 feet) and bedform 2 is located in shallow-water (3 to 7 feet). Both display east-west orientations, but with opposing steepened sides, indicating net eastward transport out of Oakland Bay.

In addition to surficial marine bedforms, a strong reflector (a line of high reflectivity, dark in color, and with sharp edges) appeared between 1 and 8 feet beneath the surface throughout Oakland Bay (Figure 4). This reflector was continuous for much of the central portion of the bay and near all of the creek deltas. It typically indicates a hard surface. For most of the bay and Shelton Harbor, the reflector was 2 to 3 feet beneath the bed surface. The reflector is not to be confused with a multiple; a line parallel to the seabed surface that occurs approximately twice the depth from water surface to seabed. An example of a multiple is illustrated in the image of Bedform 2 (Figure 4).

Side-scan data indicated submerged logs immediately north of the Shelton Marina on the western shore of Oakland Bay and at a few random locations throughout Shelton Harbor; otherwise the seabed was mostly featureless. Raw data collected during the geophysical survey can be found in Global Geophysics (2008).

4.3 Sediment Accumulation

Sediment accumulation rates were estimated using radioisotopic analysis of cored sediment. One core was collected from the center of Oakland Bay (OB-15), one was collected from the edge of Shelton Harbor (SH-17), and one was collected from south of Bayshore Point (OB-16). Table 4 summarizes ^{210}Pb measurements conducted on the three sediment cores, while Table 5 summarizes the results of the ^{137}Cs measurements. The ^{210}Pb results provide limits on sediment accumulation rates across the bay, as they show the expected drop in activity (measured in picocuries/gram) with depth below the bed surface and increasing sediment age. The ^{137}Cs results benchmark initial radioisotope deposition associated with the nuclear age. Each core location is discussed separately below, followed by a summary of the results with respect to the overall sediment budget estimate.

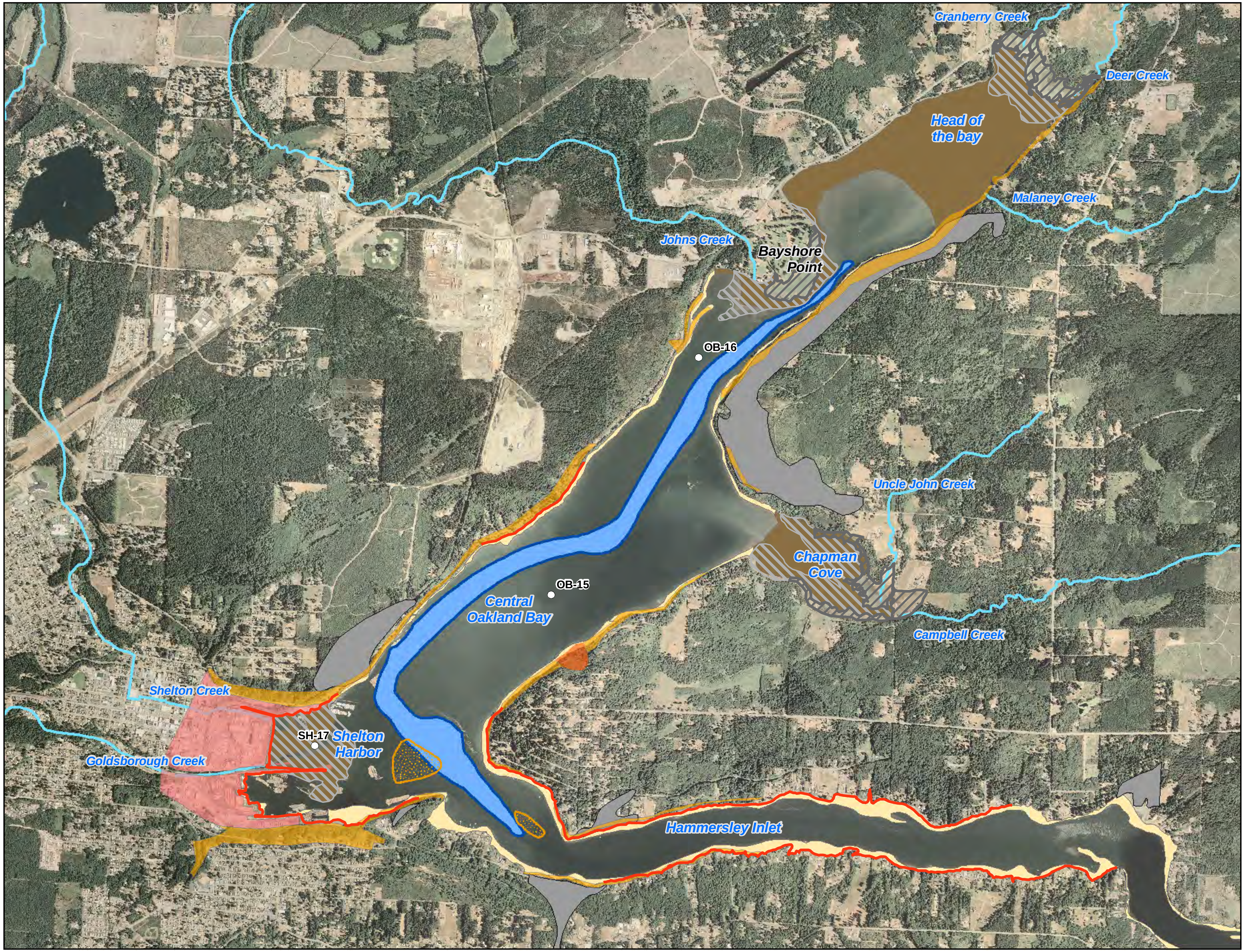

Figure 5.
Geomorphic features of Oakland Bay and Hammersley Inlet.

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Soil: USFS 1999
Aerial: USDA 2006

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Table 4. ^{210}Pb measurement results, Oakland Bay.

Core Location [a]	Depth Below Surface Interval (cm)	^{210}Pb activity (picocuries/gram)	Grain Size
OB-15	0-3	1.57	silty clay
	10-12	1.03	silty clay
	19-21	1.22	silty clay
	28-30	0.81	silty clay
	37-39	1.13	silty clay
	46-48	n/d	silty clay
	55-57	0.65	silty clay
	64-66	0.45	silty clay
	73-75	0.62	silty clay
	82-84	n/d	silty clay
	91-93	0.64	silty clay
	100-102	0.32	silty clay
	109-111	0.65	silty clay
	118-120	0.37	silty clay
OB-16	0-3	2.09	silty clay
	10-12	1.26	silty clay
	19-21	1.22	silty clay
	28-30	1.30	silty clay
	37-39	0.49	silty clay
	46-48	0.77	silty clay
	55-57	0.71	silty clay
	64-66	0.83	silty clay
	73-75	0.61	silty clay
	82-84	0.41	silty clay
	91-93	0.61	silty clay
	100-102	0.93	silty clay
	109-111	0.43	silty clay
	118-120	n/d	silty clay
SH-17	0-3	0.88	clayey silt
	10-12	0.52	clayey silt
	19-21	0.48	clayey silt
	28-30	0.38	clayey silt
	37-39	0.25	clayey silt
	46-48	0.24	sand
	55-57	n/d	sand
	64-66	n/d	gravel
	73-75	n/d	gravel
	82-84	0.30	sandy silt
	91-93	n/d	sandy silt
	100-102	n/d	sandy silt
	109-111	0.40	sandy silt
	118-120	n/d	sandy silt

[a] Core locations on Figure 5
n/d – Not detected,.

Table 5. ^{137}Cs measurement results, Oakland Bay.

Core Location	Depth Below Surface Interval (cm)	Cs-137 present? Presence of ^{137}Cs
OB-15	7-9	present
	16-18	present
	31-33	not present
OB-16	0-3	present
	16-18	present
	25-27	present

^{210}Pb data analysis first requires establishing a "supported" level of ^{210}Pb activity (Appleby 2008). This is the radioactivity level associated with no remaining atmospherically produced ^{210}Pb, which is dependent on factors such as sediment accumulation rate, grain-size distribution, and other sediment mineralogical characteristics. In the OB-15 core, the radioactivity seen in the samples deeper than 47 cm exhibit no trend with depth and average 0.53 picocuries/gram (in samples where ^{210}Pb was detected). Therefore, approximately 0.5 picocuries/gram constitute the "supported" level of ^{210}Pb activity. The presence of unsupported ^{210}Pb in the 38 cm sample and the lack of unsupported ^{210}Pb at greater depths suggest an accumulation rate of approximately 0.31 cm/year, assuming that the first undetected ^{210}Pb at 47 cm represents material that was deposited 150 years ago.

^{137}Cs samples were selected to bracket the depth expected of ^{137}Cs appearance (i.e., 63 years of sediment accumulation) based on the estimated accumulation rate (Table 5). The presence of ^{137}Cs at 17 cm deep and its absence at 32 cm implies that the accumulation rate occurs between 0.27 and 0.51 cm/year. The ^{137}Cs results provide an independent check on the accumulation rate estimated from ^{210}Pb activity. Because of the imprecise nature of dating sediment, the range of sediment accumulation rates provided by the ^{137}Cs results are the best estimate of sedimentation in central Oakland Bay.

The SH-17 core exhibited large quantities of sand and gravel associated with creek discharges, resulting in a less straightforward interpretation of lead data. ^{210}Lead only adsorbs to fine-grained sediment (predominantly clay); therefore, the total amount of ^{210}Pb per sample volume was greatly reduced (Table 4). All of the core sample activities, except for the surface, were close to or less than the laboratory detection limits of the laboratory analysis. Coarser grained materials are likely associated with rapid mass movements from stream basins to the sea. As such, they do not pick up nearly as much ^{210}Pb as clayey sediments that are transported slowly through the drainage basin. Without a clear supported level of ^{210}Pb, there is no way to make a quantitative estimate of the accumulation rate at the SH-17 core location. For these same reasons, an analysis of ^{137}Cs was not performed on this core.

The grain-size data does provide qualitative information with respect to the sedimentary environment at SH-17. The presence of sand and gravel is inconsistent with the sedimentary environment indicated prior to development because the creek mouths were far away and sediment supply was mediated by a large marsh complex (NOAA 1878). Sediment deposited prior to European settlement at SH-17 would have been restricted to silt- or clay-sized material. Therefore, the presence of sand and gravel implies that the sediment has been delivered to the SH-17 core location since upland development began, resulting in channelization of the creeks. It can therefore be assumed that nearly all of this sediment was laid down since the marshes were filled and channelized prior to 1942, implying an accumulation rate greater than 1 cm/year.

Radioisotope data results for OB-16 are unclear. Similar to OB-15, ^{210}Pb activity seen in the OB-16 core lacks an apparent trend for depths greater 38 cm; however, the apparent supported radioactivity level in OB-16 (0.64 picocuries/gram) is greater than the supported level in OB-15 (0.52 picocuries/gram). There is also more scatter in the apparent supported activities in the OB-16 core. If 0.63 picocuries/gram is the supported level of activity of ^{210}Pb, the accumulation rate at the core site would be approximately 0.25 cm/year, consistent with the OB-15 rate of 0.31 cm/year. However, the presence of ^{137}Cs at 26 cm is entirely inconsistent, suggesting an accumulation rate in excess of 0.6 cm/year. Either the site has been disturbed (if the site was dredged, old sediment with low ^{210}Pb activity would have been mixed with recent deposits containing ^{137}Cs present) or the actual supported level of ^{210}Pb is less than 0.64 picocurries/gram. In this case, the ^{210}Pb results would imply a sediment accumulation rate of 0.79 cm/year or greater. Additional ^{137}Cs testing at OB-16 is required to distinguish between the possibilities.

The three sediment cores collected for radioisotope analyses represent relatively undisturbed central Oakland Bay, the fringe of substantial creek sediment input to Shelton Harbor, and an area of transition between disturbed and undisturbed portions of Oakland Bay near Bayshore Point. Analytical results of each core reflect physical sedimentation processes associated with historical use of both the shoreline and bay for both commercial and industrial purposes. It appears that sediment accumulation rates vary across the Oakland Bay system, between 0.27 and 0.51 cm/year in central Oakland Bay and possibly exceeding 1 cm/year in areas of preferential sediment accumulation (i.e., near deltas). Average accumulation rates predicted from the sediment input analysis suggest that if 0.566 cm/year were found, it would imply that nearly all of the sediment discharged to the bay stays in the bay. The high rates of accumulation within central Oakland Bay imply that some sediment does migrate from Shelton Harbor. In sum, since many areas seem to exceed the average accumulation rate estimated from the sediment input analysis and areas far from sediment sources achieve somewhere between 50 and 90 percent of the anticipated accumulation rate, it appears that sediment does not leave Oakland Bay. It is important to note that these conclusions are consistent with other qualitative evidence of near-bed flow and associated sediment transport (e.g., bedforms oriented into the bay, hydrographic modeling, etc.).

5.0 Summary and Conclusions

Based on modeled sediment inputs and physiographic features, it appears that most Oakland Bay creeks have small sediment contributions to the bay, with the exception of Goldsborough Creek. Historical sources of sediment from the adjacent shore bluffs have been greatly reduced by shoreline development. Near Goldsborough Creek, a large sand and gravel delta has formed in recent times. Accumulation rates of sand and gravel on the delta in Shelton Harbor likely exceed 1 cm/year. Most suspended material delivered via the creeks is transported into the main body of Oakland Bay. This includes material from Goldsborough Creek, Shelton Creek and other points in Shelton Harbor.

Past work describing geologic and hydrographic conditions in Oakland Bay indicates a low-energy, tidally influenced estuary that occupies a drowned drainage network. The extreme tide range in Oakland Bay ensures strong near-bed flood currents, little ebb tide flushing (mostly through surface waters), and a high retention rate of local sediment inputs (Albertson 2004). This means that although there are local high velocity tidal currents at the junction between Oakland Bay and Hammersley Inlet, most sediment that originates in Oakland Bay remains there. Evidence from marine bedforms found at the entrance to the bay confirms this hypothesis of density stratified tidal flow. The dense seawater delivered to the bay may be flowing along the drowned channel bottom (Figure 3), as evidenced by marine bedforms at its south end (Figure 4). Shallow-water marine bedforms oriented toward the rest of Puget Sound in Hammersley Inlet also confirm that less dense, less saline flow is occurring out of Oakland Bay in shallower depths (Albertson 2004).

Subbottom profiling of the sea bed in the harbor identified a strong acoustic reflector that varied between 1 and 8 feet beneath the sediment surface. Observed accumulation rates (between 0.27 and 0.51 cm/year, or 2 to 3 feet in the 100 years since development) suggest that this reflector is likely an indication of the onset of deforestation. The onset of deforestation associated with European settlement has been shown to create significant sediment composition transitions in similar environments (Gomez et al. 2007). In Oakland Bay, the presence of wood waste may enhance the geophysical expression of this transition.

A sediment budget comparing the estimated sediment inputs with sedimentological characteristics and radioisotopic measurements suggests that very little if any sediment that originates Oakland Bay basin is transported into Hammersley Inlet and beyond.

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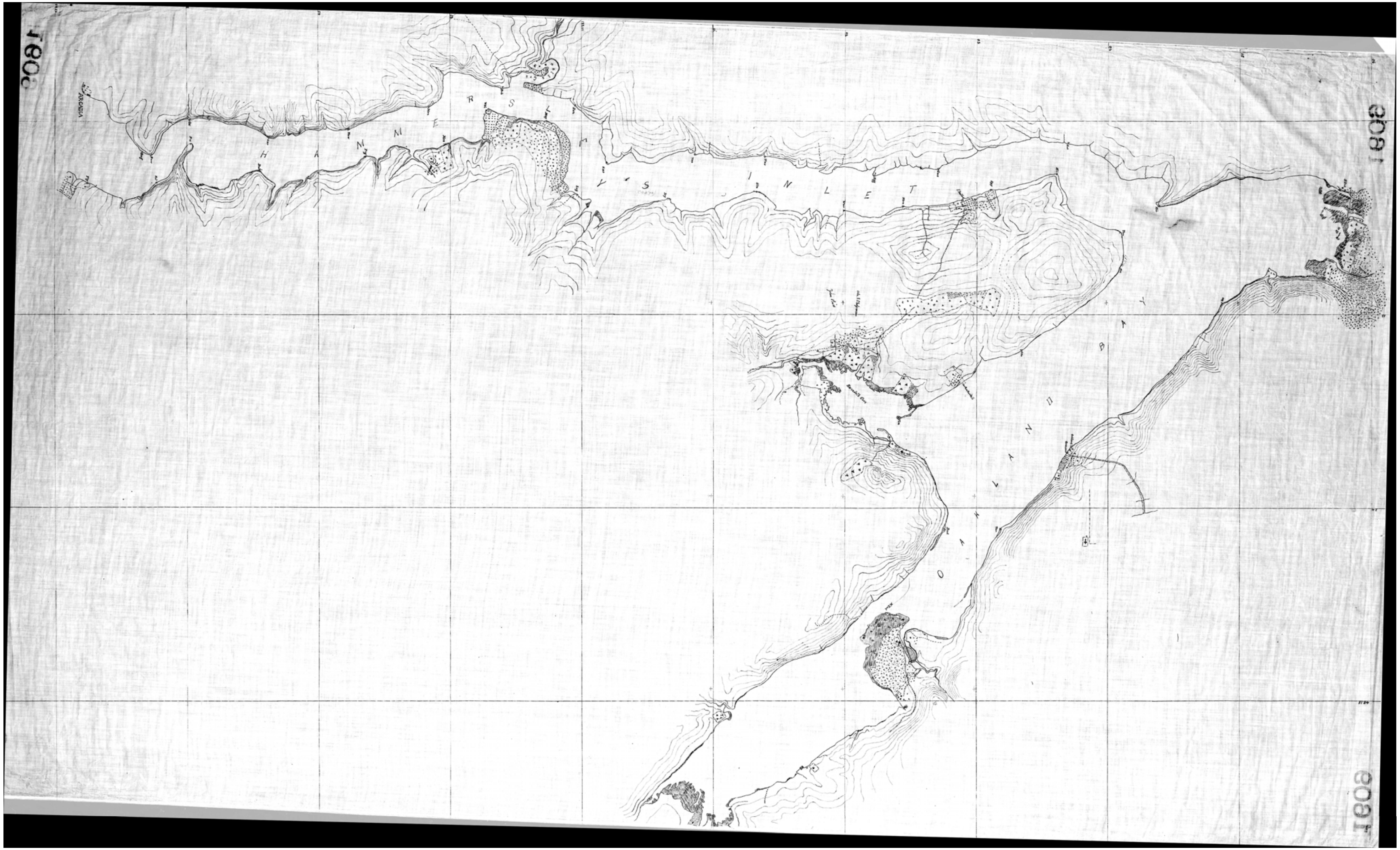
APPENDIX A

Topographic Survey of Oakland Bay in 1878



Oakland Bay 1878 Topographic Survey

APPENDIX B

Historical Photographs of Creek Deltas in Oakland Bay

B-1. Johns Creek, 1977 Coastal Atlas oblique aerial photograph.

graphics/01-15-09/rtb/HEC-R/06-03386-007

B-2. Johns Creek, 1992 Coastal Atlas oblique aerial photograph.

B-3. Johns Creek, 2001 Coastal Atlas oblique aerial photograph.

B-4. Johns Creek, 2006 Coastal Atlas oblique aerial photograph.

B-5. Malaney Creek, 1977 Coastal Atlas oblique aerial photograph.

graphics/01-15-09/rtb/HEC-R/06-03386-007

B-6. Malaney Creek, 1992 Coastal Atlas oblique aerial photograph.

B-7. Goldsborough and Shelton Creeks, 1977 Coastal Atlas oblique aerial photograph.

B-8. Goldsborough and Shelton Creeks, 1992 Coastal Atlas oblique aerial photograph.

B-9. Goldsborough and Shelton Creeks, 2001 Coastal Atlas oblique aerial photograph.

B-10. Goldsborough and Shelton Creeks, 2006 Coastal Atlas oblique aerial photograph.

B-11. Uncle John and Campbell Creeks, 1977 Coastal Atlas oblique aerial photograph.,

B-12. Uncle John and Campbell Creeks, 1992 Coastal Atlas oblique aerial photograph.

B-13. Uncle John and Campbell Creeks, 2001 Coastal Atlas oblique aerial photograph.

graphics/01-15-09/rtb/HEC-R/06-03386-007

B-14. Uncle John and Campbell Creeks, 2006 Coastal Atlas oblique aerial photograph.

graphics/01-15-09/rtb/HEC-R/06-03386-007

B-15. Deer and Cranberry Creeks, 1977 Coastal Atlas oblique aerial photograph.

B-16. Deer and Cranberry Creeks, 1992 Coastal Atlas oblique aerial photograph.

B-17. Deer and Cranberry Creeks, 2001 Coastal Atlas oblique aerial photograph.

B-18. Deer Creek, 2006 Coastal Atlas oblique aerial photograph.

graphics/01-15-09/rh/HFC-R/06-03386-007

B-19. Cranberry Creek, 2006 Coastal Atlas oblique aerial photograph.

APPENDIX C

Historical Aerial Photographs of Oakland Bay

Figure C-1. 1942 University of Washington historical aerial photograph.

Figure C-2. 1957 University of Washington historical aerial photograph.

Figure C-3. 1965 University of Washington historical aerial photograph.

Figure C-4. 1980 University of Washington historical aerial photograph.

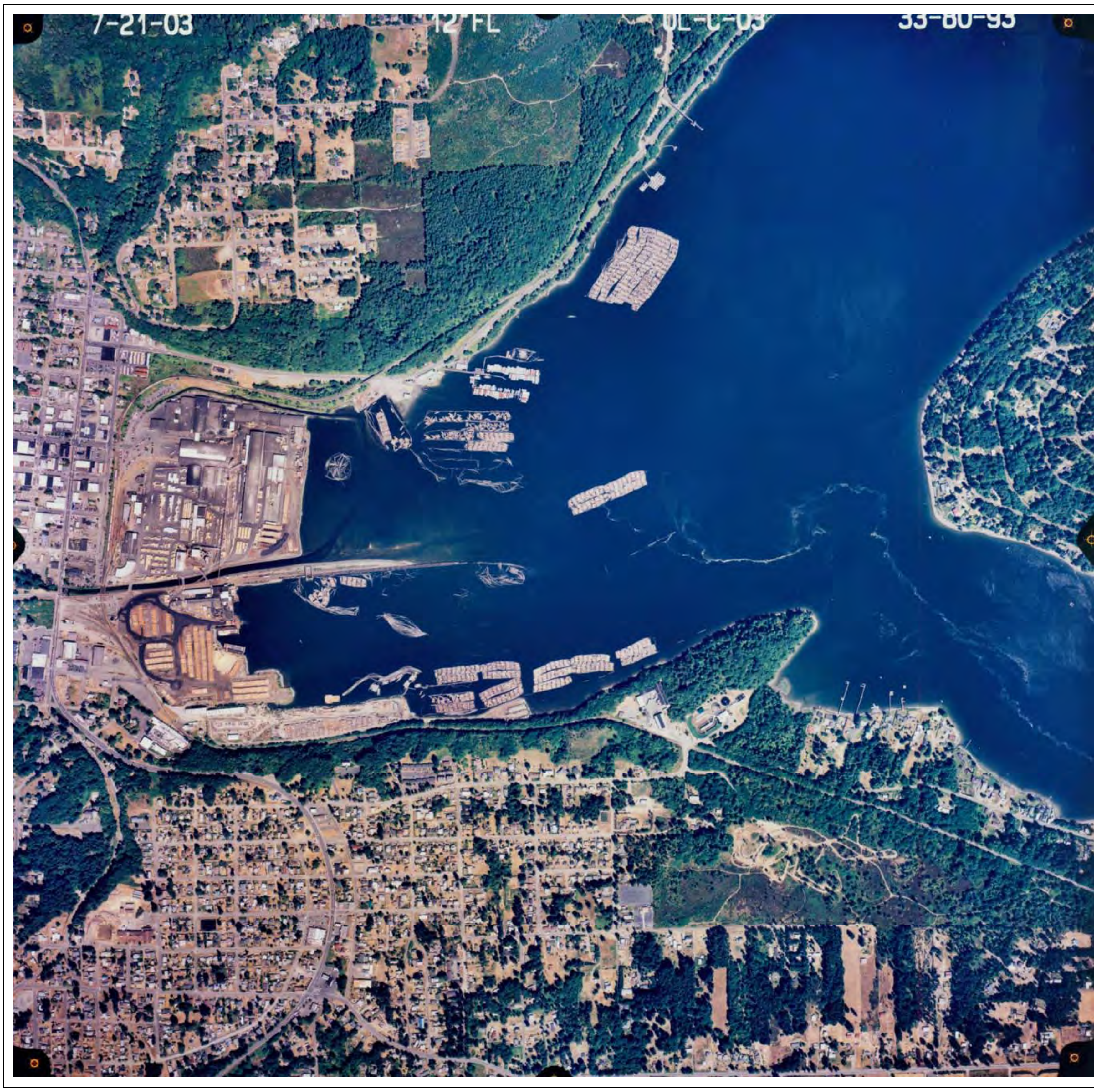


Figure C-5. 2003 University of Washington historical aerial photograph.

APPENDIX F

Sample Wood Content Summary

Table F-1. Summary of wood content in Shelton Harbor sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%)				Total Wood Content (%) [a]
		Bark	Chips	Fiber	Sawdust	
SH-01	0-0.33					
	0-1	10				10
	1-2					
	2-3					
	3-4					
	4-5					
	5-6					
	6-7					
	7-7.3					
SH-02	0-0.33		5	<5		7.5
	0-1	15				15
	1-2	5	<1			5.5
	2-3	5				5
	3-4					
	4-5					
	5-6					
	6-6.5					
SH-03	0-0.33	5				5
SH-04	0-0.33			5		5
	0-1					
	1-2				10	10
	2-3	<5			75	77.5
	3-4	<5			75	77.5
	4-5		5		75	80
	5-6		5		75	80
	6-6.6	<5				2.5
SH-05	0-0.33			5		5
	0-1					
	1-2					
SH-07	0-0.33		<1			0.5
	0-1					
	1-2					
	2-3					
	3-4					
SH-08	0-1					
	1-2					
	2-3					
	3-4					
	4-5					
SH-09	0-0.33					
	0-1		1			1
	1-2					
	2-3					
SH-10	0-0.33			<5		2.5
	0-1					
	1-2	20				20
	2-3	20				20
	3-4	10				10
	4-5					
	5-5.6					
SH-11	0-0.33		10			10
	0-1		<5			2.5
	1-2		<5			2.5
	2-3					
	3-4	<1				0.5
	4-4.6					

Table F-1 (continued). Summary of wood content in Shelton Harbor sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%)				Total Wood Content (%) [a]
		Bark	Chips	Fiber	Sawdust	
SH-12	0-0.33		5			5
	0-1		<5	10		12.5
	1-2	<1	<5	10		13
	2-3		<5	10		12.5
	3-4			10		10
	4-5			10		10
	5-5.3	10	5	50		65
	0-1			<5		2.5
	1-2			<5		2.5
	2-3			<5		2.5
	3-4			<5		2.5
	4-5	<5				2.5
	5-6	5		10		15
	6-7				75	75
	7-8				100	100
	8-9				100	100
	9-10				100	100
	10-10.4				85	85
SH-13	0-0.33			<1		0.5
	0-1					
	1-2		<1	<1		1
	2-3	<5		<5		5
	3-4	<5		5		7.5
	4-5			5		5
	5-5.7	<1				0.5
SH-14	0-0.33	5	5			10
	0-1	10				10
	1-2	10				10
	2-3	10				10
	3-4					
	4-5					
	5-6					
	6-6.7					
SH-15	0-0.33					
	0-1					
	1-2					
	2-3					
	3-4					
	4-5					
	5-6					
	6-6.3					
SH-16	0-0.33					
	0-1					
	1-2		<1			0.5
	2-3					
SH-17	0-1		<5			2.5
	1-2					
	2-3					
	3-4	5				5
	4-5	<5				2.5
	5-6	<5				2.5
SH-18	0-0.33					
	0-1	5	5	10		20
	1-2	5		10		15
	2-3	5		25		30
	3-4	5		20		25
	4-5					
	5-5.5					

Table F-1 (continued). Summary of wood content in Shelton Harbor sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%)				Total Wood Content (%) [a]
		Bark	Chips	Fiber	Sawdust	
SH-19	0-0.33	<5	5			7.5
	0-1		<1			0.5
	1-2		<1			0.5
	2-3					
	3-4					
SH-20	0-0.33			5		5
	0-1					
	1-2	5				5
	2-3	<1				0.5
	3-4					
	4-5					
	5-5.3					
SH-21	0-0.33			5		5
	0-1		20	5		25
	1-2		20	5		25
	2-3		20	20		40
	3-4	25	15	30		70
	4-5.3	25	15	30		70
	0-1	25				25
	1-2	25				25
	2-3	25				25
	3-4	20				20
	4-5	5				5
	5-6	<5				2.5
	6-7	<5				2.5
	7-8	5				5
	8-9	<5				2.5
	9-10	2				2
	10-11	<5				2.5
	11-12	1				1
SH-22	0-0.33	50				50
	0-1	20				20
	1-2	25				25
	2-2.5	40	<1			40.5
SH-23	0-0.33	<5				2.5
	0-1	<5				2.5
	1-2	10				10
	2-3	10				10
	3-4					
	4-5					
	5-6					
	6-6.7					
SH-24	0-0.33	50				50
SH-25	0-0.33					
SH-26	0-0.33					
	0-1					
	1-2					
	2-3					
	3-4					
	4-4.6					

Table F-1 (continued). Summary of wood content in Shelton Harbor sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%) Bark	Chips	Fiber	Sawdust	Total Wood Content (%) [a]
SH-27	0-0.33		5			5
	0-1	10				10
	1-2		5			5
	2-3		5			5
	3-4		<1			0.5
	4-5					
	5-6.3					
SH-28	0-0.33					
	0-1	20				20
	1-2	10				10
	2-3	10				10
	3-4	<5				2.5
	4-5					
	5-6					
	6-6.6					
SH-29	0-0.33					
	0-1					
	1-2	<1				0.5
	2-3	<5				2.5
	3-4					
	4-5					
	5-6		<1			0.5
	6-6.5					
SH-30	0-0.33					
	0-1	5				5
	1-2					
	2-3					
	3-4					
	4-5					
	5-6					
	6-6.5					

[a] For wood type values estimated as "less than" (e.g., <5), one half of the value was used to calculate the total wood content.

Table F-2. Summary of wood content in Oakland Bay sediment samples.

		Wood Type (%)				Total Wood Content (%) [a]
Sample Station	Depth Interval (feet)	Bark	Chips	Fiber	Sawdust	
OB-01	0-0.33					
	0-1					
	1-2					
	2-3	<1				0.5
	3-4					
	4-5					
	5-5.2					
OB-02	0-0.33					
	0-1	<1				0.5
	1-2	<1				0.5
	2-3					
	3-4					
	4-5	<1				0.5
	5-6					
	6-7					
	7-7.2					
OB-03	0-0.33					
	0-1					
	1-2					
	2-3					
	3-4					
	4-5					
	5-6					
OB-04	0-0.33	5				5
	0-1	15				15
	1-2					
	2-3					
	3-4					
	4-5					
	5-5.2					
OB-05	0-0.33					
	0-1					
	1-2					
	2-3					
	3-4					
	4-5					
OB-06	0-0.33			<5		2.5
	0-1					
	1-2					
	2-3	<1				0.5
	3-4	<1				0.5
	4-5					
	5-6					
	6-6.6					
OB-07	0-0.33					
	0-1					
	1-2					
	2-3	<1				0.5
	3-4	20				20
	4-5					
	5-6					
	6-6.5					
OB-08	0-0.33	<1				0.5
	0-1	<1				0.5
	1-2					
	2-3					
	3-4					

Table F-2 (continued). Summary of wood content in Oakland Bay sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%)				Total Wood Content (%) [a]
		Bark	Chips	Fiber	Sawdust	
OB-09	0-0.33					
	0-1					
	1-2					
	2-3					
	3-4					
	4-5					
OB-10	0-0.33					
	0-1					
	1-2					
	2-3	<1				0.5
	3-4					
	4-5					
OB-11	0-0.33					
	0-1					
	1-2	<1				0.5
	2-3					
	3-4					
	4-4.3					
OB-12	0-0.33					
	0-1					
	1-2	<5				2.5
	2-3					
	3-4				75	75
	4-5				100	100
	0-1					
	1-2	5				5
	2-3					
	3-4					
	4-5				50	50
	5-6				75	75
	6-7				90	90
	7-8				100	100
	8-9				100	100
	9-9.2					
OB-13	0-0.33					
	0-1					
	1-2	<1				0.5
	2-3					
OB-14	0-0.33					
	0-1					
	1-2	<1				0.5
	2-3					
	3-4					
	4-5.2					
OB-15	0-7.5					
OB-16	0-7					
OB-17	0-0.33	<5				2.5
	0-1	15				15
	1-2	<1				0.5
	2-3	<1				0.5
	3-4					
	4-5					
	5-6	<1				0.5
	6-6.5					

Table F-2 (continued). Summary of wood content in Oakland Bay sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%)				Total Wood Content (%) [a]
		Bark	Chips	Fiber	Sawdust	
OB-18	0-0.33					
	0-1	10				10
	1-2	<5				2.5
	2-3	10		1		11
	3-4					
	4-5					
	5-5.6					
OB-19	0-0.33					
	0-1					
	1-2	5				5
	2-3	<1				0.5
	3-4					

[a] For wood type values estimated as "less than" (e.g., <5), one half of the value was used to calculate the total wood content.

Table F-3. Summary of wood content in Hammersley Inlet sediment samples.

Sample Station	Depth Interval (feet)	Wood Type (%)				Total Wood Content (%) [a]
		Bark	Chips	Fiber	Sawdust	
HI-01	0-1					
	1-2					
	2-3					
	3-4					
	4-4.5					
HI-02	0-0.33					
	0-1					
	1-2					
	2-3					
	3-4					
	4-4.6					
HI-03	0-0.33					
	0-1	<1				0.5
	1-2					
	2-3					
	3-4					
	4-5					
	5-6					
	6-7					
HI-04	0-0.33	5				5
	0-1	5				5
	1-2	1				1
	2-3					
	3-4		<1			0.5
	4-5					
	5-5.5					
HI-05	0-0.33					
HI-06	0-0.33					
	0-1	5				5
	1-2	2				2
	2-3					
	3-4					
	4-5					
	5-5.3					
HI-07	0-0.33					
	0-1					
	1-2			<1		0.5
	2-3					
	3-4					
	4-5.1					

[a] For wood type values estimated as "less than" (e.g., <5), one half of the value was used to calc

APPENDIX G

Summary Chemistry Analytical Results

Parameter	Freshwater Sediment Apparent Effects Threshold[a] LAET	Marine Sediment Management Standard[b] SQS	Marine Sediment Management Standard[b] CSL	Shelton Harbor SH-01-SS-00 (0 to 10 cm)	SH-01-SC-12 (1 to 2 ft)	SH-02-SS-00 (0 to 10 cm)	SH-02-SC-12 (1 to 2 ft)	SH-02-SC-23 (2 to 3 ft)	SH-03-SS-00 (0 to 10 cm)	SH-04-SS-00 [d] (0 to 10 cm)	SH-04-SC-12 [d] (1 to 2 ft)	SH-04-SC-23 (2 to 3 ft)	SH-05-SS-00 (0 to 10 cm)	SH-05-SC-12 [d] (1 to 2 ft)	SH-07-SS-00 (0 to 10 cm)	SH-07-SC-12 (1 to 2 ft)	SH-08-SC-12 (1 to 2 ft)	SH-09-SS-00 (0 to 10 cm)	SH-09-SC-12 (1 to 2 ft)	SH-09-SC-23 (2 to 3 ft)	SH-10-SS-00 (0 to 10 cm)
Conventional Parameters																					
Particle/Grain Size, Fines (Silt/Clay)	---	---	---	27.8	47.9	59.7	57.4		66.2	76	74.4		29	2.3	34.2	28.9	30.2	32.4	21.7		15
Particle/Grain Size, Phi Scale <-1	---	---	---	0.4	1.0	2.0	7.4		2.5	1.5	2.3		36.3	49.4	1	8.3	1.3	0.5	17		0.1
Particle/Grain Size, Phi Scale >10	---	---	---	5.4	8.4	7.6	10.1		8.8	10.8	12.8		4		4.1	3.8	3.7	4.8	3.3		2.2
Particle/Grain Size, Phi Scale 0 to 1	---	---	---	0.8	1.2	2.2	4.6		2.1	3.2	4.8		3.1	13.6	1	11.4	6.2	5	8.5		5
Particle/Grain Size, Phi Scale -1 to 0	---	---	---	0.6	1.0	2.6	4.0		2.9	3.0	4.1		5.7	10.8	1.6	5.6	4.3	1.9	6.3		0.3
Particle/Grain Size, Phi Scale 1 to 2	---	---	---	2.0	1.7	3.3	7.9		4.1	4.3	4.1		4.6	21	3.4	17.2	11.8	19	16.9		14.8
Particle/Grain Size, Phi Scale 2 to 3	---	---	---	19.1	13.8	6.6	8.3		7.3	4.6	4.8		10.4	2.7	27.1	13.6	22.9	25.3	18.8		38.7
Particle/Grain Size, Phi Scale 3 to 4	---	---	---	49.4	33.4	23.6	10.5		14.8	7.4	5.5		11	0.3	31.7	15	23.3	15.8	10.7		26.2
Particle/Grain Size, Phi Scale 4 to 5	---	---	---	10	11.7	20	8.1		14.9	10.9	10.2		5.8		13.1	10	11.1	9.6	8.4		8.4
Particle/Grain Size, Phi Scale 5 to 6	---	---	---	2.9	6.7	10.5	9.8		14.6	19.1	12		6		6.2	4.3	4.9	6.1	2.9		2.1
Particle/Grain Size, Phi Scale 6 to 7	---	---	---	2.7	5.7	7.2	8.4		12.9	12.8	12		5.2		3.8	3.2	3.7	2.6	2.1		0.8
Particle/Grain Size, Phi Scale 7 to 8	---	---	---	2.1	5.2	5.2	7.9		4.9	10.5	10.3		2.4		2.8	2.9	2.6	3.6	1.9		0.5
Particle/Grain Size, Phi Scale 8 to 9	---	---	---	2.4	5.3	4.6	6.7		5.2	6.2	8.6		2.8		2.1	2.4	2.3	2.5	1.8		0.4
Particle/Grain Size, Phi Scale 9 to 10	---	---	---	2.4	4.7	4.5	6.3		5.0	5.8	8.4		2.8		2	2.2	2	3.2	1.4		0.6
Total Volatile Solids %	---	---	---																		
Ammonia (mg/kg)	---	---	---	12.9	46.3	14.8	42.5		11.2	14.8	65.8		6.33	0.03 U	8.21	6.47	21.3	7.91	2.91		9.69
Sulfide	---	---	---	283	91	548	152		155	550	461		391	36.1	158	109	433	192	192		159
Total organic carbon (%)	---	---	---	1.59	1.58	2.46	1.35		3.8	4.13	5.82		3.2	1.45	1.59	0.232	1.28	2.17	2.09		2.03
Total solids (%)	---	---	---	58.7	59.4	44.4	50.6		45.4	34.4	33.2		51.9	90.6	56.3	65.9	64.2	59.4	70.7		59.8
Metals (mg/kg dry weight)																					
Antimony	150	---	---	0.22 J	0.22 J	0.33 J	0.22 J		0.4 J	0.35 J	0.28 J		0.2 J	0.074 J	0.19 J	0.22 J	0.17 J	0.14 J	0.19 J		0.18 J
Arsenic	57	57	93	5.5	4.7	8.2	4.6		7.3	6	4.1		3.7	1.5	3.4	3.8	2.8	3.5	3.6		4.6
Cadmium	5.1	5.1	6.7	0.72	0.75	1	0.74		0.66	0.87	0.98		0.29 J	0.25	0.25 J	0.33	0.21 J	0.35	0.39		0.53
Chromium	260	260	270	35	39	51	40		52	45	35		33	43	46	45	39	40	47		36
Copper	390	390	390	28	25	55	35		51	49	41		38	44	53	50	48	42	50		33
Lead	450	450	530	7.4	4	16	15		22	14	21		6	2.2	5.6	8.7	5.9	6.2	6.4		5.9
Mercury	0.41	0.41	0.59	0.068	0.034	0.092	0.184 U		0.1	0.066	0.092		0.029 J	0.0064 U	0.029 J	0.047	0.112 U	0.027 J	0.029		0.039
Nickel	140	---	---	33	35	42	33		41	36	27		28	34	41	40	38	36	42		34
Silver	6.1	6.1	6.1	0.09 J	0.067 J	0.22 J	0.098 J		0.2 J	0.16 J	0.2 J		0.067 J	0.045 J	0.07 J	0.094 J	0.065 J	0.079 J	0.082 J		0.079 J
Zinc	410	410	960	65	45	100	57		91	88	76		53	44	58	62	55	61	63		59
Butyltins (ug/kg dry weight)																					
Butyltin Ion	---	---	---	3.9 U	1.5 U	8.0	3.9 U														
Dibutyltin Ion	---	---	---	3.0 U	3.6 U	30	3.0 U														
Tributyltin Ion	---	---	---	1.7 U	2.8 U	13	1.7 U														
Aromatic Hydrocarbons (ug/kg dry weight or mg/kg OC)																					
LPAHs																					
2-Methylnaphthalene (dry)	670	---	---	8.0 U	8.0 U	8.1 U	8.1 U		8 U	8.1 U	8.2 U		8.1 U	8.0 U	8.1 U	8.0 U	8.0 U	7.9 U	7.9 U		8.1 U
2-Methylnaphthalene (OC)	---	38	64	0.50 U	0.51 U	0.33 U	0.60 U		0.21 U	0.20 U	0.14 U		0.25 U	0.55 U	0.51 U	3.4 U	0.63 U	0.36 U	0.4 U		0.40 U
Acenaphthene (dry)	500	---	---	8 U	8.1 U	13 J	8.1 U		8.1 U	8.2 U	14 J		8.1 U	8.1 U	8.1 U	8.0 U	8 U	8.0 U	7.9 U		8.1 U
Acenaphthene (OC)	---	16	57	0.50 U	0.51 U	0.53 J	0.60 U		0.21 U	0.20 U	0.24 J		0.25 U	0.56 U	0.51 U	3.4 U	0.63 U	0.37 U	0.4 U		0.4 U
Acenaphthylene (dry)	560	---	---	8.4 U	8.5 U	32	8.5 U		8.5 U	8.6 U	12 J		8.6 U	8.5 U	8.5 U	8.4 U	8.4 U	8.4 U	8.4 U		8.5 U
Acenaphthylene (OC)	---	66	66	0.53 U	0.54 U	1.3	0.63 U		0.22 U	0.21 U	0.21 J		0.27 U	0.59 U	0.53 U	3.6 U	0.66 U	0.39 U	0.4 U		0.42 U
Anthracene (dry)	960	---	---	7.5 U	7.6 U	130	7.6 U		7.6 U	7.7 U	42		7.7 U	7.6 U	7.6 U	7.5 U	7.5 U	7.5 U	7.5 U		14 J
Anthracene (OC)	---	220	1,200	0.47 U	0.48 U	5.3	0.56 U		0.20 U	0.19 U	0.72		0.24 U	0.52 U	0.48 U	3.2 U	0.6 U	0.35 U	0.4 U		0.7 J
Fluorene (dry)	540	---	---	8.7 U	8.8 U	48	8.8 U		8.8 U	8.9 U	13 J		8.9 U	8.8 U	8.8 U	8.7 U	8.7 U	8.7 U	8.6 U		8.8 U
Fluorene (OC)	---	23	79	0.55 U	0.56 U	2.0	0.65 U		0.23 U	0.22 U	0.22 J		0.28 U	0.61 U	0.55 U	3.8 U	0.68 U	0.40 U	0.4 U		0.43 U
Naphthalene (dry)	2,100	---	---	30	8.5 U	13 J	8.6 U		8.5 U	8.6 U	8.6 U		8.6 U	8.5 U	8.6 U	8.5 U	8.5 U	8.4 U	8.4 U		8.6 U
Naphthalene (OC)	---	99	170	1.9	0.5 U	0.53 J	0.64 U		0.22 U	0.21 U	0.15 U		0.27 U	0.59 U	0.54 U	3.7 U	0.66 U	0.4 U	0.4 U		0.42 U
Phenanthrene (dry)	1500	---	---	29	8.2 U	380	26		49	8.3 U	160		27	14 J	8.3 U	24	28	8.1 U	16 J		22
Phenanthrene (OC)	---	100	480	1.8	0.5 U	15	1.9		1.3	0.20 U	2.7		0.84	1.0 J	0.52 U	10	2.2	0.4 U	0.8 J		1.1
Total LPAHs (dry)[c]	5200	---	---	59	20 U	620	26		49	20 U	240		27	14 J	20 U	24	28	19 U	16 J		36
Total LPAHs (OC)[c]	---	370	780	3.7	1.3 U	25	1.9		1.3	0.48 U	4.1		0.84	0.97 J	1.3 U	10	2.2	0.88 U	0.77 J		1.8
HPAHs																					
Benzo(a)anthracene (dry)	1,300	---	---	18 J	5.8 U	170	26		88	42	71		58	10 J	5.8 U	35	50	5.7 U	23		70
Benzo(a)anthracene (OC)	---	110	270	1.1 J	0.37 U	6.9	1.9		2.3	1.0	1.2		1.8	0.69 J	0.36 U	15	3.9	0.26 U	1.1		3.4
Benzo(a)pyrene (dry)	1,600	---	---	21	8 U	180	29		200	64	220		69	15 J	8.1 U	54	43	7.9 U	28		53
Benzo(a)pyrene (OC)	---	99	210	1.3	0.51 U	7.3	2.1		5.3	1.5	3.8		2.2	1.0 J	0.51 U	23	3.4	0.36 U	1.3		2.6
Benzo(b)fluoranthene (dry)	---	---	---	23	9.3 U	130	28		70	40	100		58	9.3 U	12 J	26	45	9.2 U	20		93
Benzo(b)fluoranthene (OC)	---	---	---	1.4	0.59 U	5.3	2.1		1.8	1.0	1.7		1.8	0.64 U	0.8 J	11	3.5	0.42 U	1.0		4.6
Benzo(g,h,i)perylene (dry)	670	---	---	20	6.6 U	66	6.7 U		82	29	80		35	16 J	6.7 U	51	6.6 U	6.6 U	11 J		28
Benzo(g,h,i)perylene (OC)	---	31	78	1.3	0.42 U	2.7	0.50 U		2.2	0.70	1.4		1.1	1.1 J	0.42 U	22	0.52 U	0.30 U	0.53 J		1.4
Benzo(k)fluoranthene (dry)	---	---	---	16 J	9.1 U	130	31		96	29	120		38	9.1 U	10 J	26	42	9 U	33		63
Benzo(k)fluoranthene (OC)	---	---	---	1.0 J	0.58 U	5.3	2.3		2.5	0.70	2.1		1.2	0.63 U	0.63 J	11	3.3	0.41 U	1.6		3.1
Benzofluoranthenes, Total (b+k+j) (dry)	3,200	---	---	39	20 U	260	59		170	69	220		96	20 U	22 J	52	87	19 U	53		160
Benzofluoranthenes, Total (b+k+j) (OC)	---	230	450	2.4	1.3 U	11	4.4		4.5	1.7	3.8		3.0	1.4 U	1.4 J	22	6.8	0.88 U	2.5		7.9
Chrysene (dry)	1,400	---	---	34	6.5 U	200	38		160	76	220		130	19 J	11 J	67	82	26	37		140
Chrysene (OC)	---	110	460	2.1	0.41 U	8.1	2.8		4.2	1.8	3.8		4.1	1.3 J	0.69 J	29	6.4	1.2	1.8		6.9
Dibenz(a,h)anthracene (dry)	230	---	---	8.3 U	8.4 U	14 J	8.4 U		8.4 U	8.5 U	8.5 U		8.5 U	8.4 U	8.4 U	8.3 U	8.3 U	8.3 U	8.3 U		11 J
Dibenz(a,h)anthracene (OC)	---	12	33	0.52 U	0.53 U	0.57 J	0.62 U		0.22 U	0.21 U	0.15 U		0.27 U	0.58 U	0.53 U	3.6 U	0.65 U	0.38 U	0.40 U		0.54 J
Fluoranthene (dry)	1,700	---	---	46	7.8 U	370	44		93	46	470		100	27	15 J	76	99	44	48		170
Fluoranthene (OC)	---	160	1,200	2.9	0.49 U	15.0	3.3		2.4	1.1	8.1		3.1	1.9	0.94 J	33	7.7	2.0	2.3		8.4
Indeno(1,2,3-cd)pyrene (dry)	600	---	---	13 J	8.4 U	60	8.5 U		23	8.5 U	33		8.5 U	8.4 U	8.5 U	13 J	8.4 U	8.3 U	8.3 U		24
Indeno(1,2,3-cd)pyrene (OC)	---	34	88	0.82 J	0.53 U	2.4	0.63 U		0.61	0.21 U	0.57		0.27 U	0.58 U	0.53 U	5.6 J	0.66 U	0.38 U	0.40 U		1.2
Pyrene (dry)	2,600	---	---	56	21	370	54		140	61	190		140	28	11 J	76	130	42	92		160
Pyrene (OC)	---	1,000	1,400	3.5	1.3	15	4.0		3.7	1.5	3.3		4.4	1.9	0.69 J	33	10	1.9	4.4		7.9
Total HPAHs (dry)[c]	12,000	---	---	250	21	1,500	250		960	390	1500		630	120	59 J	420	490	110	290		820
Total HPAHs (OC)[c]	---	960	5,300	16	1.3	61	19		25	9.4	26		20	8.3	3.7 J	180	38	5.1	14		40

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																	
				SH-01-SS-00	SH-01-SC-12	SH-02-SS-00	SH-02-SC-12	SH-02-SC-23	SH-03-SS-00	SH-04-SS-00 [d]	SH-04-SC-12 [d]	SH-04-SC-23	SH-05-SS-00	SH-05-SC-12 [d]	SH-07-SS-00	SH-07-SC-12	SH-08-SC-12	SH-09-SS-00	SH-09-SC-12	SH-09-SC-23	SH-10-SS-00
	LAET	SQS	CSL	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm
Chlorinated Benzenes (ug/kg dry weight or mg/kg OC)																					
1,2,4-Trichlorobenzene (dry)	31	---	---	8.8 U	8.9 U	9 U	8.9 U		8.9 U	9 U	9.0 U		9.0 U	8.9 U	9.0 U	8.8 U	8.8 U	8.8 U	8.8 U		8.9 U
1,2,4-Trichlorobenzene (OC)	---	0.81	1.8	0.55 U	0.56 U	0.37 U	0.66 U		0.23 U	0.22 U	0.15 U		0.28 U	0.61 U	0.57 U	3.8 U	0.69 U	0.41 U	0.42 U		0.44 U
1,2-Dichlorobenzene (dry)	35	---	---	7.7 U	7.7 U	7.8 U	7.8 U		7.7 U	7.8 U	7.8 U		7.8 U	7.7 U	7.8 U	7.7 U	7.7 U	7.6 U	7.6 U		7.8 U
1,2-Dichlorobenzene (OC)	---	2.3	2.3	0.48 U	0.49 U	0.32 U	0.58 U		0.20 U	0.19 U	0.13 U		0.24 U	0.53 U	0.49 U	3.3 U	0.60 U	0.35 U	0.36 U		0.38 U
1,4-Dichlorobenzene (dry)	110	---	---	7.2 U	7.2 U	7.3 U	7.2 U		7.2 U	7.3 U	7.3 U		7.3 U	7.2 U	7.3 U	7.2 U	7.2 U	7.1 U	7.1 U		7.2 U
1,4-Dichlorobenzene (OC)	---	3.1	9	0.45 U	0.46 U	0.30 U	0.53 U		0.19 U	0.18 U	0.13 U		0.23 U	0.50 U	0.46 U	3.1 U	0.56 U	0.33 U	0.34 U		0.35 U
Phthalates (ug/kg dry weight or mg/kg OC)																					
bis(2-Ethylhexyl)phthalate (dry)	1,300	---	---	**20**	11 U	**37**	11 U		60 U	55 U	**82** J		49 U	11 U	**24**	11 U	**45**	11 U	**27**		**65**
bis(2-Ethylhexyl)phthalate (OC)	---	47	78	**1.3**	0.70 U	**1.5**	0.81 U		1.6 U	1.3 U	**1.4** J		1.5 U	0.76 U	**1.5**	4.7 U	**3.5**	0.51 U	**1.3**		**3.2**
Butylbenzylphthalate (dry)	63	---	---	11 U	11 U	11 U	11 U		**38**	11 U	11 U		11 U	11 U	11 U	11 U	11 U	11 U	11 U		11 U
Butylbenzylphthalate (OC)	---	4.9	64	0.69 U	0.70 U	0.45 U	0.81 U		**1.0**	0.27 U	0.19 U		0.34 U	0.76 U	0.69 U	4.7 U	0.86 U	0.51 U	0.53 U		0.54 U
Di-n-Butylphthalate (dry)	1400	---	---	12 U	12 U	12 U	12 U		12 U	12 U	12 U		12 U	12 U	12 U	12 U	12 U	12 U	12 U		12 U
Di-n-Butylphthalate (OC)	---	220	1,700	0.75 U	0.76 U	0.49 U	0.89 U		0.32 U	0.29 U	0.21 U		0.38 U	0.83 U	0.75 U	5.2 U	0.94 U	0.55 U	0.57 U		0.59 U
Di-n-Octyl phthalate (dry)	6200	---	---	8.1 U	8.2 U	8.3 U	8.2 U		8.2 U	8.3 U	8.3 U		8.3 U	8.2 U	8.2 U	8.1 U	8.1 U	8.1 U	8.0 U		8.2 U
Di-n-Octyl phthalate (OC)	---	58	4,500	0.51 U	0.52 U	0.34 U	0.61 U		0.22 U	0.20 U	0.14 U		0.26 U	0.57 U	0.52 U	3.5 U	0.63 U	0.37 U	0.38 U		0.40 U
Diethylphthalate (dry)	200	---	---	16 U	16 U	16 U	16 U		16 U	16 U	16 U		16 U	16 U	16 U	16 U	16 U	16 U	16 U		16 U
Diethylphthalate (OC)	---	61	110	1.0 U	1.0 U	0.65 U	1.2 U		0.42 U	0.39 U	0.27 U		0.50 U	1.1 U	1.0 U	6.9 U	1.3 U	0.74 U	0.77 U		0.79 U
Dimethylphthalate (dry)	71	---	---	7.6 U	7.6 U	7.7 U	7.6 U		7.6 U	7.7 U	7.7 U		7.7 U	7.6 U	7.7 U	7.6 U	7.6 U	7.5 U	7.5 U		7.6 U
Dimethylphthalate (OC)	---	53	53	0.48 U	0.48 U	0.31 U	0.56 U		0.20 U	0.19 U	0.1 U		0.24 U	0.52 U	0.48 U	3.3 U	0.59 U	0.35 U	0.36 U		0.37 U
Ionizable Organic Compounds (ug/kg dry weight)																					
2,4-Dimethylphenol	29	29	29	14 U	15 U	15 U	15 U		15 U	15 U	15 U		15 U	15 U	15 U	14 U	14 U	14 U	14 U		15 U
Benzoic Acid	650	650	650	110 U	110 U	110 U	110 U		110 U	110 U	110 U		110 U	110 U	110 U	110 U	110 U	110 U	110 U		110 U
Benzyl Alcohol	57	57	73	14 U	14 U	14 U	14 U		14 U	14 U	14 U		14 U	14 U	14 U	14 U	14 U	14 U	14 U		14 U
Pentachlorophenol	360	360	690	46 U	47 U	47 U	47 U		47 U	47 U	47 U		47 U	47 U	47 U	46 U	46 U	46 U	46 U		47 U
Phenol	420	420	1,200	13 U	13 U	14 U	13 U		**20**	14 U	**40**		14 U	13 U	14 U	**36**	13 U	13 U	13 U		13 U
Miscellaneous Extractables (ug/kg dry weight or mg/kg OC)																					
Dibenzofuran (dry)	540	---	---	7.4 U	7.4 U	7.5 U	7.4 U		7.4 U	7.5 U	**15** J		7.5 U	7.4 U	7.5 U	7.4 U	7.4 U	7.3 U	7.3 U		7.4 U
Dibenzofuran (OC)	---	15	58	0.47 U	0.47 U	0.30 U	0.55 U		0.19 U	0.18 U	**0.26** J		0.23 U	0.51 U	0.47 U	3.2 U	0.58 U	0.34 U	0.35 U		0.36 U
Hexachlorobenzene (dry)	22	---	---	7.8 U	7.9 U	7.9 U	7.9 U		7.9 U	8.0 U	8.0 U		7.9 U	7.9 U	7.9 U	7.8 U	7.8 U	7.8 U	7.7 U		7.9 U
Hexachlorobenzene (OC)	---	0.38	2.3	0.49 U	0.50 U	0.32 U	0.59 U		0.21 U	0.19 U	0.14 U		0.25 U	0.54 U	0.50 U	3.4 U	0.61 U	0.36 U	0.37 U		0.39 U
Hexachlorobutadiene (dry)	11	---	---	7.9 U	8 U	8.0 U	8.0 U		8.0 U	8.1 U	8.1 U		8.0 U	8.0 U	8.0 U	7.9 U	7.9 U	7.9 U	7.8 U		8.0 U
Hexachlorobutadiene (OC)	---	3.9	6.2	0.50 U	0.5 U	0.33 U	0.59 U		0.21 U	0.20 U	0.14 U		0.25 U	0.55 U	0.50 U	3.4 U	0.62 U	0.36 U	0.37 U		0.39 U
N-Nitrosodiphenylamine (dry)	28	---	---	8.5 U	8.5 U	8.6 U	8.6 U		8.5 U	8.6 U	8.6 U		8.6 U	8.5 U	8.6 U	8.5 U	8.5 U	8.4 U	8.4 U		8.6 U
N-Nitrosodiphenylamine (OC)	---	11	11	0.53 U	0.54 U	0.35 U	0.64 U		0.22 U	0.21 U	0.15 U		0.27 U	0.59 U	0.54 U	3.7 U	0.66 U	0.39 U	0.40 U		0.42 U
2-Methylphenol	---	63	63	14 U	14 U	14 U	14 U		14 U	14 U	14 U		14 U	14 U	14 U	14 U	14 U	14 U	14 U		14 U
4-Methylphenol	---	670	670	**54**	13 U	13 U	13 U		13 U	13 U	13 U		13 U	13 U	13 U	12 U	12 U	12 U	12 U		13 U
Polychlorinated Biphenyls (ug/kg dry weight or mg/kg OC)																					
Total PCBs (OC) [c]	---	12	65	**0.62 JG**	0.25 UJ	0.12 U	0.29 UJG		0.11 UJ	0.085 UJG	0.067 U		0.12 U	0.26 U	0.25 UJ	1.7 U	0.41 U	0.18 UJ	0.19 UJ		0.14 UJG
Total PCBs (dry) [c]	130	---	---	**9.9 JG**	4.0 UJ	2.9 U	3.9 UJG		4.1 UJ	3.5 UJG	3.9 U		3.8 U	3.8 U	4.0 UJ	4.0 U	5.3 U	4.0 UJ	3.9 UJ		2.8 UJG
Aroclor 1016	---	---	---	2.8 UJG	1.6 UJ	2.9 U	1.6 UJG		1.6 UJ	1.6 UJG	1.6 U		1.5 U	1.5 U	1.6 UJ	1.6 U	2.1 U	1.6 UJ	1.5 UJ		2.8 UJG
Aroclor 1221	---	---	---	2.8 UJG	4.0 UJ	2.9 U	3.9 UJG		4.1 UJ	4 UJG	3.9 U		3.8 U	3.8 U	4 UJ	4.0 U	5.3 U	4.0 UJ	3.9 UJ		2.8 UJG
Aroclor 1232	---	---	---	2.8 UJG	3.5 UJ	2.9 U	3.4 UJG		3.6 UJ	3.5 UJG	3.4 U		3.3 U	3.3 U	3.5 UJ	3.5 U	4.7 U	3.5 UJ	3.4 UJ		2.8 UJG
Aroclor 1242	---	---	---	2.8 UJG	1.1 UJ	2.9 U	1.0 UJG		1.1 UJ	1.1 UJG	1.0 U		1.0 U	0.99 U	1.0 UJ	1.0 U	1.4 U	1.1 UJ	1.0 UJ		2.8 UJG
Aroclor 1248	---	---	---	2.8 UJG	0.66 UJ	2.9 U	0.64 UJG		0.66 UJ	0.66 UJG	0.64 U		0.62 U	0.61 U	0.65 UJ	0.65 U	0.87 U	0.65 UJ	0.63 UJ		2.8 UJG
Aroclor 1254	---	---	---	0.72 UJG	1.1 UJ	0.74 U	1.0 UJG		1.1 UJ	1.1 UJG	1.0 U		1.0 U	0.99 U	1.0 UJ	1.0 U	1.4 U	1.1 UJ	1.0 UJ		0.72 UJG
Aroclor 1260	---	---	---	**9.9 JG**	1.5 UJ	0.74 U	1.5 UJG		1.5 UJ	1.5 UJG	1.5 U		1.4 U	1.4 U	1.5 UJ	1.5 U	2.0 U	1.5 UJ	1.4 UJ		0.72 UJG
Chlorinated Pesticides (ug/kg dry weight)																					
4,4'-DDD	16	---	---	0.26 UJG	0.14 U	**0.47 J**	**0.53 J**		**1.7 J**	**2.9 J**	0.14 U		**1 J**	0.14 U	0.15 U	**0.14 JTG**	0.19 U	**0.44 J**	**0.31 J**		0.26 UJG
4,4'-DDE	9	---	---	0.23 UJG	**1.5 J**	**0.31 J**	0.14 UJ		**0.35 J**	**0.81 J**	0.14 U		**1.4 J**	0.14 U	**2.3 J**	0.13 U	0.19 U	**0.99 J**	**0.89 J**		0.22 UJG
4,4'-DDT	34	---	---	0.26 UJG	0.15 U	0.26 U	**0.27 J**		0.15 U	0.15 U	0.15 U		0.15 U	0.15 U	**0.65 J**	**1.2 JTG**	0.2 U	0.15 U	**3 J**		0.25 UJG
Aldrin	---	---	---	0.11 UJG	0.22 U	0.11 U	0.22 UJ		0.22 U	**2.0 J**	0.21 U		**2.2 J**	0.22 U	0.22 U	0.21 U	**19 J**	0.22 U	0.21 U		0.1 UJG
alpha-Chlordane	---	---	---	0.12 UJG	0.13 U	0.12 U	0.13 UJ		0.13 U	0.13 U	**0.42 J**		0.13 U	**0.14 J**	**0.14 J**	**0.13 JTG**	0.18 U	0.13 U	0.13 U		0.11 UJG
Dieldrin	---	---	---	0.22 UJG	0.12 U	0.22 U	0.12 UJ		0.12 U	**1.9** J	0.11 U		0.11 U	**0.18 J**	0.12 U	0.11 U	0.16 U	**0.12 J**	0.11 U		0.21 UJG
gamma-BHC	---	---	---	0.12 UJG	**0.33 J**	0.11 U	0.076 UJ		0.077 U	**3.1 J**	0.075 U		0.076 U	0.077 U	0.079 U	0.074 U	**0.77 J**	**0.48 J**	**0.3 J**		**0.39 JTG**
Heptachlor	---	---	---	**0.19** JTG	0.46 U	0.13 U	0.45 UJ		0.46 U	0.46 U	0.45 U		0.45 U	0.46 U	0.47 U	0.44 U	**16 J**	0.46 U	0.44 U		**0.27 JTG**
Petroleum Hydrocarbons (mg/kg dry weight)																					
Gasoline	---	---	---	31 U	30 U	43 U	38 UJ						33 U								
Diesel Range	---	---	---	78 U	76 U	110 U	96 UJ						82 U								
Motor Oil	---	---	---	160 U	150 U	210 U	**270 J**						**220**								
Dioxins/Furans (ng/kg dry weight)																					
DX TOTAL (TEQ ND=1/2 DL)	---	---	---	**22.7**		**53**		**14**	**175**	**57.9**		**315**	**26.5**		**6.47**			**10.6**		**2.68**	**35.5**
1,2,3,4,6,7,8-HPCDD	---	---	---	**468**		**1,040**		**255 B**	**5,590 B**	**1,550**		**5,100 B**	**712**		**152 B**			**247**		**67.9 B**	**754**
1,2,3,4,6,7,8-HPCDF	---	---	---	**176**		**290**		**95.4**	**1,700 B**	**368**		**1,500**	**179**		**42.8 B**			**87.4**		**22.3**	**336**
1,2,3,4,7,8,9-HPCDF	---	---	---	**10**		**16.2**		**4.26 B**	**98.8**	**24.1**		**76.3 B**	**11.5**		**2.91**			**5.4**		**1.38 B**	**31.7**
1,2,3,4,7,8-HXCDD	---	---	---	**4.74**		**21**		**6.51**	**29.3**	**15.9**		**169**	**6.73**		**1.97**			**2.95**		**0.517 J**	**3.41**
1,2,3,4,7,8-HXCDF	---	---	---	**15.7**		**27.2**		**7.53**	**126**	**31.2**		**124**	**16.1**		**3.46**			**7.27**		**2.31**	**73.1**
1,2,3,6,7,8-HXCDD	---	---	---	**30.3**		**76.8**		**20.4**	**220**	**75.2**		**502**	**31.7**		**8**			**14**		**3.63**	**48.3**
1,2,3,6,7,8-HXCDF	---	---	---	**5.15**		**10.5**		**2.79**	**37.4**	**11.9**		**65**	**5.8**		**1.33**			**2.63**		**0.683**	**12.5**
1,2,3,7,8,9-HXCDD	---	---	---	**16.7**		**50.6**		**14.8**	**85.9**	**44**		**357**	**19.2**		**5.09**			**8.67**		**1.74**	**11.2**
1,2,3,7,8,9-HXCDF	---	---	---	**0.482 J**		**0.98**		**2.28**	**4.04**	**1.15**		**8.17**	**0.556**		**0.132 J**			**0.225 J**		**0.089 J**	**1.21**
1,2,3,7,8-PECDD	---	---	---	**3.88**		**11.6**		**3.19**	**15.4**	**7.91**		**75.1**	**3.44**		**1.17**			**1.72**		**0.233 J**	**2.1**
1,2,3,7,8-PECDF	---	---	---	**2.85**		**5.5**		**1.42**	**12.6**	**4.76**		**32.2**	**2.31**		**0.592**			**1.01**		**0.31 J**	**4.01**
2,3,4,6,7,8-HXCDF	---	---	---	**4.52**		**9.37**		**2.51**	**29.9**	**10.7**		**51.2**	**4.71**		**1.2**			**2.25**		**0.545**	**7.06**
2,3,4,7,8-PECDF	---	---	---	**4.91**		**8.17**		**2.3 B**	**20.4 B**	**6.84**		**51.1 B**	**3.22**		**0.801 B**			**1.47**		**0.564 B**	**14.3**
2,3,7,8-TCDD	---	---	---	**0.978**		**2.45**		**0.387 J**	**2.88**	**1.33**		**9.1 B**	**0.621**		**0.295**			**0.351**		**0.092 BJ**	**0.477**
2,3,7,8-TCDF	---	---	---	**3.78**		**5.21**		**1.8**	**7.47**	**3.89**		**38.2**	**1.66 J**		**0.581**			**0.341 J**		**0.217**	**1.75**
OCDD	---	---	---	**4,850 B**		**8,030 B**		**1,860 B**	**67,600 B**	**24,200 B**		**48,700 B**	**12,500 B**		**1,810 B**			**2,470 B**		**894 B**	**3,500 B**
OCDF	---	---	---	**652**		**947**		**220 B**	**7,660 B**	**1,210**		**4,230 B**	**607**		**157 B**			**292**		**56.7 B**	**1,230**

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																	
				SH-01-SS-00	SH-01-SC-12	SH-02-SS-00	SH-02-SC-12	SH-02-SC-23	SH-03-SS-00	SH-04-SS-00 [d]	SH-04-SC-12 [d]	SH-04-SC-23	SH-05-SS-00	SH-05-SC-12 [d]	SH-07-SS-00	SH-07-SC-12	SH-08-SC-12	SH-09-SS-00	SH-09-SC-12	SH-09-SC-23	SH-10-SS-00
	LAET	SQS	CSL	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm
TOTAL HEPTA-DIOXINS	---	---	---	**1,260**		**2,370**		**552**	**14,000 B**	**4,870**		**12,000**	**2,280**		**421 B**			**636**		**194**	**1,460**
TOTAL HEPTA-FURANS	---	---	---	**722**		**1,150**		**335**	**8,090**	**1,410**		**5,670**	**687**		**246**			**329**		**81.3**	**1,780**
TOTAL HEXA-DIOXINS	---	---	---	**574**		**1,680**		**505**	**2,090**	**1,130**		**12,500**	**452**		**113**			**207**		**53.7**	**319**
TOTAL HEXA-FURANS	---	---	---	**314**		**466**		**123**	**2,570**	**579**		**2,180**	**272**		**56.2**			**121**		**36.3**	**687**
TOTAL PENTA-DIOXINS	---	---	---	**207**		**1,380**		**430**	**660**	**449**		**9,650**	**163**		**55.4**			**89.8**		**16.5**	**76.1**
TOTAL PENTA-FURANS	---	---	---	**115**		**177**		**44.9**	**457**	**155**		**857**	**72**		**18.3**			**36.4**		**9.18**	**140**
TOTAL TETRA-DIOXINS	---	---	---	**243**		**1,640**		**382**	**640**	**409**		**7,780**	**132**		**44.6**			**88.8**		**12.5**	**68**
TOTAL TETRA-FURANS	---	---	---	**96.5**		**170**		**51.7**	**198**	**78.8**		**923**	**32.3**		**12.7**			**21.8**		**4.04**	**36.8**
Guaicols and Resin Acids (ug/kg dry weight)																					
12-Chlorodehydroabietic Acid	---	---	---																		
14-Chlorodehydroabietic Acid	---	---	---																		
3,4,5-Trichloroguaiacol	---	---	---																		
3,4,6-Trichloroguaiacol	---	---	---																		
3,4-Dichloroguaiacol	---	---	---																		
4,5,6-Trichloroguaiacol	---	---	---																		
4,5-Dichloroguaiacol	---	---	---																		
4,6-Dichloroguaiacol	---	---	---																		
4-Chloroguaiacol	---	---	---																		
9,10-Dichlorostearic Acid	---	---	---																		
Abietic Acid	---	---	---																		
Dehydroabietic Acid	---	---	---																		
Dichlorodehydroabietic Acid	---	---	---																		
Guaiacol	---	---	---																		
Isopimaric Acid	---	---	---																		
Linolenic Acid	---	---	---																		
Neoabietic Acid	---	---	---																		
Oleic Acid	---	---	---																		
Palustric Acid	---	---	---																		
Pimaric Acid	---	---	---																		
Retene	---	---	---																		
Sandaracopimaric Acid	---	---	---																		
Tetrachloroguaiacol	---	---	---																		
Total resin acids [c]	---	---	---																		

[a] Lowest and second lowest apparent effects thresholds for freshwater sediments in Washington State 2003).

[b] Washington State Marine Sediment Management Standards, Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) (WAC Chapter 173-204).

[c] Totals only include detected and estimated values

[d] Sample has organic carbon content less than 0.5 percent or greater than 4.0 percent and should be compared to LAET criteria rather than organic-carbon normalized SMS criteria.

ng/kg nanograms per kilogram
µg/kg micrograms per kilogram.
mg/kg milligrams per kilogram.
PCBs polychlorinated biphenyls.

Bold type indicates the sample result is greater than the laboratory detection limit.

Underlined value indicates the sample result or detection limit is greater than the LAET or SQS value.

Shaded value indicates the sample result or detection limit is greater than the CSL value.

U The material was analyzed for, but was not detected. The associated numerical value is the detection limit. For petroleum hydrocarbons, guaiacols and resin acids, the associated numerical value is the reporting limit.

J The associated numerical value is considered an estimated concentration.

G Bias is high.

B Specifyied compound was detected in the associated method blank.

LPAH represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH sum.

HPAH represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total benzofluoranthenes represents the sum of the concentrations of the "b" and "k" isomers.

Total PAHs (carcinogenic) represents the sum of the following PAH compounds: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene.

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																			
				SH-10-SC-12	SH-10-SC-23	SH-11-SS-00	SH-11-SC-12 [d]	SH-12-SS-00 [d]	SH-12-SC-12 [d]	SH-12-SC-23	SH-13-SS-00 [d]	SH-13-SC-12	SH-13-SC-23	SH-14-SS-00	SH-14-SC-12	SH-14-SC-23	SH-15-SS-00	SH-15-SC-12	SH-16-SS-00	SH-16-SC-12	SH-18-WS-00 [d]	SH-18-WC-12 [d]	SH-19-WS-00 [d]
	LAET	SQS	CSL	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
Conventional Parameters																							
Particle/Grain Size, Fines (Silt/Clay)	---	---	---	**28.3**		**63.4**	**36.8**	**57.6**	**69.2**		**65.3**	**9.4**		**51.7**	**48.9**		**4.6**	**5.6**	**2.2**	**1.6**	**85**	**74.5**	**67.3**
Particle/Grain Size, Phi Scale <-1	---	---	---	**1.7**		**7.2**	**1.3**	**4.6**	**3.5**		**7.3**	**62.8**		**1.3**	**1.8**		**0.1**	**0.3**	**1.7**	**3.5**	**2.7**	**3.1**	**7.9**
Particle/Grain Size, Phi Scale >10	---	---	---	**4.9**		**10.2**	**5.4**	**8.5**	**10.4**		**10.2**	**1.8**		**9.8**	**7.8**		**1.4**	**1.3**			**12.7**	**14.4**	**11.3**
Particle/Grain Size, Phi Scale 0 to 1	---	---	---	**1.8**		**4.5**	**8.1**	**5.9**	**5.8**		**4.4**	**6.6**		**3.1**	**1.6**		**0.4**	**0.4**	**13.2**	**9.9**	**1.9**	**4.2**	**4.2**
Particle/Grain Size, Phi Scale -1 to 0	---	---	---	**1.9**		**4.6**	**2.6**	**4.6**	**4.8**		**5.6**	**7.6**		**3**	**1.7**		**0.1**	**0.3**	**4.6**	**2.7**	**4**	**4.5**	**4.4**
Particle/Grain Size, Phi Scale 1 to 2	---	---	---	**8.5**		**7.5**	**25**	**9.1**	**6.1**		**5.2**	**7.1**		**3.6**	**2.2**		**28.4**	**20.2**	**62.6**	**64**	**2.3**	**5.2**	**5.9**
Particle/Grain Size, Phi Scale 2 to 3	---	---	---	**27.5**		**6.3**	**17.1**	**8.5**	**5**		**4.8**	**4.2**		**11**	**12.1**		**65.2**	**69.5**	**15.3**	**17**	**1.7**	**4.5**	**4.6**
Particle/Grain Size, Phi Scale 3 to 4	---	---	---	**30.3**		**6.5**	**9.1**	**9.6**	**5.6**		**7.4**	**2.4**		**26.3**	**31.8**		**1.1**	**3.6**	**0.5**	**1.5**	**2.5**	**4**	**5.9**
Particle/Grain Size, Phi Scale 4 to 5	---	---	---	**8.9**		**8**	**7**	**10.2**	**8.1**		**10.5**	**1.2**		**11**	**14.7**		**0.6**	**1.1**			**5.7**	**7.1**	**5.8**
Particle/Grain Size, Phi Scale 5 to 6	---	---	---	**3.1**		**13**	**6.4**	**13.1**	**12.8**		**14.3**	**1.8**		**7.3**	**6.2**		**0.4**	**0.6**			**18.3**	**10.6**	**14.1**
Particle/Grain Size, Phi Scale 6 to 7	---	---	---	**3.4**		**11.2**	**5.9**	**10.2**	**12.1**		**11.4**	**1.5**		**6.5**	**5.8**		**0.5**	**0.8**			**23.9**	**13.7**	**12.6**
Particle/Grain Size, Phi Scale 7 to 8	---	---	---	**2.8**		**9.5**	**5.2**	**7.2**	**10.4**		**8.6**	**1.3**		**5.5**	**5.1**		**0.5**	**0.7**			**10.8**	**10.5**	**11.2**
Particle/Grain Size, Phi Scale 8 to 9	---	---	---	**2.7**		**6.1**	**3.8**	**4**	**8.7**		**4.9**	**1**		**6.1**	**5**		**0.6**	**0.6**			**6.6**	**10.1**	**6.6**
Particle/Grain Size, Phi Scale 9 to 10	---	---	---	**2.5**		**5.4**	**3.2**	**4.2**	**6.7**		**5.3**	**0.8**		**5.6**	**4.3**		**0.6**	**0.6**			**6.9**	**8.1**	**5.8**
Total Volatile Solids %	---	---	---																		**14.3**	**23.78**	**17.72**
Ammonia (mg/kg)	---	---	---	**39.3**		**4.96**	**61.4**	**10.7**	**12.4**		**7.34**	**1.16**		**18.7**	**39.1**		**4.3**	**4.33**	**2.76**	0.03 U	**32.4**	**113**	**17.1**
Sulfide	---	---	---	**259**		**541**	**123**	**1070**	**27**		**518**	**15.3**		**1,350**	**19.7**		**5.01**	**123**	0.01 U	**14.5**	**1,710**	**24.6**	**916**
Total organic carbon (%)	---	---	---	**2.49**		**2.32**	**4.31**	**4.79**	**8.79**		**11**	**2.84**		**3.1**	**3**		**0.542**	**1.12**	**0.511**	**1.03**	**4.79**	**5.08**	**4.44**
Total solids (%)	---	---	---	**59.2**		**94.1**	**55.1**	**37.7**	**33.2**		**35.1**	**77.4**		**40.8**	**56.8**		**74.3**	**79**	**75.4**	**79.7**	**27.7**	**34.3**	**31.5**
Metals (mg/kg dry weight)																							
Antimony	150	---	---	**0.23 J**		**0.83**	**0.62**	**0.36 J**	**0.69**		**0.41 J**	**0.12 J**		**0.33 J**	**0.37**		**0.12 J**	**0.15 J**	**0.1 J**	**0.14 J**	**0.45 J**	**0.67**	**0.54 J**
Arsenic	57	57	93	**4.7**		**6.2**	**4.9**	**6.9**	**9.1**		**7**	**2.1**		**8.1**	**5.9**		**2.3**	**3.6**	**2.9**	**2.6**	**8**	**7.6**	**8.5**
Cadmium	5.1	5.1	6.7	**0.43**		**1.2**	**1.2**	**0.97**	**1.4**		**1.1**	**0.32**		**0.88**	**0.88**		**0.11 J**	**0.17 J**	**0.13 J**	**0.18 J**	**1.8**	**1.8**	**1.3**
Chromium	260	260	270	**40**		**62**	**65**	**43**	**54**		**41**	**32**		**41**	**40**		**20**	**25**	**21**	**24**	**58**	**55**	**53**
Copper	390	390	390	**42**		**120**	**110**	**73**	**110**		**60**	**30**		**37**	**44**		**10**	**15**	**13**	**16**	**83**	**84**	**76**
Lead	450	450	530	**9.2**		**43**	**47**	**21**	**34**		**19**	**4.3**		**11**	**16**		**2.4**	**4.2**	**2.8**	**3.9**	**22**	**43**	**26**
Mercury	0.41	0.41	0.59	**0.055**		**0.19**	**0.11**	**0.17**	**0.29**		**0.15**	**0.065**		**0.088**	**0.11**		**0.036**	**0.012 J**	0.0078 U	**0.013 J**	**0.12**	**0.29**	**0.16**
Nickel	140	---	---	**38**		**44**	**45**	**34**	**41**		**31**	**22**		**37**	**35**		**21**	**27**	**24**	**26**	**46**	**40**	**42**
Silver	6.1	6.1	6.1	**0.12 J**		**0.18 J**	**0.15 J**	**0.16 J**	**0.55 J**		**0.18 J**	**0.053 J**		**0.13 J**	**0.17 J**		**0.033 J**	**0.036 J**	**0.018 J**	**0.023 J**	**0.23 J**	**0.37 J**	**0.19 J**
Zinc	410	410	960	**63**		**110**	**80**	**98**	**130**		**95**	**33**		**83**	**69**		**29**	**35**	**35**	**36**	**130**	**120**	**110**
Butyltins (ug/kg dry weight)																							
Butyltin Ion	---	---	---																				
Dibutyltin Ion	---	---	---																				
Tributyltin Ion	---	---	---																				
Aromatic Hydrocarbons (ug/kg dry weight or mg/kg OC)																							
LPAHs																							
2-Methylnaphthalene (dry)	670	---	---	8.1 U		8.0 U	8.0 U	8.1 U	24 U		8.1 U	8.1 U		8.1 U	8.1 U		7.9 U	7.9 U	8.0 U	7.9 U	8.1 U	24 U	8.1 U
2-Methylnaphthalene (OC)	---	38	64	0.33 U		0.34 U	0.19 U	0.17 U	0.27 U		0.07 U	0.29 U		0.26 U	0.27 U		1.5 U	0.71 U	1.6 U	0.77 U	0.17 U	0.47 U	0.18 U
Acenaphthene (dry)	500	---	---	8.1 U		8.0 U	8.0 U	**10 J**	**120**		8.1 U	8.1 U		8.1 U	8.1 U		8.0 U	8.0 U	8.1 U	7.9 U	8.1 U	**68**	8.1 U
Acenaphthene (OC)	---	16	57	0.33 U		0.34 U	0.19 U	**0.21 J**	**1.4**		0.07 U	0.29 U		0.26 U	0.27 U		1.5 U	0.71 U	1.6 U	0.77 U	0.17 U	**1.3**	0.18 U
Acenaphthylene (dry)	560	---	---	8.5 U		**14 J**	8.5 U	**23**	**60**		**12 J**	8.6 U		8.6 U	8.6 U		8.4 U	8.4 U	8.5 U	8.3 U	8.6 U	25 U	8.6 U
Acenaphthylene (OC)	---	66	66	0.34 U		**0.60 J**	0.20 U	**0.48**	**0.68**		**0.11 J**	0.30 U		0.28 U	0.29 U		1.5 U	0.75 U	1.7 U	0.81 U	0.18 U	0.49 U	0.19 U
Anthracene (dry)	960	---	---	7.6 U		**18 J**	7.6 U	**67**	**190**		**37**	7.7 U		7.7 U	7.6 U		7.5 U	7.5 U	7.6 U	7.5 U	**21**	**100**	7.7 U
Anthracene (OC)	---	220	1,200	0.31 U		**0.78 J**	0.18 U	**1.4**	**2.2**		**0.34**	0.27 U		0.25 U	0.25 U		1.4 U	0.7 U	1.5 U	0.73 U	**0.44**	**2.0**	0.17 U
Fluorene (dry)	540	---	---	8.8 U		**10 J**	8.8 U	**18 J**	**110**		**15 J**	8.9 U		8.9 U	8.9 U		8.7 U	8.7 U	8.8 U	8.6 U	8.9 U	**88**	8.9 U
Fluorene (OC)	---	23	79	0.35 U		**0.4 J**	0.20 U	**0.38 J**	**1.3**		**0.14 J**	0.31 U		0.29 U	0.30 U		1.6 U	0.78 U	1.7 U	0.83 U	0.19 U	**1.7**	0.20 U
Naphthalene (dry)	2,100	---	---	**23**		**45**	**47**	**25**	**190**		**14 J**	**10 J**		8.6 U	**18 J**		8.4 U	8.4 U	8.5 U	8.4 U	**16 J**	**150**	8.6 U
Naphthalene (OC)	---	99	170	**0.92**		**1.9**	**1.1**	**0.52**	**2.2**		**0.13 J**	**0.4 J**		0.28 U	**0.60 J**		1.5 U	0.75 U	1.7 U	0.82 U	**0.33 J**	**3.0**	0.19 U
Phenanthrene (dry)	1500	---	---	**33**		**73**	**89**	**140**	**430**		**110**	**12 J**		**21**	**20**		8.1 U	8.1 U	8.2 U	8.1 U	**36**	**390**	**20**
Phenanthrene (OC)	---	100	480	**1.3**		**3.1**	**2.1**	**2.9**	**4.9**		**1.0**	**0.4 J**		**0.68**	**0.67**		1.5 U	0.72 U	1.6 U	0.79 U	**0.75**	**7.7**	**0.45**
Total LPAHs (dry) [c]	5200	---	---	**56**		**160**	**140**	**280**	**1100**		**190**	**22 J**		**21**	**38**		19 U	19 U	20 U	19 U	**73**	**800**	**20**
Total LPAHs (OC) [c]	---	370	780	**2.2**		**53**	**3.2**	**5.9**	**13**		**1.7**	**0.77 J**		**0.68**	**1.3**		3.5 U	1.7 U	3.9 U	1.8 U	**1.5**	**16**	**0.45**
HPAHs																							
Benzo(a)anthracene (dry)	1,300	---	---	**38**		**26**	5.8 U	**130**	**490**		**76**	5.9 U		**26**	**15 J**		5.7 U	5.7 U	5.8 U	5.7 U	**58**	**200**	**24**
Benzo(a)anthracene (OC)	---	110	270	**1.5**		**1.1**	0.13 U	**2.7**	**5.6**		**0.69**	0.21 U		**0.84**	**0.50 J**		1.1 U	0.51 U	1.1 U	0.55 U	**1.2**	**3.9**	**0.54**
Benzo(a)pyrene (dry)	1,600	---	---	**56**		**40**	8.0 U	**120**	**330**		**74**	8.1 U		**19 J**	**18 J**		7.9 U	7.9 U	8.0 U	7.9 U	**67**	**230**	**24**
Benzo(a)pyrene (OC)	---	99	210	**2.2**		**1.7**	0.2 U	**2.5**	**3.8**		**0.67**	0.29 U		**0.61 J**	**0.60 J**		1.5 U	0.71 U	1.6 U	0.77 U	**1.4**	**4.5**	**0.54**
Benzo(b)fluoranthene (dry)	---	---	---	**32**		**54**	9.3 U	**190**	**370**		**85**	9.4 U		**34**	9.4 U		9.2 U	9.2 U	9.3 U	9.2 U	**64**	**210**	**36**
Benzo(b)fluoranthene (OC)	---	---	---	**1.3**		**2.3**	0.2 U	**4.0**	**4.2**		**0.77**	0.33 U		**1.1**	0.31 U		1.7 U	0.82 U	1.8 U	0.89 U	**1.3**	**4.1**	**0.81**
Benzo(g,h,i)perylene (dry)	670	---	---	**51**		**17 J**	6.6 U	**30**	**110**		**23**	6.7 U		**9.9 J**	**19 J**		6.6 U	6.5 U	6.6 U	6.5 U	**30**	**83**	6.7 U
Benzo(g,h,i)perylene (OC)	---	31	78	**2.0**		**0.73 J**	0.2 U	**0.63**	**1.3**		**0.21**	0.24 U		**0.32 J**	**0.63 J**		1.2 U	0.58 U	1.3 U	0.63 U	**0.63**	**1.6**	0.15 U
Benzo(k)fluoranthene (dry)	---	---	---	**38**		**49**	9.1 U	**160**	**490**		**100**	9.2 U		**20**	9.1 U		9.0 U	9.0 U	9.1 U	8.9 U	**100**	**250**	**35**
Benzo(k)fluoranthene (OC)	---	---	---	**1.5**		**2.1**	0.2 U	**3.3**	**5.6**		**0.91**	0.32 U		**0.65**	0.30 U		1.7 U	0.80 U	1.8 U	0.86 U	**2.1**	**4.9**	**0.79**
Benzofluoranthenes, Total (b+k+j) (dry)	3,200	---	---	**70**		**100**	20 U	**350**	**860**		**190**	20 U		**54**	20 U		19 U	19 U	20 U	19 U	**160**	**460**	**71**
Benzofluoranthenes, Total (b+k+j) (OC)	---	230	450	**2.8**		**4.3**	0.46 U	**7.3**	**9.8**		**1.7**	0.70 U		**1.7**	0.67 U		3.5 U	1.7 U	3.9 U	1.8 U	**3.3**	**9.1**	**1.6**
Chrysene (dry)	1,400	---	---	**66**		**39**	**23**	**290**	**800**		**200**	6.6 U		**47**	**20**		6.4 U	6.4 U	6.5 U	6.4 U	**93**	**320**	**44**
Chrysene (OC)	---	110	460	**2.7**		**1.7**	**0.53**	**6.1**	**9.1**		**1.8**	0.23 U		**1.5**	**0.67**		1.2 U	0.57 U	1.3 U	0.62 U	**1.9**	**6.3**	**1.0**
Dibenz(a,h)anthracene (dry)	230	---	---	8.4 U		8.4 U	8.4 U	8.5 U	25 U		8.4 U	8.5 U		8.5 U	8.5 U		8.3 U	8.3 U	8.4 U	8.2 U	8.5 U	25 U	8.5 U
Dibenz(a,h)anthracene (OC)	---	12	33	0.34 U		0.36 U	0.19 U	0.18 U	0.28 U		0.08 U	0.30 U		0.27 U	0.28 U		1.5 U	0.74 U	1.6 U	0.80 U	0.18 U	0.49 U	0.19 U
Fluoranthene (dry)	1,700	---	---	**68**		**140**	**100**	**360**	**1,000**		**280**	**26**		**65**	**29**		7.7 U	**22**	7.8 U	7.6 U	**110**	**540**	**58**
Fluoranthene (OC)	---	160	1,200	**2.7**		**6.0**	**2.3**	**7.5**	**11.4**		**2.5**	**0.92**		**2.1**	**1.0**		1.4 U	**2.0**	1.5 U	0.74 U	**2.3**	**10.6**	**1.3**
Indeno(1,2,3-cd)pyrene (dry)	600	---	---	**15 J**		**11 J**	8.4 U	**31**	**110**		**25**	8.5 U		8.5 U	8.5 U		8.3 U	8.3 U	8.4 U	8.3 U	**23**	25 U	8.5 U
Indeno(1,2,3-cd)pyrene (OC)	---	34	88	**0.60 J**		**0.47 J**	0.19 U	**0.65**	**1.3**		**0.23**	0.30 U		0.27 U	0.28 U		1.5 U	0.74 U	1.6 U	0.81 U	**0.48**	0.49 U	0.19 U
Pyrene (dry)	2,600	---	---	**72**		**100**	**110**	**320**	**1,000**		**210**	**26**		**59**	**36**		7.5 U	**23**	7.6 U	7.5 U	**110**	**680**	**62**
Pyrene (OC)	---	1,000	1,400	**2.9**		**4.3**	**2.6**	**6.7**	**11.4**		**1.9**	**0.92**		**1.9**	**1.2**		1.4 U	**2.1**	1.5 U	0.73 U	**2.3**	**13.4**	**1.4**
Total HPAHs (dry) [c]	12,000	---	---	**440**		**470**	**230**	**1600**	**4700**		**1,100**	**52**		**280**	**140**		19 U	**55**	20 U	19 U	**650**	**2,500**	**280**
Total HPAHs (OC) [c]	---	960	5,300	**18**		**20**	**5.3**	**33**	**53**		**10**	**1.8**		**9**	**4.7**		3.5 U	**4.9**	3.9 U	1.8 U	**14**	**49**	**6.3**

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																			
				SH-10-SC-12	SH-10-SC-23	SH-11-SS-00	SH-11-SC-12 [d]	SH-12-SS-00 [d]	SH-12-SC-12 [d]	SH-12-SC-23	SH-13-SS-00 [d]	SH-13-SC-12	SH-13-SC-23	SH-14-SS-00	SH-14-SC-12	SH-14-SC-23	SH-15-SS-00	SH-15-SC-12	SH-16-SS-00	SH-16-SC-12	SH-18-WS-00 [d]	SH-18-WC-12 [d]	SH-19-WS-00 [d]
	LAET	SQS	CSL	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
Chlorinated Benzenes (ug/kg dry weight or mg/kg OC)																							
1,2,4-Trichlorobenzene (dry)	31	---	---	8.9 U		8.9 U	8.9 U	9.0 U	27 U		8.9 U	9.0 U		9.0 U	9.0 U		8.8 U	8.8 U	8.9 U	8.7 U	9.0 U	27 U	9.0 U
1,2,4-Trichlorobenzene (OC)	---	0.81	1.8	0.36 U		0.38 U	0.21 U	0.19 U	0.31 U		0.081 U	0.32 U		0.29 U	0.30 U		1.6 U	0.79 U	1.7 U	0.84 U	0.19 U	0.53 U	0.20 U
1,2-Dichlorobenzene (dry)	35	---	---	7.7 U		7.7 U	7.7 U	7.8 U	23 U		7.7 U	7.8 U		7.8 U	7.8 U		7.6 U	7.6 U	7.7 U	7.6 U	7.8 U	23 U	7.8 U
1,2-Dichlorobenzene (OC)	---	2.3	2.3	0.31 U		0.33 U	0.18 U	0.16 U	0.26 U		0.07 U	0.27 U		0.25 U	0.26 U		1.4 U	0.68 U	1.5 U	0.74 U	0.16 U	0.45 U	0.18 U
1,4-Dichlorobenzene (dry)	110	---	---	7.2 U		7.2 U	7.2 U	7.3 U	22 U		7.2 U	7.3 U		7.3 U	7.3 U		7.1 U	7.1 U	7.2 U	7.1 U	7.3 U	22 U	7.3 U
1,4-Dichlorobenzene (OC)	---	3.1	9	0.29 U		0.31 U	0.17 U	0.15 U	0.25 U		0.07 U	0.26 U		0.24 U	0.24 U		1.3 U	0.63 U	1.4 U	0.69 U	0.15 U	0.43 U	0.16 U
Phthalates (ug/kg dry weight or mg/kg OC)																							
bis(2-Ethylhexyl)phthalate (dry)	1,300	---	---	**11 J**		**19 J**	11 U	**68**	73 U		**16 J**	11 U		**12 J**	11 U		11 U	11 U	11 U	**15 J**	**40**	32 U	35 U
bis(2-Ethylhexyl)phthalate (OC)	---	47	78	**0.44 J**		**0.82 J**	0.26 U	**1.4**	0.83 U		**0.15 J**	0.39 U		**0.39 J**	0.37 U		2.0 U	1.0 U	2.2 U	**1.5 J**	**0.8**	0.63 U	0.79 U
Butylbenzylphthalate (dry)	63	---	---	11 U		11 U	11 U	11 U	33 U		11 U	11 U		11 U	11 U		11 U	11 U	11 U	11 U	11 U	33 U	11 U
Butylbenzylphthalate (OC)	---	4.9	64	0.44 U		0.47 U	0.26 U	0.23 U	0.38 U		0.10 U	0.39 U		0.35 U	0.37 U		2.0 U	1.0 U	2.2 U	1.1 U	0.23 U	0.65 U	0.25 U
Di-n-Butylphthalate (dry)	1400	---	---	12 U		12 U	12 U	12 U	37 U		12 U	12 U		12 U	12 U		12 U	12 U	12 U	12 U	12 U	36 U	12 U
Di-n-Butylphthalate (OC)	---	220	1,700	0.48 U		0.52 U	0.28 U	0.25 U	0.42 U		0.11 U	0.42 U		0.39 U	0.40 U		2.2 U	1.1 U	2.3 U	1.2 U	0.3 U	0.71 U	0.27 U
Di-n-Octyl phthalate (dry)	6200	---	---	8.2 U		8.1 U	8.2 U	8.3 U	25 U		8.2 U	8.3 U		8.3 U	8.2 U		8.1 U	8.1 U	8.2 U	8 U	8.3 U	25 U	8.3 U
Di-n-Octyl phthalate (OC)	---	58	4,500	0.33 U		0.35 U	0.19 U	0.17 U	0.28 U		0.07 U	0.29 U		0.27 U	0.27 U		1.5 U	0.72 U	1.6 U	0.78 U	0.17 U	0.49 U	0.19 U
Diethylphthalate (dry)	200	---	---	16 U		16 U	16 U	16 U	49 U		16 U	16 U		16 U	16 U		16 U	16 U	16 U	16 U	16 U	48 U	16 U
Diethylphthalate (OC)	---	61	110	0.64 U		0.69 U	0.37 U	0.33 U	0.56 U		0.15 U	0.56 U		0.52 U	0.53 U		3.0 U	1.4 U	3.1 U	1.6 U	0.3 U	0.94 U	0.36 U
Dimethylphthalate (dry)	71	---	---	7.6 U		7.6 U	7.6 U	7.7 U	23 U		7.6 U	7.7 U		7.7 U	7.7 U		7.5 U	7.5 U	7.6 U	7.5 U	7.7 U	23 U	7.7 U
Dimethylphthalate (OC)	---	53	53	0.31 U		0.33 U	0.18 U	0.16 U	0.26 U		0.07 U	0.27 U		0.25 U	0.26 U		1.4 U	0.67 U	1.5 U	0.73 U	0.16 U	0.45 U	0.17 U
Ionizable Organic Compounds (ug/kg dry weight)																							
2,4-Dimethylphenol	29	29	29	15 U		14 U	14 U	15 U	44 U		15 U	15 U		15 U	15 U		14 U	14 U	15 U	14 U	15 U	44 U	15 U
Benzoic Acid	650	650	650	110 U		110 U	110 U	110 U	340 U		110 U	110 U		110 U	110 U		110 U	110 U	110 U	110 U	110 U	340 U	110 U
Benzyl Alcohol	57	57	73	14 U		14 U	14 U	14 U	43 U		14 U	14 U		14 U	14 U		14 U	14 U	14 U	14 U	14 U	43 U	14 U
Pentachlorophenol	360	360	690	47 U		46 U	47 U	47 U	140 U		47 U	47 U		47 U	47 U		46 U	46 U	47 U	46 U	47 U	140 U	47 U
Phenol	420	420	1,200	13 U		13 U	13 U	14 U	41 U		13 U	14 U		**66**	14 U		13 U	13 U	13 U	13 U	14 U	40 U	14 U
Miscellaneous Extractables (ug/kg dry weight or mg/kg OC)																							
Dibenzofuran (dry)	540	---	---	7.4 U		7.4 U	7.4 U	7.5 U	**75**		7.4 U	7.5 U		7.5 U	7.5 U		7.3 U	7.3 U	7.4 U	7.3 U	7.5 U	**62**	7.5 U
Dibenzofuran (OC)	---	15	58	0.30 U		0.32 U	0.17 U	0.16 U	**0.9**		0.07 U	0.26 U		0.24 U	0.25 U		1.3 U	0.65 U	1.4 U	0.71 U	0.16 U	**1.2**	0.17 U
Hexachlorobenzene (dry)	22	---	---	7.9 U		7.8 U	7.8 U	8 U	24 U		7.9 U	7.9 U		7.9 U	7.9 U		7.8 U	7.8 U	7.9 U	7.7 U	8 U	24.0 U	7.9 U
Hexachlorobenzene (OC)	---	0.38	2.3	0.32 U		0.34 U	0.18 U	0.17 U	0.27 U		0.07 U	0.28 U		0.25 U	0.26 U		1.4 U	0.70 U	1.5 U	0.75 U	0.17 U	0.47 U	0.18 U
Hexachlorobutadiene (dry)	11	---	---	8.0 U		7.9 U	7.9 U	8.1 U	24 U		8.0 U	8.0 U		8.0 U	8.0 U		7.9 U	7.9 U	8.0 U	7.8 U	8 U	24 U	8.0 U
Hexachlorobutadiene (OC)	---	3.9	6.2	0.32 U		0.34 U	0.18 U	0.17 U	0.27 U		0.07 U	0.28 U		0.26 U	0.27 U		1.5 U	0.71 U	1.6 U	0.76 U	0.17 U	0.47 U	0.18 U
N-Nitrosodiphenylamine (dry)	28	---	---	8.5 U		8.5 U	8.5 U	8.6 U	26 U		8.5 U	8.6 U		8.6 U	8.6 U		8.4 U	8.4 U	8.5 U	8.4 U	8.6 U	26 U	8.6 U
N-Nitrosodiphenylamine (OC)	---	11	11	0.34 U		0.37 U	0.20 U	0.18 U	0.30 U		0.08 U	0.30 U		0.28 U	0.29 U		1.5 U	0.75 U	1.7 U	0.82 U	0.18 U	0.51 U	0.19 U
2-Methylphenol	---	63	63	14 U		14 U	14 U	14 U	42 U		14 U	14 U		14 U	14 U		14 U	14 U	14 U	14 U	14 U	42 U	14 U
4-Methylphenol	---	670	670	13 U		**410**	**320**	**50**	**140**		13 U	**18 J**		13 U	**23**		12 U	12 U	13 U	12 U	**18 J**	**84**	**100**
Polychlorinated Biphenyls (ug/kg dry weight or mg/kg OC)																							
Total PCBs (OC) [c]	---	12	65	0.11 U		0.17 U	0.09 U	0.084 UJ	0.046 UJG		0.036 UJ	0.14 U		0.094 U	0.093 U		0.72 U	0.34 UJ	0.74 UJG	0.37 UJ	0.086 UJ	0.077 UJG	0.79 UJG
Total PCBs (dry) [c]	130	---	---	2.8 U		3.9 U	3.9 U	4 UJ	4 UJG		4 UJ	3.9 U		2.9 U	2.8 U		3.9 U	3.8 UJ	3.8 UJG	3.8 UJ	4.1 UJ	3.9 UJG	3.5 UJG
Aroclor 1016	---	---	---	2.8 U		1.6 U	1.6 U	1.6 UJ	1.6 UJG		1.6 UJ	1.6 U		2.9 U	2.8 U		1.6 U	1.5 UJ	1.5 UJG	1.5 UJ	1.6 UJ	1.6 UJG	1.6 UJG
Aroclor 1221	---	---	---	2.8 U		3.9 U	3.9 U	4 UJ	4 UJG		4 UJ	3.9 U		2.9 U	2.8 U		3.9 U	3.8 UJ	3.8 UJG	3.8 UJ	4.1 UJ	3.9 UJG	4 UJG
Aroclor 1232	---	---	---	2.8 U		3.4 U	3.4 U	3.5 UJ	3.5 UJG		3.5 UJ	3.4 U		2.9 U	2.8 U		3.5 U	3.3 UJ	3.3 UJG	3.3 UJ	3.5 UJ	3.4 UJG	3.5 UJG
Aroclor 1242	---	---	---	2.8 U		1.0 U	1 U	1.1 UJ	1.1 UJG		1 UJ	1 U		2.9 U	2.8 U		1.0 U	0.98 UJ	1.0 UJG	0.99 UJ	1.1 UJ	1.0 UJG	1.0 UJG
Aroclor 1248	---	---	---	2.8 U		0.63 U	0.64 U	0.65 UJ	0.66 UJG		0.65 UJ	0.63 U		2.9 U	2.8 U		0.64 U	0.61 UJ	0.62 UJG	0.61 UJ	0.66 UJ	0.63 UJG	0.64 UJG
Aroclor 1254	---	---	---	0.73 U		1.0 U	1 U	1.1 UJ	1.1 UJG		1 UJ	1 U		0.75 U	0.72 U		1.0 U	0.98 UJ	1.0 UJG	0.99 UJ	1.1 UJ	1.0 UJG	1.0 UJG
Aroclor 1260	---	---	---	0.73 U		1.5 U	1.5 U	1.5 UJ	1.5 UJG		1.5 UJ	1.5 U		0.75 U	0.72 U		1.5 U	1.4 UJ	1.4 UJG	1.4 UJ	1.5 UJ	1.5 UJG	1.5 UJG
Chlorinated Pesticides (ug/kg dry weight)																							
4,4'-DDD	16	---	---	**0.95 JTG**		0.14 U	0.14 U	**1.2 J**	0.15 U		**0.34 J**	0.14 U		**2.9 JG**	**1.1 JTG**		0.14 U	0.14 UJG	0.14 UJG	0.13 U	0.15 U	**1.1 J**	0.14 UJG
4,4'-DDE	9	---	---	0.23 U		**0.24 J**	0.14 U	**2 J**	**1.4 J**		**0.42 J**	0.14 U		**4.1 JG**	0.22 U		0.14 U	0.14 UJG	0.13 UJG	**0.45 J**	0.14 U	**1.3 J**	0.14 UJG
4,4'-DDT	34	---	---	0.26 U		**0.24 J**	**0.8 J**	**4.8 J**	**0.71 J**		0.15 U	0.15 U		**2.7 JG**	**5.8 JG**		0.15 U	0.15 UJG	0.14 UJG	**2.5**	**3 J**	**1 J**	0.15 UJG
Aldrin	---	---	---	**0.19 J**		0.22 U	0.21 U	0.23 U	0.22 U		0.22 U	0.21 U		**4.8 JG**	**0.15 JTG**		0.22 U	0.22 UJG	0.21 UJG	0.2 U	0.22 U	**0.48 J**	0.22 UJG
alpha-Chlordane	---	---	---	0.12 U		0.13 U	0.13 U	**0.85 J**	**1.3 J**		**0.32 J**	**0.34 J**		**4.3 JG**	0.12 U		0.13 U	0.13 UJG	0.13 UJG	0.12 U	0.14 U	**0.62 J**	0.13 UJG
Dieldrin	---	---	---	0.22 U		0.11 U	0.11 U	0.12 U	0.12 U		0.12 U	0.11 U		**3.4 JG**	0.21 U		0.12 U	0.12 UJG	0.11 UJG	0.11 U	0.12 U	0.11 U	**1.7 JTG**
gamma-BHC	---	---	---	0.12 U		0.076 U	0.075 U	0.079 U	0.078 U		0.077 U	0.075 U		**4.4 JG**	0.11 U		0.077 U	0.076 UJG	0.074 UJG	**0.17 J**	**0.62 J**	0.076 U	**0.29 JTG**
Heptachlor	---	---	---	0.13 U		0.45 U	0.45 U	0.47 U	0.46 U		0.46 U	0.45 U		**5.6 JG**	0.13 U		0.46 U	0.45 UJG	0.44 UJG	0.43 U	0.47 U	0.45 U	0.46 UJG
Petroleum Hydrocarbons (mg/kg dry weight)																							
Gasoline	---	---	---																		72 U		
Diesel Range	---	---	---																		180 U		
Motor Oil	---	---	---																		360 U		
Dioxins/Furans (ng/kg dry weight)																							
DX TOTAL (TEQ ND=1/2 DL)	---	---	---		**902**	**48.6**		**100**	**202**	**309**	**106**	**12.6**	**16.2**	**35**		**8.02**	**1.89**		**1**		**69**		**78.6**
1,2,3,4,6,7,8-HPCDD	---	---	---		**32,000 B**	**498 B**		**1,980 B**	**3,680 B**	**5,820 B**	**2,870 B**	**330 B**	**516 B**	**815**		**149 B**	**41.6**		**22.2**		**1,610 B**		**1,660**
1,2,3,4,6,7,8-HPCDF	---	---	---		**14,100**	**180 B**		**605 B**	**1,270**	**2,200**	**652 B**	**156**	**207**	**300**		**96.9**	**18.2**		**10.2**		**558 B**		**688**
1,2,3,4,7,8,9-HPCDF	---	---	---		**801 B**	**10.7**		**33.6**	**72.7 B**	**98.8 B**	**38.9**	**8.05 B**	**12.6 B**	**15.2**		**3.95 B**	**1.13**		**0.579**		**29.1**		**36.3**
1,2,3,4,7,8-HXCDD	---	---	---		**61.6**	**16.8**		**32**	**66.9**	**135**	**28.8**	**2.78**	**1.74**	**8.38**		**1.44**	**0.525 J**		**0.288 J**		**18.2**		**17.6**
1,2,3,4,7,8-HXCDF	---	---	---		**1110**	**24.4**		**64.3**	**127**	**173**	**72.4**	**8.85**	**8.46**	**24.6**		**6.48**	**1.43**		**0.786**		**51.6**		**61.4**
1,2,3,6,7,8-HXCDD	---	---	---		**1170**	**40.1**		**122**	**251**	**415**	**121**	**16.4**	**20.3**	**44.5**		**10.2**	**2.34**		**1.28**		**85.4**		**99.8**
1,2,3,6,7,8-HXCDF	---	---	---		**211**	**10.4**		**22**	**41.4**	**59.9**	**20.9**	**2.73**	**2.84**	**8.38**		**1.97**	**0.521**		**0.296 J**		**16.5**		**19.1**
1,2,3,7,8,9-HXCDD	---	---	---		**237**	**32.7**		**71.3**	**152**	**268**	**79.8**	**7.27**	**5.53**	**24.1**		**4.04**	**1.59**		**0.811**		**48.8**		**45.1**
1,2,3,7,8,9-HXCDF	---	---	---		**15.7**	**1.04**		**1.94**	**3.67**	**5.13**	**2.48**	**0.563**	**0.219 J**	**0.669**		**0.17 J**	**0.047 J**		**0.026 J**		**1.26**		**1.51**
1,2,3,7,8-PECDD	---	---	---		**31.4**	**14.6**		**20.1**	**43**	**65.3**	**15.6**	**1.53**	**1.26**	**5.67**		**1.4**	**0.297 J**		**0.162 J**		**11.2**		**13**
1,2,3,7,8-PECDF	---	---	---		**40.7**	**10.8**		**15.5**	**27.5**	**34.1**	**12.7**	**1.04**	**0.795**	**3.73**		**1.15**	**0.177 J**		**0.077 J**		**8.43**		**10.9**
2,3,4,6,7,8-HXCDF	---	---	---		**118**	**8.71**		**18**	**55.5**	**46.9**	**18.3**	**1.89**	**2.03**	**7.49**		**1.76**	**0.505 J**		**0.284 J**		**13.6**		**16.7**
2,3,4,7,8-PECDF	---	---	---		**88.7 B**	**14.2**		**21.2**	**38.2 B**	**49.2 B**	**17**	**1.57 B**	**1.35 B**	**6.44**		**1.55 B**	**0.271 J**		**0.157 J**		**12.5**		**16.6**
2,3,7,8-TCDD	---	---	---		**9.51 B**	**5.72**		**5.67**	**9.93 B**	**12.7 B**	**4.09**	**0.337 B**	**0.321 B**	**1.23**		**0.433 B**	**0.061 J**		**0.043 J**		0.0976 U		**3.69**
2,3,7,8-TCDF	---	---	---		**23.1**	**20.5**		**22.1**	**46.8**	**54.1**	**13.4**	**1.25**	**1.07**	**3.68**		**1.46**	**0.138**		**0.079 J**		**11.5**		**16.3**
OCDD	---	---	---		**171,000 B**	**3,900 B**		**18,600 B**	**34,900 B**	**53,400 B**	**28,900 B**	**3,290 B**	**8,090 B**	**7,300 B**		**1220 B**	**373 B**		**203 B**		**14,600 B**		**14,500 B**
OCDF	---	---	---		**59,400 B**	**562 B**		**1,970 B**	**4,380 B**	**6,170 B**	**1,880 B**	**475 B**	**556 B**	**1,160**		**242 B**	**45**		**22.4**		**1,820 B**		**2,260**

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																			
				SH-10-SC-12	SH-10-SC-23	SH-11-SS-00	SH-11-SC-12 [d]	SH-12-SS-00 [d]	SH-12-SC-12 [d]	SH-12-SC-23	SH-13-SS-00 [d]	SH-13-SC-12	SH-13-SC-23	SH-14-SS-00	SH-14-SC-12	SH-14-SC-23	SH-15-SS-00	SH-15-SC-12	SH-16-SS-00	SH-16-SC-12	SH-18-WS-00 [d]	SH-18-WC-12 [d]	SH-19-WS-00 [d]
	LAET	SQS	CSL	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	2 to 3 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
TOTAL HEPTA-DIOXINS	---	---	---		**62,500**	**1,190 B**		**5,850 B**	**10,100**	**14,800**	**7,490 B**	**899**	**1,870**	**2,100**		**355**	**98.3**		**52.8**		**4,240 B**		**3,970**
TOTAL HEPTA-FURANS	---	---	---		**80,900**	**668 B**		**2,450 B**	**5,270**	**8,240**	**2,620**	**705**	**971**	**1,200**		**336**	**54.2**		**29**		**2,160 B**		**2,660**
TOTAL HEXA-DIOXINS	---	---	---		**9,040**	**911**		**2,250**	**4,870**	**10,000**	**2,110**	**278**	**392**	**617**		**113**	**35**		**18.3**		**1,190**		**1,100**
TOTAL HEXA-FURANS	---	---	---		**19,100**	**296**		**970**	**1,940**	**2,990**	**1,100**	**170**	**221**	**434**		**116**	**22.9**		**13.2**		**800**		**1,040**
TOTAL PENTA-DIOXINS	---	---	---		**687**	**874**		**1,560**	**3,560**	**7,530**	**1,230**	**167**	**59.7**	**267**		**42.3**	**11.6**		**5.54**		**600**		**569**
TOTAL PENTA-FURANS	---	---	---		**1930**	**222**		**397**	**711**	**931**	**335**	**38.3**	**36.7**	**149**		**41.1**	**6.91**		**3.79**		**254**		**351**
TOTAL TETRA-DIOXINS	---	---	---		**420**	**1,200**		**1,790**	**3,680**	**7,620**	**1,530**	**174**	**55.8**	**317**		**52.8**	**7.62**		**3.52**		**602**		**682**
TOTAL TETRA-FURANS	---	---	---		**526**	**477**		**552**	**1,010**	**1,110**	**330**	**33.1**	**35.8**	**111**		**44.6**	**3.25**		**1.74**		**270**		**427**
Guaicols and Resin Acids (ug/kg dry weight)																							
12-Chlorodehydroabietic Acid	---	---	---																		190 U	300 U	**130**
14-Chlorodehydroabietic Acid	---	---	---																		190 U	300 U	98 U
3,4,5-Trichloroguaiacol	---	---	---																		20 U	59 U	20 U
3,4,6-Trichloroguaiacol	---	---	---																		20 U	59 U	20 U
3,4-Dichloroguaiacol	---	---	---																		20 U	59 U	20 U
4,5,6-Trichloroguaiacol	---	---	---																		20 U	59 U	20 U
4,5-Dichloroguaiacol	---	---	---																		20 U	59 U	20 U
4,6-Dichloroguaiacol	---	---	---																		20 U	59 U	20 U
4-Chloroguaiacol	---	---	---																		20 U	59 U	20 U
9,10-Dichlorostearic Acid	---	---	---																		190 U	300 U	98 U
Abietic Acid	---	---	---																		**760**	**33,000**	**1,200**
Dehydroabietic Acid	---	---	---																		**1600**	**9,000**	**1,700**
Dichlorodehydroabietic Acid	---	---	---																		190 U	300 U	98 U
Guaiacol	---	---	---																		20 U	59 U	20 U
Isopimaric Acid	---	---	---																		**220**	**3300**	**190**
Linolenic Acid	---	---	---																		**200**	300 U	98 U
Neoabietic Acid	---	---	---																		190 UJ	**550 J**	98 UJ
Oleic Acid	---	---	---																		**430**	300 U	**210**
Palustric Acid	---	---	---																		190 U	**920**	98 U
Pimaric Acid	---	---	---																		190 U	300 U	98 U
Retene	---	---	---																		**110**	**7300**	**900**
Sandaracopimaric Acid	---	---	---																		190 U	**580**	98 U
Tetrachloroguaiacol	---	---	---																		20 U	59 U	20 U
Total resin acids [c]	---	---	---																		**3,300**	**53,000**	**4,200**

[a] Lowest and second lowest apparent effects thresholds for freshwater sediments in Washington State 2003).

[b] Washington State Marine Sediment Management Standards, Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) (WAC Chapter 173-204).

[c] Totals only include detected and estimated values

[d] Sample has organic carbon content less than 0.5 percent or greater than 4.0 percent and should be compared to LAET criteria rather than organic-carbon normalized SMS criteria.

ng/kg nanograms per kilogram

µg/kg micrograms per kilogram.

mg/kg milligrams per kilogram.

PCBs polychlorinated biphenyls.

Bold type indicates the sample result is greater than the laboratory detection limit.

Underlined value indicates the sample result or detection limit is greater than the LAET or SQS value.

Shaded value indicates the sample result or detection limit is greater than the CSL value.

U The material was analyzed for, but was not detected. The associated numerical value is the detection limit. For petroleum hydrocarbons, guaiacols and resin acids, the associated numerical value is the reporting limit.

J The associated numerical value is considered an estimated concentration.

G Bias is high.

B Specifyied compound was detected in the associated method blank.

LPAH represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH sum.

HPAH represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total benzofluoranthenes represents the sum of the concentrations of the "b" and "k" isomers.

Total PAHs (carcinogenic) represents the sum of the following PAH compounds: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene.

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																			
				SH-19-WC-12	SH-20-WS-00 [d]	SH-20-WC-12	SH-21-WS-00 [d]	SH-21-WC-12 [d]	SH-22-WS-00 [d]	SH-22-WC-12	SH-23-WS-00	SH-23-WC-12 [d]	SH-24-WS-00 [d]	SH-25-WS-00	SH-26-WS-00	SH-26-WC-12 [d]	SH-27-WS-00	SH-27-WC-12	SH-28-WS-00	SH-28-WC-12	SH-29-WS-00	SH-29-WC-12	SH-30-WS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
Conventional Parameters																							
Particle/Grain Size, Fines (Silt/Clay)	---	---	---	56.8	77.2	62.5	76.2	39.1	36.8	31.1	64.8	60.4	42	49.6	12.8	1.8	21.6	10.3	24.1	39.4	4.1	5.8	31.2
Particle/Grain Size, Phi Scale <-1	---	---	---	1	2.2	8.5	1.1	21.8	12.5	11.8	1.8	4.6	6.1	6.3	21.3	6.7	25.3	37	0.2	4	5.8	6.8	1.2
Particle/Grain Size, Phi Scale >10	---	---	---	6.7	12.1	12.1	10.8	7.2	6.6	5.4	10.6	10.6	7.1	7.4	1.9		3.4	2	5	6.9	1.1	1.1	6
Particle/Grain Size, Phi Scale 0 to 1	---	---	---	3.9	4.9	6	3.4	8.8	5.6	11.6	2.4	2.7	5.1	4.5	13.9	21.1	8	9.8	1.5	2.3	23.7	19.4	2.4
Particle/Grain Size, Phi Scale -1 to 0	---	---	---	1.6	8.9	5.3	8.4	10.9	6.7	9	2.5	3.4	4.3	4.2	7.7	6.1	7.6	8.9	1.1	2.4	16.8	11.9	1.7
Particle/Grain Size, Phi Scale 1 to 2	---	---	---	14	1.9	8.8	3.4	9.1	11.2	17	3.9	3.8	15.5	5.7	26.4	53.7	15	15.4	2.5	2.5	33.3	32.5	3.8
Particle/Grain Size, Phi Scale 2 to 3	---	---	---	11.4	1.3	7.5	2.9	6.1	14.2	12.4	7.3	8.7	15.8	9.5	14.4	9.9	12.8	13.3	28.6	17.1	15.3	21.4	19
Particle/Grain Size, Phi Scale 3 to 4	---	---	---	11.3	3.5	1.4	4.6	4.3	13	7.1	17.2	16.3	11.2	20.2	3.7	0.7	9.7	5.2	42	32.3	1	2.1	40.7
Particle/Grain Size, Phi Scale 4 to 5	---	---	---	11.1	6.6	8.7	8	2.5	8.1	6.4	13.8	13.6	7.8	13.8	4.2		7.5	1.7	6.1	11.3	0.6	1.1	8.6
Particle/Grain Size, Phi Scale 5 to 6	---	---	---	10.1	15.3	8.3	16.6	7.1	7	4.6	10.6	9.4	7.7	9.2	1.8		3.1	2	2.4	4.7	0.4	0.8	3.7
Particle/Grain Size, Phi Scale 6 to 7	---	---	---	9.3	15	11.4	14.7	7.1	4.8	4.4	9.6	8.1	6.1	5.7	1.5		2.4	1.5	2.8	4.7	0.5	1	3.1
Particle/Grain Size, Phi Scale 7 to 8	---	---	---	8.5	12.2	8.3	11.1	6.3	4	3.9	8.3	7.8	4.6	5.5	1.2		1.9	1.4	2.6	4.2	0.5	0.9	3.3
Particle/Grain Size, Phi Scale 8 to 9	---	---	---	6	8.4	7.5	6.8	4.8	3.5	3.4	6.3	5.8	4.4	4.2	1.2		1.8	0.9	2.6	4.1	0.5	0.6	3.1
Particle/Grain Size, Phi Scale 9 to 10	---	---	---	5.1	7.7	6.1	8.2	4.1	2.9	3	5.6	5.2	4.4	3.8	1		1.5	0.9	2.6	3.5	0.5	0.4	3.4
Total Volatile Solids %	---	---	---	8.62	12.81	9.23	16.64	39.5	19.68	17.13	10.26	16.65	14.17	10.77	2.62	1.85	3.52	6.72	5.47	8.42	1.55	2.07	8.31
Ammonia (mg/kg)	---	---	---	6.74	17.8	58.3	18.6	59.7	30.5	37.2	21.4	59.7	17.2	8.45	8.77	1.71	6.97	8.65	12	42.7	6.67	0.19	17.1
Sulfide	---	---	---	65.1	1,810	490	1,890 J	759	969	200	1,760	239	148	950	510	0.01 U	15.8	678	338	227	1.42	87.6	896
Total organic carbon (%)	---	---	---	2.47	5.15	1.38	5.59	11.1	5.77	3.4	3.33	6.88	4.97	2.6	1.92	0.153	1.38	3.48	1.24	2.76	0.594	1.14	1.99
Total solids (%)	---	---	---	43.7	30.2	50.5	30.1	31.5	39.8	58.5	38.6	44.7	45.7	42.1	67.9	84.7	63.8	60.8	57.3	55.7	77.5	81.7	51.8
Metals (mg/kg dry weight)																							
Antimony	150	---	---	0.35 J	0.34 J	0.37 J	0.37 J	0.22 J	0.27 J	0.24 J	0.29 J	0.39 J	0.26 J	0.33 J	0.11 J	0.065 J	0.1 J	0.14 J	0.21 J	0.24 J	0.13 J	0.17 J	0.25 J
Arsenic	57	57	93	3.2	7	6.1	7.8	3	6.5	5.5	7.6	7.1	6.1	7.5	2.1	1.3	3.5	2.6	5.6	5.9	4.1	2.9	7.6
Cadmium	5.1	5.1	6.7	0.62	1.6	1.2	1.6	0.74	0.59	0.52	0.89	1	0.71	0.64	0.25 J	0.23 J	0.34	0.29 J	0.58	0.66	0.1 J	0.15 J	1.1
Chromium	260	260	270	60	51	53	55	32	32	41	47	53	37	41	44	38	33	33	30	37	27	23	32
Copper	390	390	390	62	63	62	66	50	29	42	47	60	37	41	44	49	25	31	26	32	18	15	29
Lead	450	450	530	12	17	19	17	14	7.2	9.3	12	17	9.8	12	3.4	2	2.5	4.3	6.1	9.2	3.2	3.5	13
Mercury	0.41	0.41	0.59	0.045	0.1	0.222	0.1 J	0.088	0.048	0.141 U	0.072	0.12	0.086	0.06	0.019 J	0.11 U	0.012 J	0.122 U	0.07	0.056	0.0073 U	0.104 U	0.095
Nickel	140	---	---	42	42	39	44	26	26	32	41	44	31	36	39	37	25	28	30	34	30	31	30
Silver	6.1	6.1	6.1	0.097 J	0.18 J	0.18 J	0.21 J	0.14 J	0.095 J	0.11 J	0.14 J	0.16 J	0.11 J	0.13 J	0.046 J	0.035 J	0.04 J	0.038 J	0.075 J	0.11 J	0.017 J	0.02 J	0.11 J
Zinc	410	410	960	66	120	100	120	59	63	59	92	82	71	76	48	45	40	40	55	57	35	30	82
Butyltins (ug/kg dry weight)																							
Butyltin Ion	---	---	---																				3.6 U
Dibutyltin Ion	---	---	---																				2.8 U
Tributyltin Ion	---	---	---																				1.6 U
Aromatic Hydrocarbons (ug/kg dry weight or mg/kg OC)																							
LPAHs																							
2-Methylnaphthalene (dry)	670	---	---	8 U	8.1 U	8.1 U	8.1 U	20 U	8.1 U	8.0 U	8.0 U	8.0 U	8.0 U	8.0 U	8.0 U	8.1 U	8.2 U	8.0 U	7.9 U	8.1 U	7.8 U	8.0 U	8.1 U
2-Methylnaphthalene (OC)	---	38	64	0.32 U	0.16 U	0.59 U	0.14 U	0.18 U	0.14 U	0.24 U	0.24 U	0.12 U	0.16 U	0.31 U	0.42 U	5.3 U	0.59 U	0.23 U	0.64 U	0.29 U	1.3 U	0.70 U	0.41 U
Acenaphthene (dry)	500	---	---	8 U	8.1 U	8.1 U	8.2 U	20 U	13 J	8.0 U	8.0 U	8.1 U	8.0 U	8.1 U	8.0 U	8.1 U	8.2 U	8.0 U	7.9 U	8.1 U	7.9 U	8.1 U	8.1 U
Acenaphthene (OC)	---	16	57	0.32 U	0.16 U	0.59 U	0.15 U	0.18 U	0.23 J	0.24 U	0.24 U	0.12 U	0.16 U	0.31 U	0.42 U	5.3 U	0.59 U	0.23 U	0.64 U	0.29 U	1.3 U	0.71 U	0.41 U
Acenaphthylene (dry)	560	---	---	8.5 U	8.6 U	8.5 U	8.6 U	21 U	29	8.4 U	8.5 U	8.5 U	8.5 U	8.5 U	8.4 U	8.6 U	8.6 U	8.5 U	8.4 U	8.5 U	8.3 U	8.5 U	8.5 U
Acenaphthylene (OC)	---	66	66	0.34 U	0.17 U	0.62 U	0.15 U	0.19 U	0.50	0.25 U	0.26 U	0.12 U	0.17 U	0.33 U	0.44 U	5.6 U	0.62 U	0.24 U	0.68 U	0.31 U	1.4 U	0.75 U	0.43 U
Anthracene (dry)	960	---	---	7.6 U	7.7 U	7.6 U	7.7 U	160	100	20	7.6 U	7.6 U	7.6 U	21	7.5 U	7.7 U	7.7 U	7.6 U	7.5 U	7.6 U	7.4 U	7.6 U	7.6 U
Anthracene (OC)	---	220	1,200	0.31 U	0.15 U	0.55 U	0.14 U	1.4	1.7	0.59	0.23 U	0.11 U	0.15 U	0.8	0.39 U	5.0 U	0.56 U	0.22 U	0.60 U	0.28 U	1.2 U	0.67 U	0.38 U
Fluorene (dry)	540	---	---	8.8 U	8.9 U	8.8 U	8.9 U	22 U	17 J	8.7 U	8.8 U	8.8 U	8.8 U	8.8 U	8.7 U	8.9 U	8.9 U	8.8 U	8.6 U	8.8 U	8.6 U	8.8 U	8.8 U
Fluorene (OC)	---	23	79	0.36 U	0.17 U	0.64 U	0.16 U	0.20 U	0.29 J	0.26 U	0.26 U	0.13 U	0.18 U	0.34 U	0.45 U	5.8 U	0.64 U	0.25 U	0.69 U	0.32 U	1.4 U	0.77 U	0.44 U
Naphthalene (dry)	2,100	---	---	36	8.6 U	8.5 U	8.6 U	22 U	8.6 U	8.4 U	8.5 U	8.5 U	8.5 U	8.5 U	8.4 U	8.6 U	8.6 U	8.5 U	8.4 U	8.6 U	8.3 U	8.5 U	8.5 U
Naphthalene (OC)	---	99	170	1.5	0.17 U	0.62 U	0.15 U	0.20 U	0.15 U	0.25 U	0.26 U	0.12 U	0.17 U	0.33 U	0.44 U	5.6 U	0.62 U	0.24 U	0.68 U	0.31 U	1.4 U	0.75 U	0.43 U
Phenanthrene (dry)	1500	---	---	88	8.3 U	24	21	74	270	61	18 J	14 J	8.20 U	56	8.2 U	8.3 U	8.4 U	8.2 U	9.6 J	20 J	25	8.2 U	25
Phenanthrene (OC)	---	100	480	3.6	0.16 U	1.7	0.38	0.67	4.7	1.8	0.54 J	0.20 J	0.16 U	2.2	0.43 U	5.4 U	0.61 U	0.24 U	0.77 J	0.72 J	4.2	0.72 U	1.3
Total LPAHs (dry) [c]	5200	---	---	120	20 U	24	21	230	430	81	18 J	14 J	20 U	77	19 U	20 U	20 U	20 U	9.6 J	20 J	25	20 U	25
Total LPAHs (OC) [c]	---	370	780	4.9	0.39 U	1.7	0.38	2.1	7.4	2.4	0.54 J	0.20 J	0.40 U	3.0	0.99 U	13 U	1.4 U	0.57 U	0.77 J	0.72 J	4.2	1.8 U	1.3
HPAHs																							
Benzo(a)anthracene (dry)	1,300	---	---	24	5.9 U	27	41	150	290	64	19 J	15 J	5.8 U	38	5.7 U	5.9 U	5.9 U	5.8 U	9.6 J	14 J	5.7 U	5.8 U	26
Benzo(a)anthracene (OC)	---	110	270	1.0	0.11 U	2.0	0.73	1.4	5.0	1.9	0.57 J	0.22 J	0.12 U	1.5	0.30 U	3.9 U	0.43 U	0.17 U	0.8 J	0.51 J	1.0 U	0.51 U	1.3
Benzo(a)pyrene (dry)	1,600	---	---	33	8.1 U	30	36	150	200	59	20	22	8.0 U	61	7.9 U	8.1 U	8.1 U	8.0 U	12 J	15 J	7.8 U	8 U	21
Benzo(a)pyrene (OC)	---	99	210	1.3	0.16 U	2.2	0.64	1.4	3.5	1.7	0.60	0.32	0.16 U	2.3	0.41 U	5.3 U	0.59 U	0.23 U	1.0 J	0.54 J	1.3 U	0.70 U	1.1
Benzo(b)fluoranthene (dry)	---	---	---	26	9.4 U	26	45	290	380	89	31	18 J	22	51	9.2 U	9.4 U	9.5 U	9.3 U	9.2 U	11 J	9.1 U	9.3 U	21
Benzo(b)fluoranthene (OC)	---	---	---	1.1	0.18 U	1.9	0.81	2.6	6.6	2.6	0.93	0.26 J	0.44	2.0	0.48 U	6.1 U	0.69 U	0.27 U	0.74 U	0.40 J	1.5 U	0.82 U	1.1
Benzo(g,h,i)perylene (dry)	670	---	---	22	6.7 U	6.7 U	6.7 U	47 J	64	6.6 U	6.6 U	6.6 U	6.6 U	26	6.6 U	6.7 U	6.7 U	6.6 U	6.5 U	15 J	6.5 U	6.6 U	6.7 U
Benzo(g,h,i)perylene (OC)	---	31	78	0.89	0.13 U	0.49 U	0.12 U	0.42 J	1.1	0.19 U	0.20 U	0.10 U	0.13 U	1.0	0.34 U	4.4 U	0.49 U	0.19 U	0.52 U	0.54 J	1.1 U	0.58 U	0.34 U
Benzo(k)fluoranthene (dry)	---	---	---	23	9.2 U	45	99	390	370	110	24	12 J	9.1 U	74	9 U	9.2 U	9.2 U	9.1 U	8.9 U	11 J	8.9 U	9.1 U	27
Benzo(k)fluoranthene (OC)	---	---	---	0.93	0.18 U	3.3	1.8	3.5	6.4	3.2	0.72	0.17 J	0.18 U	2.8	0.47 U	6.0 U	0.67 U	0.26 U	0.72 U	0.40 J	1.5 U	0.80 U	1.4
Benzofluoranthenes, Total (b+k+j) (dry)	3,200	---	---	49	20 U	71	140	680	750	200	55	30 J	22	120	19 U	20 U	20 U	20 U	19 U	22 J	19 U	20 U	48
Benzofluoranthenes, Total (b+k+j) (OC)	---	230	450	2	0.39 U	5.1	2.5	6.1	13	5.9	1.7	0.44 J	0.44	4.6	0.99 U	13 U	1.4 U	0.57 U	1.5 U	0.80 J	3.2 U	1.8 U	2.4
Chrysene (dry)	1,400	---	---	30	26	34	100	240	800	130	58	22	34	76	12 J	6.6 U	6.6 U	6.5 U	14 J	18 J	6.3 U	6.5 U	44
Chrysene (OC)	---	110	460	1.2	0.50	2.5	1.8	2.2	13.9	3.8	1.7	0.32	0.68	2.9	0.63 J	4.3 U	0.48 U	0.19 U	1.1 J	0.65 J	1.1 U	0.57 U	2.2
Dibenz(a,h)anthracene (dry)	230	---	---	8.4 U	8.5 U	8.4 U	8.5 U	21 U	18 J	8.3 U	8.4 U	8.4 U	8.4 U	8.4 U	8.3 U	8.5 U	8.5 U	8.4 U	8.3 U	8.4 U	8.2 U	8.4 U	8.4 U
Dibenz(a,h)anthracene (OC)	---	12	33	0.34 U	0.17 U	0.61 U	0.15 U	0.19 U	0.31 J	0.24 U	0.25 U	0.12 U	0.17 U	0.32 U	0.43 U	5.6 U	0.62 U	0.24 U	0.67 U	0.30 U	1.4 U	0.74 U	0.42 U
Fluoranthene (dry)	1,700	---	---	170	28	43	78	1,500	2,000	320	81	29	43	93	14 J	7.8 U	7.9 U	7.7 U	17 J	34	34	7.8 U	78
Fluoranthene (OC)	---	160	1,200	6.9	0.54	3.1	1.4	13.5	34.7	9.4	2.4	0.42	0.87	3.6	0.73 J	5.1 U	0.57 U	0.22 U	1.4 J	1.2	5.7	0.68 U	3.9
Indeno(1,2,3-cd)pyrene (dry)	600	---	---	8.4 U	8.5 U	8.5 U	8.5 U	33 J	78	8.3 U	8.4 U	8.4 U	8.4 U	22	8.3 U	8.5 U	8.6 U	8.4 U	8.3 U	8.5 U	8.2 U	8.4 U	8.5 U
Indeno(1,2,3-cd)pyrene (OC)	---	34	88	0.34 U	0.17 U	0.62 U	0.15 U	0.30 J	1.4	0.24 U	0.25 U	0.12 U	0.17 U	0.85	0.43 U	5.6 U	0.62 U	0.24 U	0.67 U	0.31 U	1.4 U	0.74 U	0.43 U
Pyrene (dry)	2,600	---	---	200	28	49	86	640	1,000	230	68	31	45	85	14 J	7.7 U	7.7 U	7.6 U	19	24	34	7.6 U	71
Pyrene (OC)	---	1,000	1,400	8.1	0.54	3.6	1.5	5.8	17.3	6.8	2.0	0.45	0.91	3.3	0.73 J	5.0 U	0.56 U	0.22 U	1.5	0.87	5.7	0.67 U	3.6
Total HPAHs (dry) [c]	12,000	---	---	530	82	250	480	3,400	5,200	1,000	300	150	140	520	40	20 U	20 U	20 U	91	140	68	20 U	290
Total HPAHs (OC) [c]	---	960	5,300	21	1.6	18	8.6	31	90	29	9.0	2.2	2.8	20	2.1	13 U	1.4 U	0.57 U	7.3	5.1	11	1.8 U	15

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																			
				SH-19-WC-12	SH-20-WS-00 [d]	SH-20-WC-12	SH-21-WS-00 [d]	SH-21-WC-12 [d]	SH-22-WS-00 [d]	SH-22-WC-12	SH-23-WS-00	SH-23-WC-12 [d]	SH-24-WS-00 [d]	SH-25-WS-00	SH-26-WS-00	SH-26-WC-12 [d]	SH-27-WS-00	SH-27-WC-12	SH-28-WS-00	SH-28-WC-12	SH-29-WS-00	SH-29-WC-12	SH-30-WS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
Chlorinated Benzenes (ug/kg dry weight or mg/kg OC)																							
1,2,4-Trichlorobenzene (dry)	31	---	---	8.9 U	9.0 U	8.9 U	9.0 U	23 U	8.9 U	8.8 U	8.9 U	8.9 U	8.9 U	8.9 U	8.8 U	9.0 U	9.0 U	8.9 U	8.8 U	9.0 U	8.7 U	8.9 U	8.9 U
1,2,4-Trichlorobenzene (OC)	---	0.81	1.8	0.36 U	0.17 U	0.64 U	0.16 U	0.21 U	0.15 U	0.26 U	0.27 U	0.13 U	0.18 U	0.34 U	0.46 U	5.9 U	0.65 U	0.26 U	0.71 U	0.33 U	1.5 U	0.78 U	0.45 U
1,2-Dichlorobenzene (dry)	35	---	---	7.7 U	7.8 U	7.8 U	7.8 U	20 U	7.8 U	7.6 U	7.7 U	7.7 U	7.7 U	7.7 U	7.6 U	7.8 U	7.8 U	7.7 U	7.6 U	7.8 U	7.5 U	7.7 U	7.8 U
1,2-Dichlorobenzene (OC)	---	2.3	2.3	0.31 U	0.15 U	0.57 U	0.14 U	0.18 U	0.14 U	0.22 U	0.23 U	0.11 U	0.15 U	0.30 U	0.40 U	5.1 U	0.57 U	0.22 U	0.61 U	0.28 U	1.3 U	0.68 U	0.39 U
1,4-Dichlorobenzene (dry)	110	---	---	7.2 U	7.3 U	7.2 U	7.3 U	18 U	7.2 U	7.1 U	7.2 U	7.2 U	7.2 U	7.2 U	7.1 U	7.3 U	7.3 U	7.2 U	7.1 U	7.3 U	7.0 U	7.2 U	7.2 U
1,4-Dichlorobenzene (OC)	---	3.1	9	0.29 U	0.14 U	0.52 U	0.13 U	0.16 U	0.12 U	0.21 U	0.22 U	0.10 U	0.14 U	0.28 U	0.37 U	4.8 U	0.53 U	0.21 U	0.57 U	0.26 U	1.2 U	0.63 U	0.36 U
Phthalates (ug/kg dry weight or mg/kg OC)																							
bis(2-Ethylhexyl)phthalate (dry)	1,300	---	---	11 U	23 U	11 U	11 U	**72**	**11 J**	11 U	**11 J**	11 U	11 U	**36**	**25**	**20**	11 U	**36**	11 U	11 U	11 U	**24**	21 U
bis(2-Ethylhexyl)phthalate (OC)	---	47	78	0.45 U	0.45 U	0.80 U	0.20 U	**0.65**	**0.19 J**	0.32 U	**0.33 J**	0.16 U	0.22 U	**1.4**	**1.3**	**13.1**	0.80 U	**1.0**	0.89 U	0.40 U	1.9 U	**2.1**	1.1 U
Butylbenzylphthalate (dry)	63	---	---	11 U	11 U	11 U	11 U	28 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
Butylbenzylphthalate (OC)	---	4.9	64	0.45 U	0.21 U	0.80 U	0.20 U	0.25 U	0.19 U	0.32 U	0.33 U	0.16 U	0.22 U	0.42 U	0.57 U	7.2 U	0.80 U	0.32 U	0.89 U	0.40 U	1.9 U	1.0 U	0.55 U
Di-n-Butylphthalate (dry)	1400	---	---	12 U	12 U	12 U	12 U	31 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Di-n-Butylphthalate (OC)	---	220	1,700	0.49 U	0.23 U	0.87 U	0.21 U	0.28 U	0.21 U	0.35 U	0.36 U	0.17 U	0.24 U	0.46 U	0.63 U	7.8 U	0.87 U	0.34 U	1.0 U	0.43 U	2.0 U	1.1 U	0.60 U
Di-n-Octyl phthalate (dry)	6200	---	---	8.2 U	8.3 U	8.2 U	8.3 U	21 U	8.2 U	8.1 U	8.2 U	8.2 U	8.2 U	8.2 U	8.1 U	8.3 U	8.3 U	8.2 U	8.0 U	8.2 U	8 U	8.2 U	8.2 U
Di-n-Octyl phthalate (OC)	---	58	4,500	0.33 U	0.16 U	0.59 U	0.15 U	0.19 U	0.14 U	0.24 U	0.25 U	0.12 U	0.16 U	0.32 U	0.42 U	5.4 U	0.60 U	0.24 U	0.65 U	0.30 U	1.3 U	0.72 U	0.41 U
Diethylphthalate (dry)	200	---	---	16 U	16 U	16 U	16 U	41 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U	16 U
Diethylphthalate (OC)	---	61	110	0.65 U	0.31 U	1.2 U	0.29 U	0.37 U	0.28 U	0.47 U	0.48 U	0.23 U	0.32 U	0.62 U	0.83 U	10.5 U	1.2 U	0.46 U	1.3 U	0.58 U	2.7 U	1.4 U	0.80 U
Dimethylphthalate (dry)	71	---	---	7.6 U	7.7 U	7.6 U	7.7 U	19 U	7.6 U	7.5 U	7.6 U	7.6 U	7.6 U	7.6 U	7.5 U	7.7 U	7.7 U	7.6 U	7.5 U	7.7 U	7.4 U	7.6 U	7.6 U
Dimethylphthalate (OC)	---	53	53	0.31 U	0.15 U	0.55 U	0.14 U	0.17 U	0.13 U	0.22 U	0.23 U	0.11 U	0.15 U	0.29 U	0.39 U	5.0 U	0.56 U	0.22 U	0.60 U	0.28 U	1.2 U	0.67 U	0.38 U
Ionizable Organic Compounds (ug/kg dry weight)																							
2,4-Dimethylphenol	29	29	29	14 U	15 U	15 U	15 U	37 U	15 U	14 U	14 U	15 U	14 U	15 U	14 U	15 U	15 U	14 U	14 U	15 U	14 U	15 U	15 U
Benzoic Acid	650	650	650	110 U	110 U	110 U	110 U	290 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U
Benzyl Alcohol	57	57	73	14 U	14 U	14 U	14 U	36 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U
Pentachlorophenol	360	360	690	47 U	47 U	47 U	47 U	120 U	47 U	46 U	47 U	47 U	47 U	47 U	46 U	47 U	47 U	47 U	46 U	47 U	46 U	47 U	47 U
Phenol	420	420	1,200	13 U	14 U	13 U	14 U	**47 J**	**16 J**	13 U	13 U	**19 J**	13 U	13 U	13 U	14 U	**21**	13 U	**40**	**20**	**54**	13 U	13 U
Miscellaneous Extractables (ug/kg dry weight or mg/kg OC)																							
Dibenzofuran (dry)	540	---	---	7.4 U	7.5 U	7.4 U	7.5 U	19 U	7.4 U	7.3 U	7.4 U	7.4 U	7.4 U	7.4 U	7.3 U	7.5 U	7.5 U	7.4 U	7.3 U	7.5 U	7.2 U	7.4 U	7.4 U
Dibenzofuran (OC)	---	15	58	0.30 U	0.15 U	0.54 U	0.13 U	0.17 U	0.13 U	0.21 U	0.22 U	0.11 U	0.15 U	0.28 U	0.38 U	4.9 U	0.54 U	0.21 U	0.59 U	0.27 U	1.2 U	0.65 U	0.37 U
Hexachlorobenzene (dry)	22	---	---	7.9 U	7.9 U	7.9 U	8 U	20 U	7.9 U	7.8 U	7.9 U	7.9 U	7.9 U	7.9 U	7.8 U	7.9 U	8.0 U	7.8 U	7.7 U	7.9 U	7.7 U	7.9 U	7.9 U
Hexachlorobenzene (OC)	---	0.38	2.3	0.32 U	0.15 U	0.57 U	0.14 U	0.18 U	0.14 U	0.23 U	0.24 U	0.11 U	0.16 U	0.30 U	0.41 U	5.2 U	0.58 U	0.22 U	0.62 U	0.29 U	1.3 U	0.69 U	0.40 U
Hexachlorobutadiene (dry)	11	---	---	7.9 U	8.0 U	8.0 U	8.1 U	20 U	8.0 U	7.9 U	8.0 U	8.0 U	8.0 U	8.0 U	7.9 U	8 U	8.1 U	7.9 U	7.8 U	8.0 U	7.8 U	8.0 U	8.0 U
Hexachlorobutadiene (OC)	---	3.9	6.2	0.32 U	0.16 U	0.58 U	0.14 U	0.18 U	0.14 U	0.23 U	0.24 U	0.12 U	0.16 U	0.31 U	0.41 U	5.2 U	0.59 U	0.23 U	0.63 U	0.29 U	1.3 U	0.70 U	0.40 U
N-Nitrosodiphenylamine (dry)	28	---	---	8.5 U	8.6 U	8.5 U	8.6 U	22 U	8.6 U	8.4 U	8.5 U	8.5 U	8.5 U	8.5 U	8.4 U	8.6 U	8.6 U	8.5 U	8.4 U	8.6 U	8.3 U	8.5 U	8.5 U
N-Nitrosodiphenylamine (OC)	---	11	11	0.34 U	0.17 U	0.62 U	0.15 U	0.20 U	0.15 U	0.25 U	0.26 U	0.12 U	0.17 U	0.33 U	0.44 U	5.6 U	0.62 U	0.24 U	0.68 U	0.31 U	1.4 U	0.75 U	0.43 U
2-Methylphenol	---	63	63	14 U	14 U	14 U	14 U	35 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U	14 U
4-Methylphenol	---	670	670	**140**	13 U	13 U	13 U	32 U	13 U	12 U	13 U	13 U	**34**	**22**	12 U	13 U	13 U	13 U	**27**	13 U	12 U	13 U	32
Polychlorinated Biphenyls (ug/kg dry weight or mg/kg OC)																							
Total PCBs (OC) [c]	---	12	65	0.16 U	0.78 UJG	0.29 UJ	0.14 UJG	0.035 UJ	0.049 U	0.11 UJ	0.087 UJG	0.041 UJG	0.076 UJG	0.15 UJ	0.15 U	2.5 U	0.2 U	0.11 UJ	0.22 UJG	0.11 UJG	0.66 U	0.33 U	0.19 UJ
Total PCBs (dry) [c]	130	---	---	3.9 U	4.0 UJG	4.0 UJ	8.0 UJG	3.9 UJ	2.8 U	3.9 UJ	2.9 UJG	2.8 UJG	3.8 UJG	3.9 UJ	2.8 U	3.8 U	2.8 U	4 UJ	2.7 UJG	2.9 UJG	3.9 U	3.8 U	3.8 UJ
Aroclor 1016	---	---	---	1.6 U	1.6 UJG	1.6 UJ	3.2 UJG	1.6 UJ	2.8 U	1.6 UJ	2.9 UJG	2.8 UJG	1.5 UJG	1.6 UJ	2.8 U	1.5 U	2.8 U	1.6 UJ	2.7 UJG	2.9 UJG	1.5 U	1.5 U	1.5 UJ
Aroclor 1221	---	---	---	3.9 U	4.0 UJG	4.0 UJ	8.0 UJG	3.9 UJ	2.8 U	3.9 UJ	2.9 UJG	2.8 UJG	3.8 UJG	3.9 UJ	2.8 U	3.8 U	2.8 U	4 UJ	2.7 UJG	2.9 UJG	3.9 U	3.8 U	3.8 UJ
Aroclor 1232	---	---	---	3.4 U	3.5 UJG	3.5 UJ	7.0 UJG	3.4 UJ	2.8 U	3.4 UJ	2.9 UJG	2.8 UJG	3.4 UJG	3.5 UJ	2.8 U	3.3 U	2.8 U	3.5 UJ	2.7 UJG	2.9 UJG	3.4 U	3.4 U	3.3 UJ
Aroclor 1242	---	---	---	1.0 U	1.0 UJG	1.0 UJ	2.1 UJG	1.0 UJ	2.8 U	1.0 UJ	2.9 UJG	2.8 UJG	1.0 UJG	1.0 UJ	2.8 U	0.99 U	2.8 U	1.1 UJ	2.7 UJG	2.9 UJG	1.0 U	1.0 U	0.99 UJ
Aroclor 1248	---	---	---	0.64 U	0.65 UJG	0.64 UJ	1.3 UJG	0.63 UJ	2.8 U	0.63 UJ	2.9 UJG	2.8 UJG	0.62 UJG	0.6 UJ	2.8 U	0.61 U	2.8 U	0.65 UJ	2.7 UJG	2.9 UJG	0.63 U	0.62 U	0.61 UJ
Aroclor 1254	---	---	---	1.0 U	1.0 UJG	1.0 UJ	2.1 UJG	1.0 UJ	0.73 U	1.0 UJ	0.75 UJG	0.72 UJG	1.0 UJG	1.0 UJ	0.72 U	0.99 U	0.72 U	1.1 UJ	0.71 UJG	0.75 UJG	1.0 U	1.0 U	0.99 UJ
Aroclor 1260	---	---	---	1.5 U	1.5 UJG	1.5 UJ	3.0 UJG	1.5 UJ	0.73 U	1.5 UJ	0.75 UJG	0.72 UJG	1.4 UJG	1.5 UJ	0.72 U	1.4 U	0.72 U	1.5 UJ	0.71 UJG	0.75 UJG	1.4 U	1.4 U	1.4 UJ
Chlorinated Pesticides (ug/kg dry weight)																							
4,4'-DDD	16	---	---	0.15 U	0.14 U	**2.7 J**	0.15 UJG	**3.6 J**	0.25 U	**1.1 J**	0.27 U	**1.1 J**	0.14 U	0.14 UJG	0.26 U	0.14 U	0.25 U	0.15 U	0.25 U	0.26 U	0.14 U	**0.34 J**	**2.3**
4,4'-DDE	9	---	---	0.14 U	0.14 U	0.14 U	0.14 UJG	0.14 U	0.22 U	**0.52 J**	0.23 U	0.22 U	0.14 U	**1.3 JTG**	0.22 U	0.13 U	0.22 U	0.14 U	0.22 U	**0.9 J**	0.14 U	**0.14 J**	0.14 U
4,4'-DDT	34	---	---	0.15 U	0.15 U	0.15 U	0.15 UJG	0.15 U	0.25 U	0.15 U	0.27 U	0.25 U	0.15 U	0.15 UJG	0.26 U	0.14 U	0.25 U	0.15 U	0.25 U	0.26 U	0.15 U	0.15 U	0.15 U
Aldrin	---	---	---	0.22 U	0.22 U	0.22 U	0.22 UJG	0.22 U	**0.63 JTG**	0.22 U	0.11 U	0.1 U	0.22 U	0.22 UJG	0.1 U	0.21 U	0.1 U	**2.9 J**	0.1 U	0.1 U	0.21 U	**0.36 J**	0.21 U
alpha-Chlordane	---	---	---	**0.15 J**	0.13 U	0.13 U	0.13 UJG	**2.5 J**	0.11 U	0.13 U	0.12 U	0.11 U	0.13 U	0.13 UJG	0.12 U	0.13 U	0.11 U	0.13 U	0.11 U	0.12 U	0.13 U	0.13 U	0.13 U
Dieldrin	---	---	---	0.12 U	0.12 U	0.12 U	0.12 UJG	0.12 U	0.21 U	0.11 U	0.22 U	0.21 U	0.12 U	0.12 UJG	**0.37 JTG**	**0.37 J**	0.21 U	0.12 U	0.21 U	**1.9 J**	0.11 U	0.11 U	0.11 U
gamma-BHC	---	---	---	0.078 U	0.077 U	**2.8**	0.078 UJG	0.076 U	0.11 U	0.076 U	0.12 U	0.11 U	**0.4 J**	**0.48 JTG**	0.11 U	0.074 U	0.11 U	**0.95 J**	0.11 U	0.11 U	0.075 U	0.075 U	**0.51 J**
Heptachlor	---	---	---	0.47 U	0.46 U	0.46 U	0.46 UJG	0.45 U	0.13 U	0.45 U	0.14 U	0.13 U	0.46 U	0.45 UJG	0.13 U	0.44 U	**0.22 JTG**	0.46 U	0.13 U	0.13 U	0.45 U	0.45 U	0.45 U
Petroleum Hydrocarbons (mg/kg dry weight)																							
Gasoline	---	---	---		65 U																		
Diesel Range	---	---	---		160 U																		
Motor Oil	---	---	---		320 U																		
Dioxins/Furans (ng/kg dry weight)																							
DX TOTAL (TEQ ND=1/2 DL)	---	---	---		**50.8**		**53.7**		**47.4**		**28.8**		**31.8**	**37.9**	**5.16**		**3.8**		**29.8**		**2.08**		**36**
1,2,3,4,6,7,8-HPCDD	---	---	---		**1,230**		**1,420**		**1,810**		**712**		**717**	**820 B**	**113**		**83.7**		**654**		**45.4**		**649 B**
1,2,3,4,6,7,8-HPCDF	---	---	---		**447**		**393**		**197**		**217**		**298**	**330 B**	**37.5**		**29.2**		**262**		**18.7**		**204 B**
1,2,3,4,7,8,9-HPCDF	---	---	---		**24.8**		**22.2**		**11**		**13.5**		**16.1**	**16.7**	**2.42**		**1.53**		**15.3**		**1.07**		**12.4**
1,2,3,4,7,8-HXCDD	---	---	---		**13.4**		**15.7**		**9.27**		**7.04**		**8.19**	**9.34**	**1.88**		**1.34**		**6.82**		**0.606**		**9.84**
1,2,3,4,7,8-HXCDF	---	---	---		**39.4**		**33.4**		**22.5**		**22**		**26.5**	**26.2**	**3.16**		**2.32**		**27.1**		**1.56**		**25.5**
1,2,3,6,7,8-HXCDD	---	---	---		**62.8**		**70.8**		**61.6**		**36.1**		**42.3**	**48.5**	**6.56**		**5.48**		**40.3**		**2.6**		**48.4**
1,2,3,6,7,8-HXCDF	---	---	---		**12.9**		**11.4**		**7.18**		**7.13**		**8.21**	**9.18**	**1.29**		**0.878**		**7.86**		**0.595**		**8.77**
1,2,3,7,8,9-HXCDD	---	---	---		**35.9**		**43.2**		**39.5**		**28.6**		**22.1**	**26.9**	**5.34**		**3.48**		**21.8**		**1.85**		**31.1**
1,2,3,7,8,9-HXCDF	---	---	---		**1.1**		**1.02**		**0.792**		**0.611 J**		**0.666**	**0.715**	**0.111 J**		**0.075 J**		**0.66**		**0.052 J**		**0.785**
1,2,3,7,8-PECDD	---	---	---		**7.26**		**8.34**		**4.23**		**3.93 J**		**5.01**	**6.82**	**0.951**		**0.657**		**4.39**		**0.339 J**		**7.39**
1,2,3,7,8-PECDF	---	---	---		**5.29**		**5.62**		**4.18**		**2.65 J**		**3.25**	**4.12**	**0.433 J**		**0.373 J**		**3.14**		**0.179 J**		**4.56**
2,3,4,6,7,8-HXCDF	---	---	---		**10.6**		**11**		**7.41**		**6.2**		**7.51**	**8.07**	**1.02**		**0.896**		**6.41**		**0.5 J**		**7.39**
2,3,4,7,8-PECDF	---	---	---		**7.88**		**7.56**		**5.81**		**4.27 J**		**5.22**	**6.23**	**0.602**		**0.488**		**5.74**		**0.279 J**		**8.02**
2,3,7,8-TCDD	---	---	---		**1.62**		**1.72**		**0.885**		**1.19**		**1.05**	**1.59**	**0.211**		**0.143**		**0.813**		**0.073 J**		**1.84**
2,3,7,8-TCDF	---	---	---		**5.35**		**5.08 J**		**4.59**		**2.3 J**		**2.92 J**	**4.01**	**0.325 J**		**0.284 J**		**3.89**		**0.163**		**5.51**
OCDD	---	---	---		**12,400 B**		**12,900 B**		**16,100 B**		**6,340 B**		**6,430 B**	**7,400 B**	**1,030 B**		**756 B**		**5,860 B**		**394 B**		**5,720 B**
OCDF	---	---	---		**1,750**		**1,230**		**490**		**634**		**1,030**	**1,020 B**	**105**		**80.2**		**735**		**50**		**586 B**

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor																			
				SH-19-WC-12	SH-20-WS-00 [d]	SH-20-WC-12	SH-21-WS-00 [d]	SH-21-WC-12 [d]	SH-22-WS-00 [d]	SH-22-WC-12	SH-23-WS-00	SH-23-WC-12 [d]	SH-24-WS-00 [d]	SH-25-WS-00	SH-26-WS-00	SH-26-WC-12 [d]	SH-27-WS-00	SH-27-WC-12	SH-28-WS-00	SH-28-WC-12	SH-29-WS-00	SH-29-WC-12	SH-30-WS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
TOTAL HEPTA-DIOXINS	---	---	---		**3,080**		**4,450**		**10,200**		**2,280**		**1,750**	**2,120 B**	**283**		**204**		**1,600**		**109**		**2,090 B**
TOTAL HEPTA-FURANS	---	---	---		**1,810**		**1,500**		**744**		**776**		**1,160**	**1,230 B**	**132**		**98.1**		**931**		**61.3**		**836 B**
TOTAL HEXA-DIOXINS	---	---	---		**898**		**1,180**		**1,130**		**570**		**527**	**655**	**121**		**92.8**		**646**		**39.5**		**924**
TOTAL HEXA-FURANS	---	---	---		**605**		**553**		**400**		**342**		**429**	**456**	**48.1**		**37.1**		**434**		**24.4**		**439**
TOTAL PENTA-DIOXINS	---	---	---		**391**		**574**		**182**		**215**		**259**	**293**	**67.9**		**54**		**248**		**13.6**		**400**
TOTAL PENTA-FURANS	---	---	---		**165**		**163**		**129**		**102**		**119**	**143**	**14.4**		**11.7**		**143**		**7.25**		**195**
TOTAL TETRA-DIOXINS	---	---	---		**367**		**545**		**169**		**163**		**247**	**262**	**61.5**		**40.8**		**263**		**9.78**		**441**
TOTAL TETRA-FURANS	---	---	---		**131**		**132**		**72.8**		**63.1**		**78.9**	**94.9**	**10**		**7.09**		**87.3**		**3.74**		**158**
Guaicols and Resin Acids (ug/kg dry weight)																							
12-Chlorodehydroabietic Acid	---	---	---	99 U	300 U	290 U	100 U	220 UJ	99 U	480 U	98 U	99 U	290 U	98 U	97 U	98 U	98 U	97 U	98 U	99 U	96 U	97 U	290 U
14-Chlorodehydroabietic Acid	---	---	---	99 U	300 U	290 U	100 U	220 UJ	99 U	480 U	98 U	99 U	290 U	98 U	97 U	98 U	98 U	97 U	98 U	99 U	96 U	97 U	290 U
3,4,5-Trichloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
3,4,6-Trichloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
3,4-Dichloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
4,5,6-Trichloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
4,5-Dichloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
4,6-Dichloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
4-Chloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
9,10-Dichlorostearic Acid	---	---	---	99 U	300 U	290 U	100 U	220 UJ	99 U	480 U	98 U	99 U	290 U	98 U	97 U	98 U	98 U	97 U	98 U	99 U	96 U	97 U	290 U
Abietic Acid	---	---	---	**960**	**840**	**2,600**	**1,900**	**38,000 J**	**3,300**	**13,000**	**1,100**	**1,000**	**3,000**	**1,300**	**210**	98 U	**120**	**8,500**	**600**	**1,600**	96 U	**230**	**710**
Dehydroabietic Acid	---	---	---	**460**	**1,200**	**1,400**	**1,600**	**22,000 J**	**3,200**	**5,300**	**740**	**530**	**4,200**	**1,800**	**120**	98 U	98 U	**7,500**	**710**	**360**	96 U	**110**	**580**
Dichlorodehydroabietic Acid	---	---	---	99 U	300 U	290 U	100 U	220 UJ	99 U	480 U	98 U	99 U	290 U	98 U	97 U	98 U	98 U	97 U	98 U	99 U	96 U	97 U	290 U
Guaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
Isopimaric Acid	---	---	---	**140**	300 U	**290 J**	100 U	**3,700 J**	**540**	**2,400**	**130**	**120**	**520**	**340**	97 U	98 U	98 U	**3,300**	**100**	99 U	96 U	97 U	290 U
Linolenic Acid	---	---	---	99 U	300 U	290 U	**180**	**1,000 J**	99 U	480 U	**190**	99 U	290 U	**160**	97 U	98 U	98 U	**150**	**160**	99 U	96 U	97 U	**290 J**
Neoabietic Acid	---	---	---	99 UJ	300 UJ	290 UJ	100 UJ	**280 J**	99 U	480 UJ	98 U	99 U	290 UJ	98 UJ	97 U	98 UJ	98 U	97 UJ	98 U	99 U	96 UJ	97 UJ	290 UJ
Oleic Acid	---	---	---	99 U	300 U	290 U	**450**	**820 J**	**310**	480 U	**320**	**140**	**650**	**240**	**200**	98 U	**150**	**190**	**280**	**140**	**300**	97 U	**370**
Palustric Acid	---	---	---	99 U	300 U	290 U	100 U	220 U	99 U	**600**	98 U	99 U	290 U	98 U	97 U	98 U	98 U	**530**	98 U	99 U	96 U	97 U	290 U
Pimaric Acid	---	---	---	99 U	300 U	290 U	100 U	**220 J**	99 U	480 U	98 U	99 U	290 U	98 U	97 U	98 U	98 U	97 U	98 U	99 U	96 U	97 U	290 U
Retene	---	---	---	**220**	**26**	**21,000**	**230**	**220 J**	**36**	**16,000**	**10**	**30**	**640**	**62**	8.7 U	20 U	8.9 U	**50**	**18**	**15**	19 U	20 U	20 U
Sandaracopimaric Acid	---	---	---	99 U	300 U	290 U	**1,300**	**1,300 J**	99 U	480 U	98 U	99 U	290 U	98 U	97 U	98 U	98 U	**570**	98 U	99 U	96 U	97 U	290 U
Tetrachloroguaiacol	---	---	---	20 U	20 U	20 U	20 U	50 U	20 U	19 U	20 U	20 U	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	20 U	20 U
Total resin acids [c]	---	---	---	**1,800**	**2,100**	**25,000**	**5,700**	**68,000**	**7,400**	**38,000**	**2,500**	**1,800**	**9,000**	**3,900**	**530**	98 U	**270**	**21,000**	**1,900**	**2,100**	**300**	**340**	**2,000**

[a] Lowest and second lowest apparent effects thresholds for freshwater sediments in Washington State 2003).

[b] Washington State Marine Sediment Management Standards, Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) (WAC Chapter 173-204).

[c] Totals only include detected and estimated values

[d] Sample has organic carbon content less than 0.5 percent or greater than 4.0 percent and should be compared to LAET criteria rather than organic-carbon normalized SMS criteria.

ng/kg	nanograms per kilogram
µg/kg	micrograms per kilogram.
mg/kg	milligrams per kilogram.
PCBs	polychlorinated biphenyls.

Bold type indicates the sample result is greater than the laboratory detection limit.

Underlined	value indicates the sample result or detection limit is greater than the LAET or SQS value.
Shaded	value indicates the sample result or detection limit is greater than the CSL value.
U	The material was analyzed for, but was not detected. The associated numerical value is the detection limit. For petroleum hydrocarbons, guaiacols and resin acids, the associated numerical value is the reporting limit.
J	The associated numerical value is considered an estimated concentration.
G	Bias is high.
B	Specifyied compound was detected in the associated method blank.

LPAH represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH sum.

HPAH represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total benzofluoranthenes represents the sum of the concentrations of the "b" and "k" isomers.

Total PAHs (carcinogenic) represents the sum of the following PAH compounds: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene.

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor	Oakland Bay																
				SH-30-WC-12	OB-01-SS-00	OB-01-SC-12 [d]	OB-02-SS-00	OB-02-SC-12	OB-03-SS-00	OB-03-SC-12	OB-04-SS-00	OB-04-SC-12	OB-05-SS-00	OB-05-SC-12	OB-06-SS-00 [d]	OB-06-SC-12	OB-07-SS-00	OB-07-SC-12	OB-08-SS-00	OB-08-SC-12	OB-09-SS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
Conventional Parameters																					
Particle/Grain Size, Fines (Silt/Clay)	---	---	---	54.3	11.9	3.1	31.1	61.6	69.5	67.6	42.6	54.3	71.6	67.2	96.9	87.2	16.9	21.2	87.4	62	87.8
Particle/Grain Size, Phi Scale <-1	---	---	---	0.5	17.9	66.5	0.1	0.3	6	0.8	0.7	2.5	2.1	1	0.5	0.7	24.4	45.6	0.4	13.8	3.5
Particle/Grain Size, Phi Scale >10	---	---	---	10.5	2.2		6.6	11.4	13.5	13.8	5.1	10.3	12.4	11.4	9.2	14.4	2.9	3.2	12.8	12.7	13.4
Particle/Grain Size, Phi Scale 0 to 1	---	---	---	0.9	16.5	7.6	1.4	0.5	4	1.3	1.8	1.3	3.4	1.7	0.3	2.3	4	3.4	1.7	4.1	1.6
Particle/Grain Size, Phi Scale -1 to 0	---	---	---	0.6	12	10.4	0.8	0.5	5.1	1.1	0.8	0.9	3	1.7	0.2	4.6	3.6	3.5	1.3	2.2	2.9
Particle/Grain Size, Phi Scale 1 to 2	---	---	---	1.4	27.7	8.9	2.2	0.8	3	1.5	3.6	1.7	3.7	2.3	0.2	1.1	11.7	8.3	1.6	7.4	1
Particle/Grain Size, Phi Scale 2 to 3	---	---	---	10	10.4	2.7	21.1	10.6	2.4	5.4	13.4	11.6	4.1	7.1	0.3	1	22.2	9.4	2.2	5.1	0.8
Particle/Grain Size, Phi Scale 3 to 4	---	---	---	32.3	3.6	0.9	43.3	25.6	10.1	22.2	37	27.6	12.1	19	1.6	3.2	17.2	8.6	5.5	5.3	2.3
Particle/Grain Size, Phi Scale 4 to 5	---	---	---	9.8	1.9		6.1	7.6	8.1	13	13.3	8.2	7.2	9.4	10.8	10.9	4.3	6.8	13.4	4.9	5.5
Particle/Grain Size, Phi Scale 5 to 6	---	---	---	7.2	1.1		3.3	6.7	10.1	9.1	14.9	6.4	12.2	11.1	24.3	15.2	2.4	2.6	18.7	8.9	18.1
Particle/Grain Size, Phi Scale 6 to 7	---	---	---	7.1	1.5		3.4	8	10.7	8.9	3.3	7.7	14.9	9	22.4	15.7	1.9	2.5	16.5	11	21.7
Particle/Grain Size, Phi Scale 7 to 8	---	---	---	7.7	1.8		4.4	9.3	10.9	9.4	1.9	8.1	9.4	9.7	13.1	12.3	1.9	2.4	10.7	11.3	12.1
Particle/Grain Size, Phi Scale 8 to 9	---	---	---	6.4	1.6		3.9	9.7	8.4	6.6	1.9	7.3	8.1	8.5	11	10.3	1.8	2.1	8.1	7.4	9.1
Particle/Grain Size, Phi Scale 9 to 10	---	---	---	5.6	1.7		3.4	8.7	7.8	6.8	2.1	6.3	7.5	8	6.2	8.5	1.7	1.7	7.3	5.8	8
Total Volatile Solids %	---	---	---	4.76																	
Ammonia (mg/kg)	---	---	---	45.1	15.1	0.18	4.79	40	11.7	13.5	8.52	58.6	11.6	36.3	9.47	0.03 U	9.34	6	8.22	7.38	10.8
Sulfide	---	---	---	19.3	6.83	0.01 U	489	216	1,240	241	599	216	761	555	1,190	351	0.01 U	141	167	0.01 U	1,530
Total organic carbon (%)	---	---	---	0.736	0.878	0.164	1.4	1.15	2.79	2.64	3.45	1.55	2.35	2.94	4.68	2.09	0.995	0.986	1.36	1.38	2.69
Total solids (%)	---	---	---	55.4	69.1	85.6	55.7	49	35.4	45.8	49.1	56.4	35.3	45.4	34.7	80.9	63.7	71.5	46.3	57	31.5
Metals (mg/kg dry weight)																					
Antimony	150	---	---	0.33 J	0.23 J		0.25 J		0.35 J		0.26 J		0.39 J		0.31 J		0.14 J		0.27 J		0.18 J
Arsenic	57	57	93	4.8	4.7		6.1		6.9		7.2		5.3		7.3		3.6		6.6		3.6
Cadmium	5.1	5.1	6.7	0.78	0.36		0.64		0.87		0.74		0.71		0.96		0.2 J		0.37 J		0.44
Chromium	260	260	270	37	29		37		46		33		36		47		28		46		24
Copper	390	390	390	26	18		26		43		26		34		47		19		34		23
Lead	450	450	530	3.5	4.1		7.2		13		8.1		10		15		5.2		11		7.1
Mercury	0.41	0.41	0.59	0.026 J	0.017 J		0.053		0.08		0.038		0.056		0.057 J		0.014 J		0.063		0.025 J
Nickel	140	---	---	35	22		36		43		31		33		42		24		37		21
Silver	6.1	6.1	6.1	0.16 J	0.037 J		0.089 J		0.16 J		0.097 J		0.34 J		0.21 J		0.065 J		0.14 J		0.1 J
Zinc	410	410	960	45	55		69		95		70		74		97		45		75		50
Butyltins (ug/kg dry weight)																					
Butyltin Ion	---	---	---	3.8 U																	
Dibutyltin Ion	---	---	---	3.0 U																	
Tributyltin Ion	---	---	---	1.7 U																	
Aromatic Hydrocarbons (ug/kg dry weight or mg/kg OC)																					
LPAHs																					
2-Methylnaphthalene (dry)	670	---	---	8.1 U	8.1 U		8.1 U		8.1 U		8.1 U		8.1 U		8.1 U		8.0 U		8.0 U		8.1 U
2-Methylnaphthalene (OC)	---	38	64	1.1 U	0.92 U		0.58 U		0.29 U		0.23 U		0.34 U		0.17 U		0.80 U		0.59 U		0.30 U
Acenaphthene (dry)	500	---	---	8.1 U	8.1 U		8.1 U		8.1 U		8.1 U		8.1 U		8.1 U		8.0 U		8.0 U		8.1 U
Acenaphthene (OC)	---	16	57	1.1 U	0.92 U		0.58 U		0.29 U		0.23 U		0.34 U		0.17 U		0.80 U		0.59 U		0.30 U
Acenaphthylene (dry)	560	---	---	8.6 U	8.6 U		8.5 U		8.5 U		8.6 U		8.6 U		8.5 U		8.5 U		8.5 U		8.6 U
Acenaphthylene (OC)	---	66	66	1.2 U	1.0 U		0.61 U		0.30 U		0.25 U		0.37 U		0.18 U		0.85 U		0.63 U		0.32 U
Anthracene (dry)	960	---	---	7.7 U	7.7 U		7.6 U		7.6 U		7.7 U		7.7 U		7.6 U		7.6 U		7.6 U		7.7 U
Anthracene (OC)	---	220	1,200	1.0 U	0.88 U		0.54 U		0.27 U		0.22 U		0.33 U		0.16 U		0.76 U		0.56 U		0.29 U
Fluorene (dry)	540	---	---	8.9 U	8.9 U		8.8 U		8.8 U		8.9 U		8.9 U		8.8 U		8.8 U		8.8 U		8.9 U
Fluorene (OC)	---	23	79	1.2 U	1.0 U		0.63 U		0.32 U		0.26 U		0.38 U		0.19 U		0.88 U		0.65 U		0.33 U
Naphthalene (dry)	2,100	---	---	8.6 U	8.6 U		8.5 U		8.6 U		8.6 U		8.6 U		8.6 U		8.5 U		8.5 U		8.6 U
Naphthalene (OC)	---	99	170	1.2 U	1.0 U		0.61 U		0.31 U		0.25 U		0.37 U		0.18 U		0.85 U		0.63 U		0.32 U
Phenanthrene (dry)	1500	---	---	8.3 U	8.3 U		8.3 U		8.3 U		51		8.3 U		8.3 U		25		8.2 U		8.3 U
Phenanthrene (OC)	---	100	480	1.1 U	0.95 U		0.59 U		0.30 U		1.5		0.35 U		0.18 U		2.5		0.60 U		0.31 U
Total LPAHs (dry) [c]	5200	---	---	20 U	20 U		20 U		20 U		51		20 U		20 U		25		20 U		20 U
Total LPAHs (OC) [c]	---	370	780	2.7 U	2.3 U		1.4 U		0.72 U		1.5		0.85 U		0.43 U		2.5		1.5 U		0.74 U
HPAHs																					
Benzo(a)anthracene (dry)	1,300	---	---	5.9 U	5.9 U		5.8 U		5.8 U		24		5.9 U		5.8 U		18 J		5.8 U		5.9 U
Benzo(a)anthracene (OC)	---	110	270	0.80 U	0.67 U		0.41 U		0.21 U		0.70		0.25 U		0.12 U		1.8 J		0.43 U		0.22 U
Benzo(a)pyrene (dry)	1,600	---	---	8.1 U	8.1 U		8.0 U		8.0 U		8.1 U		8.1 U		8.1 U		15 J		8.0 U		8.1 U
Benzo(a)pyrene (OC)	---	99	210	1.1 U	0.92 U		0.57 U		0.29 U		0.23 U		0.34 U		0.17 U		1.5 J		0.59 U		0.30 U
Benzo(b)fluoranthene (dry)	---	---	---	9.4 U	9.4 U		9.4 U		9.4 U		9.4 U		9.4 U		9.4 U		9.8 J		9.3 U		9.4 U
Benzo(b)fluoranthene (OC)	---	---	---	1.3 U	1.1 U		0.67 U		0.34 U		0.27 U		0.40 U		0.20 U		1.0 J		0.68 U		0.35 U
Benzo(g,h,i)perylene (dry)	670	---	---	6.7 U	6.7 U		6.6 U		6.7 U		6.7 U		6.7 U		6.7 U		6.6 U		6.6 U		6.7 U
Benzo(g,h,i)perylene (OC)	---	31	78	0.91 U	0.76 U		0.47 U		0.24 U		0.19 U		0.29 U		0.14 U		0.66 U		0.49 U		0.25 U
Benzo(k)fluoranthene (dry)	---	---	---	9.2 U	9.2 U		9.1 U		9.1 U		9.2 U		9.2 U		9.1 U		18 J		9.1 U		9.2 U
Benzo(k)fluoranthene (OC)	---	---	---	1.3 U	1.0 U		0.65 U		0.33 U		0.27 U		0.39 U		0.19 U		1.8 J		0.67 U		0.34 U
Benzofluoranthenes, Total (b+k+j) (dry)	3,200	---	---	20 U	20 U		20 U		20 U		20 U		20 U		20 U		28 J		20 U		20 U
Benzofluoranthenes, Total (b+k+j) (OC)	---	230	450	2.7 U	2.3 U		1.4 U		0.72 U		0.58 U		0.85 U		0.43 U		2.8 J		1.5 U		0.74 U
Chrysene (dry)	1,400	---	---	6.6 U	6.6 U		11 J		15 J		25		6.6 U		6.6 U		21		6.5 U		6.6 U
Chrysene (OC)	---	110	460	0.90 U	0.75 U		0.8 J		0.54 J		0.72		0.28 U		0.14 U		2.1		0.48 U		0.25 U
Dibenz(a,h)anthracene (dry)	230	---	---	8.5 U	8.5 U		8.4 U		8.4 U		8.5 U		8.5 U		8.4 U		8.4 U		8.4 U		8.5 U
Dibenz(a,h)anthracene (OC)	---	12	33	1.2 U	1.0 U		0.60 U		0.30 U		0.25 U		0.36 U		0.18 U		0.84 U		0.62 U		0.32 U
Fluoranthene (dry)	1,700	---	---	7.8 U	7.8 U		20 U		13 J		48		7.8 U		7.8 U		36		7.7 U		7.8 U
Fluoranthene (OC)	---	160	1,200	1.1 U	0.89 U		1.4 U		0.47 J		1.4		0.33 U		0.17 U		3.6		0.57 U		0.29 U
Indeno(1,2,3-cd)pyrene (dry)	600	---	---	8.5 U	8.5 U		16 J		8.5 U		8.5 U		8.5 U		8.5 U		8.4 U		8.4 U		8.5 U
Indeno(1,2,3-cd)pyrene (OC)	---	34	88	1.2 U	1.0 U		1.1 J		0.30 U		0.25 U		0.36 U		0.18 U		0.84 U		0.62 U		0.32 U
Pyrene (dry)	2,600	---	---	7.7 U	7.7 U		10 J		17 J		61		7.7 U		7.7 U		33		7.6 U		7.7 U
Pyrene (OC)	---	1,000	1,400	1.0 U	0.88 U		0.71 J		0.61 J		1.8		0.33 U		0.16 U		3.3		0.56 U		0.29 U
Total HPAHs (dry) [c]	12,000	---	---	20 U	20 U		37 J		45 J		160		20 U		20 U		151		20 U		20 U
Total HPAHs (OC) [c]	---	960	5,300	2.7 U	2.3 U		2.6 J		1.6 J		4.6		0.85 U		0.43 U		15		1.5 U		0.74 U

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Shelton Harbor	Oakland Bay																
				SH-30-WC-12	OB-01-SS-00	OB-01-SC-12 [d]	OB-02-SS-00	OB-02-SC-12	OB-03-SS-00	OB-03-SC-12	OB-04-SS-00	OB-04-SC-12	OB-05-SS-00	OB-05-SC-12	OB-06-SS-00 [d]	OB-06-SC-12	OB-07-SS-00	OB-07-SC-12	OB-08-SS-00	OB-08-SC-12	OB-09-SS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm
Chlorinated Benzenes (ug/kg dry weight or mg/kg OC)																					
1,2,4-Trichlorobenzene (dry)	31	---	---	9.0 U	9.0 U		8.9 U		8.9 U		9.0 U		9.0 U		9.0 U		8.9 U		8.9 U		9.0 U
1,2,4-Trichlorobenzene (OC)	---	0.81	1.8	1.2 U	1.0 U		0.64 U		0.32 U		0.26 U		0.38 U		0.19 U		0.89 U		0.65 U		0.33 U
1,2-Dichlorobenzene (dry)	35	---	---	7.8 U	7.8 U		7.7 U		7.8 U		7.8 U		7.8 U		7.8 U		7.7 U		7.7 U		7.8 U
1,2-Dichlorobenzene (OC)	---	2.3	2.3	1.1 U	0.89 U		0.55 U		0.28 U		0.23 U		0.33 U		0.17 U		0.77 U		0.57 U		0.29 U
1,4-Dichlorobenzene (dry)	110	---	---	7.3 U	7.3 U		7.2 U		7.3 U		7.3 U		7.3 U		7.3 U		7.2 U		7.2 U		7.3 U
1,4-Dichlorobenzene (OC)	---	3.1	9	1.0 U	0.83 U		0.51 U		0.26 U		0.21 U		0.31 U		0.16 U		0.72 U		0.53 U		0.27 U
Phthalates (ug/kg dry weight or mg/kg OC)																					
bis(2-Ethylhexyl)phthalate (dry)	1,300	---	---	**13 J**	11 U		**16 J**		**18 J**		11 U		11 U		11 U		11 U		11 U		11 U
bis(2-Ethylhexyl)phthalate (OC)	---	47	78	**1.8 J**	1.3 U		**1.1 J**		**0.6 J**		0.32 U		0.47 U		0.24 U		1.1 U		0.81 U		0.41 U
Butylbenzylphthalate (dry)	63	---	---	11 U	11 U		11 U		11 U		11 U		11 U		11 U		11 U		11 U		11 U
Butylbenzylphthalate (OC)	---	4.9	64	1.5 U	1.3 U		0.79 U		0.39 U		0.32 U		0.47 U		0.24 U		1.1 U		0.81 U		0.41 U
Di-n-Butylphthalate (dry)	1400	---	---	12 U	12 U		12 U		12 U		12 U		12 U		12 U		12 U		12 U		12 U
Di-n-Butylphthalate (OC)	---	220	1,700	1.6 U	1.4 U		0.86 U		0.43 U		0.35 U		0.51 U		0.26 U		1.2 U		0.88 U		0.45 U
Di-n-Octyl phthalate (dry)	6200	---	---	8.2 U	8.3 U		8.2 U		8.2 U		8.3 U		8.3 U		8.2 U		8.2 U		8.2 U		8.3 U
Di-n-Octyl phthalate (OC)	---	58	4,500	1.1 U	0.95 U		0.59 U		0.29 U		0.24 U		0.35 U		0.18 U		0.82 U		0.60 U		0.31 U
Diethylphthalate (dry)	200	---	---	16 U	16 U		16 U		16 U		16 U		16 U		16 U		16 U		16 U		16 U
Diethylphthalate (OC)	---	61	110	2.2 U	1.8 U		1.1 U		0.57 U		0.46 U		0.68 U		0.34 U		1.6 U		1.2 U		0.59 U
Dimethylphthalate (dry)	71	---	---	7.7 U	7.7 U		7.6 U		7.6 U		7.70 U		7.7 U		7.7 U		7.6 U		7.6 U		7.7 U
Dimethylphthalate (OC)	---	53	53	1.0 U	0.88 U		0.54 U		0.27 U		0.22 U		0.33 U		0.16 U		0.76 U		0.56 U		0.29 U
Ionizable Organic Compounds (ug/kg dry weight)																					
2,4-Dimethylphenol	29	29	29	15 U	15 U		15 U		15 U		15 U		15 U		15 U		14 U		14 U		15 U
Benzoic Acid	650	650	650	110 U	110 U		110 U		110 U		110 U		110 U		110 U		110 U		110 U		110 U
Benzyl Alcohol	57	57	73	14 U	14 U		14 U		14 U		14 U		14 U		14 U		14 U		14 U		14 U
Pentachlorophenol	360	360	690	47 U	47 U		47 U		47 U		47 U		47 U		47 U		47 U		47 U		47 U
Phenol	420	420	1,200	14 U	**150**		13 U		**23**		14 U		14 U		14 U		**63**		13 U		14 U
Miscellaneous Extractables (ug/kg dry weight or mg/kg OC)																					
Dibenzofuran (dry)	540	---	---	7.5 U	7.5 U		7.4 U		7.4 U		7.5 U		7.5 U		7.5 U		7.4 U		7.4 U		7.5 U
Dibenzofuran (OC)	---	15	58	1.0 U	0.85 U		0.53 U		0.27 U		0.22 U		0.32 U		0.16 U		0.74 U		0.54 U		0.28 U
Hexachlorobenzene (dry)	22	---	---	7.9 U	7.9 U		7.9 U		7.9 U		8 U		7.9 U		7.9 U		7.8 U		7.8 U		7.9 U
Hexachlorobenzene (OC)	---	0.38	2.3	1.1 U	0.90 U		0.56 U		0.28 U		0.23 U		0.34 U		0.17 U		0.78 U		0.57 U		0.29 U
Hexachlorobutadiene (dry)	11	---	---	8.0 U	8.0 U		8.0 U		8.0 U		8.0 U		8.0 U		8.0 U		7.9 U		7.9 U		8.0 U
Hexachlorobutadiene (OC)	---	3.9	6.2	1.1 U	0.91 U		0.57 U		0.29 U		0.23 U		0.34 U		0.17 U		0.79 U		0.58 U		0.30 U
N-Nitrosodiphenylamine (dry)	28	---	---	8.6 U	8.6 U		8.5 U		8.6 U		8.6 U		8.6 U		8.6 U		8.5 U		8.5 U		8.6 U
N-Nitrosodiphenylamine (OC)	---	11	11	1.2 U	1.0 U		0.61 U		0.31 U		0.25 U		0.37 U		0.18 U		0.85 U		0.63 U		0.32 U
2-Methylphenol	---	63	63	14 U	14 U		14 U		14 U		14 U		14 U		14 U		14 U		14 U		14 U
4-Methylphenol	---	670	670	13 U	13 U		13 U		**43**		13 U		13 U		13 U		13 U		13 U		13 U
Polychlorinated Biphenyls (ug/kg dry weight or mg/kg OC)																					
Total PCBs (OC) [c]	---	12	65	0.54 UJ	0.44 UJ		0.28 UJ		0.14 UJ		0.11 UJ		0.17 UJ		0.085 UJ		0.36 UJ		0.29 UJ		0.17 UJ
Total PCBs (dry) [c]	130	---	---	4 UJ	3.9 UJ		3.9 UJ		4.0 UJ		3.9 UJ		4.0 UJ		4.0 UJ		3.6 UJ		3.9 UJ		4.6 UJ
Aroclor 1016	---	---	---	1.6 UJ	1.5 UJ		1.5 UJ		1.6 UJ		1.6 UJ		1.6 UJ		1.6 UJ		1.5 UJ		1.6 UJ		1.8 UJ
Aroclor 1221	---	---	---	4 UJ	3.9 UJ		3.9 UJ		4.0 UJ		3.9 UJ		4.0 UJ		4.0 UJ		3.6 UJ		3.9 UJ		4.6 UJ
Aroclor 1232	---	---	---	3.5 UJ	3.4 UJ		3.4 UJ		3.5 UJ		3.5 UJ		3.5 UJ		3.5 UJ		3.2 UJ		3.5 UJ		4.0 UJ
Aroclor 1242	---	---	---	1.1 UJ	1.0 UJ		1.0 UJ		1.0 UJ		1.0 UJ		1.1 UJ		1.0 UJ		0.96 UJ		1.0 UJ		1.2 UJ
Aroclor 1248	---	---	---	0.65 UJ	0.63 UJ		0.63 UJ		0.64 UJ		0.64 UJ		0.66 UJ		0.65 UJ		0.59 UJ		0.64 UJ		0.75 UJ
Aroclor 1254	---	---	---	1.1 UJ	1.0 UJ		1.0 UJ		1.0 UJ		1.0 UJ		1.1 UJ		1.0 UJ		0.96 UJ		1.0 UJ		1.2 UJ
Aroclor 1260	---	---	---	1.5 UJ	1.5 UJ		1.4 UJ		1.5 UJ		1.5 UJ		1.5 UJ		1.5 UJ		1.4 UJ		1.5 UJ		1.7 UJ
Chlorinated Pesticides (ug/kg dry weight)																					
4,4'-DDD	16	---	---	**0.68 J**	0.14 U		**0.36 J**		0.14 U		0.14 U		**0.31 J**		0.15 U		0.14 U		0.14 U		0.17 U
4,4'-DDE	9	---	---	**0.71 J**	**0.63 J**		**3.1 J**		0.14 U		0.14 U		0.14 U		0.14 U		0.13 U		0.14 U		0.16 U
4,4'-DDT	34	---	---	**1.6 J**	**3.3 J**		0.14 U		0.15 U		**5.6**		**0.31 J**		0.15 U		**3.3**		0.15 U		0.17 U
Aldrin	---	---	---	**0.74 J**	0.22 U		0.21 U		0.22 U		0.22 U		0.22 U		0.22 U		0.21 U		0.22 U		0.25 U
alpha-Chlordane	---	---	---	**0.9 J**	0.13 U		0.13 U		0.13 U		0.13 U		0.98 U		0.13 U		0.13 U		0.13 U		0.15 U
Dieldrin	---	---	---	0.12 U	0.12 U		0.11 U		0.12 U		0.12 U		0.12 U		0.12 U		**0.12 J**		0.12 U		0.13 U
gamma-BHC	---	---	---	**0.31 J**	0.077 U		0.073 U		0.077 U		0.076 U		**1.4 J**		0.078 U		0.074 U		0.077 U		0.089 U
Heptachlor	---	---	---	0.45 U	0.46 U		0.44 U		0.46 U		0.45 U		0.46 U		0.46 U		0.44 U		0.46 U		**1.1 J**
Petroleum Hydrocarbons (mg/kg dry weight)																					
Gasoline	---	---	---		30 UJG																
Diesel Range	---	---	---		76 UJG																
Motor Oil	---	---	---		150 UJG																
Dioxins/Furans (ng/kg dry weight)																					
DX TOTAL (TEQ ND=1/2 DL)	---	---	---		**4.44**		**16.6**		**29**	**82**	**27.2**		**27.6**		**43.3**	**180**	**8.72**		**37**		**38.5**
1,2,3,4,6,7,8-HPCDD	---	---	---		**97.4 B**		**345 B**		**664 B**	**1,910 B**	**467 B**		**634 B**		**965 B**	**4,470 B**	**181 B**		**856 B**		**849 B**
1,2,3,4,6,7,8-HPCDF	---	---	---		**36.8 B**		**133 B**		**256 B**	**921**	**186 B**		**246 B**		**405 B**	**2170**	**68.6 B**		**269 B**		**333 B**
1,2,3,4,7,8,9-HPCDF	---	---	---		**2.21**		**7.99**		**13.9**	**48.3 B**	**10.1**		**12.9**		**21.3**	**109 B**	**3.94**		**16.5**		**18.3**
1,2,3,4,7,8-HXCDD	---	---	---		**1.37**		**5.09**		**8.23**	**20.5**	**7.09**		**8.06**		**13.4**	**39.1**	**2.91**		**14**		**12.5**
1,2,3,4,7,8-HXCDF	---	---	---		**3.54**		**14.7**		**22.9**	**83.1**	**22.8**		**24.1**		**34.2**	**181**	**6.31**		**25.8**		**32**
1,2,3,6,7,8-HXCDD	---	---	---		**5.67**		**20.3**		**37.3**	**106**	**38.8**		**34**		**55.4**	**232**	**12.1**		**45.3**		**48.2**
1,2,3,6,7,8-HXCDF	---	---	---		**1.17**		**4.59**		**8.04**	**24.1**	**7.07**		**7.95**		**12**	**51.1**	**2.36**		**10.5**		**10.9**
1,2,3,7,8,9-HXCDD	---	---	---		**3.92**		**14.6**		**24.6**	**55.2**	**21.5**		**22.7**		**38.6**	**115**	**8.69**		**40**		**35.3**
1,2,3,7,8,9-HXCDF	---	---	---		**0.12 J**		**0.408 J**		**0.689**	**2.14**	**0.514**		**0.596**		**0.964**	**5.89**	**0.229 J**		**0.763**		**0.925**
1,2,3,7,8-PECDD	---	---	---		**0.749**		**2.8**		**4.41**	**10.7**	**5.44**		**4.26**		**6.83**	**20.8**	**1.58**		**6.84**		**6.2**
1,2,3,7,8-PECDF	---	---	---		**0.445 J**		**2.16**		**2.88**	**7.8**	**3.37**		**2.58**		**4.23**	**14.3**	**0.914**		**3.5**		**3.55**
2,3,4,6,7,8-HXCDF	---	---	---		**1.14**		**4.29**		**7.56**	**17.7**	**7.06**		**7.27**		**11.3**	**39.4**	**2.2**		**9.71**		**10.4**
2,3,4,7,8-PECDF	---	---	---		**0.566**		**2.84**		**3.95**	**12.6 B**	**5.99**		**3.76**		**5.62**	**23.7 B**	**1.15 B**		**4.5 B**		**4.83**
2,3,7,8-TCDD	---	---	---		**0.125**		**0.567**		**0.828**	**1.34 B**	**1.19**		**0.734**		**1.1**	**2.62 B**	**0.233**		**0.756**		**0.982**
2,3,7,8-TCDF	---	---	---		**0.387**		**2.19**		**2.41**	**6.67**	**3.87**		**2.25**		**3.06**	**11.8**	**0.692**		**2.8**		**2.85**
OCDD	---	---	---		**833 B**		**2,570 B**		**5,830 B**	**16,400 B**	**3,480 B**		**5,240 B**		**8,080 B**	**40,800 B**	**1,410 B**		**4,860 B**		**7,230 B**
OCDF	---	---	---		**112 B**		**350 B**		**783 B**	**2,320 B**	**488 B**		**759 B**		**1,230 B**	**6,010 B**	**171 B**		**529 B**		**938 B**

Parameter	Freshwater Sediment Apparent Effects Threshold[a] LAET	Marine Sediment Management Standard[b] SQS	CSL	Shelton Harbor SH-30-WC-12 1 to 2 ft	Oakland Bay OB-01-SS-00 0 to 10 cm	OB-01-SC-12 [d] 1 to 2 ft	OB-02-SS-00 0 to 10 cm	OB-02-SC-12 1 to 2 ft	OB-03-SS-00 0 to 10 cm	OB-03-SC-12 1 to 2 ft	OB-04-SS-00 0 to 10 cm	OB-04-SC-12 1 to 2 ft	OB-05-SS-00 0 to 10 cm	OB-05-SC-12 1 to 2 ft	OB-06-SS-00 [d] 0 to 10 cm	OB-06-SC-12 1 to 2 ft	OB-07-SS-00 0 to 10 cm	OB-07-SC-12 1 to 2 ft	OB-08-SS-00 0 to 10 cm	OB-08-SC-12 1 to 2 ft	OB-09-SS-00 0 to 10 cm
TOTAL HEPTA-DIOXINS	---	---	---		**233 B**		**923 B**		**1,640 B**	**4,390**	**1,340 B**		**1,550 B**		**2,230 B**	**10,300**	**471 B**		**2,550 B**		**2,020 B**
TOTAL HEPTA-FURANS	---	---	---		**127 B**		**518**		**932 B**	**3,960**	**700 B**		**864 B**		**1,520 B**	**8,880**	**228**		**886**		**1,140 B**
TOTAL HEXA-DIOXINS	---	---	---		**89.8**		**357**		**594**	**1,800**	**597**		**555**		**956**	**3760**	**194**		**949**		**818**
TOTAL HEXA-FURANS	---	---	---		**51**		**222**		**359**	**1,290**	**394**		**342**		**558**	**2850**	**95.9**		**400**		**460**
TOTAL PENTA-DIOXINS	---	---	---		**33.4**		**112**		**192**	**624**	**206**		**184**		**387**	**1170**	**69.5**		**326**		**303**
TOTAL PENTA-FURANS	---	---	---		**15**		**78.6**		**108**	**344**	**187**		**104**		**149**	**677**	**32.8**		**135**		**131**
TOTAL TETRA-DIOXINS	---	---	---		**23.9**		**82.7**		**146**	**487**	**228**		**149**		**277**	**832**	**42.5**		**233**		**212**
TOTAL TETRA-FURANS	---	---	---		**7.83**		**55.1**		**60.1**	**198**	**123**		**55.6**		**81.6**	**326**	**17.2**		**72.7**		**67.3**
Guaicols and Resin Acids (ug/kg dry weight)																					
12-Chlorodehydroabietic Acid	---	---	---	98 U			100 U						99 U		99 U						
14-Chlorodehydroabietic Acid	---	---	---	98 U			100 U						99 U		99 U						
3,4,5-Trichloroguaiacol	---	---	---	20 U																	
3,4,6-Trichloroguaiacol	---	---	---	20 U																	
3,4-Dichloroguaiacol	---	---	---	20 U																	
4,5,6-Trichloroguaiacol	---	---	---	20 U																	
4,5-Dichloroguaiacol	---	---	---	20 U																	
4,6-Dichloroguaiacol	---	---	---	20 U																	
4-Chloroguaiacol	---	---	---	20 U																	
9,10-Dichlorostearic Acid	---	---	---	98 U			100 U						99 U		99 U						
Abietic Acid	---	---	---	98 U			**770**						**130**		**120**						
Dehydroabietic Acid	---	---	---	**110**			**580**						99 U		99 U						
Dichlorodehydroabietic Acid	---	---	---	98 U			100 U						99 U		99 U						
Guaiacol	---	---	---	20 U																	
Isopimaric Acid	---	---	---	98 U			100 U						99 U		99 U						
Linolenic Acid	---	---	---	98 U			**100**						99 U		99 U						
Neoabietic Acid	---	---	---	98 UJ			100 U						99 U		99 U						
Oleic Acid	---	---	---	98 U			**1,800**						**870**		**1,100**						
Palustric Acid	---	---	---	98 U			100 U						99 U		99 U						
Pimaric Acid	---	---	---	98 U			100 U						99 U		99 U						
Retene	---	---	---	**19**																	
Sandaracopimaric Acid	---	---	---	98 U			100 U						99 U		99 U						
Tetrachloroguaiacol	---	---	---	20 U																	
Total resin acids [c]	---	---	---	**130**			**3,200**						**1,000**		**1,200**						

[a] Lowest and second lowest apparent effects thresholds for freshwater sediments in Washington State 2003).

[b] Washington State Marine Sediment Management Standards, Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) (WAC Chapter 173-204).

[c] Totals only include detected and estimated values

[d] Sample has organic carbon content less than 0.5 percent or greater than 4.0 percent and should be compared to LAET criteria rather than organic-carbon normalized SMS criteria.

ng/kg nanograms per kilogram

µg/kg micrograms per kilogram.

mg/kg milligrams per kilogram.

PCBs polychlorinated biphenyls.

Bold type indicates the sample result is greater than the laboratory detection limit.

Underlined value indicates the sample result or detection limit is greater than the LAET or SQS value.

Shaded value indicates the sample result or detection limit is greater than the CSL value.

U The material was analyzed for, but was not detected. The associated numerical value is the detection limit. For petroleum hydrocarbons, guaiacols and resin acids, the associated numerical value is the reporting limit.

J The associated numerical value is considered an estimated concentration.

G Bias is high.

B Specifyied compound was detected in the associated method blank.

LPAH represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH sum.

HPAH represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total benzofluoranthenes represents the sum of the concentrations of the "b" and "k" isomers.

Total PAHs (carcinogenic) represents the sum of the following PAH compounds: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene.

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Oakland Bay																	Hammersley Inlet	
				OB-09-SC-12	OB-10-SS-00	OB-10-SC-12	OB-11-SS-00	OB-11-SC-12	OB-12-SS-00	OB-12-SC-12	OB-13-SS-00	OB-13-SC-12	OB-14-SS-00	OB-14-SC-12	OB-17-WS-00	OB-17-WC-12	OB-18-WS-00	OB-18-WC-12 [d]	OB-19-WS-00	OB-19-WC-12 [d]	HI-01-SC-12 [d]	HI-02-SS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	1 to 2 ft	0 to 10 cm
Conventional Parameters																						
Particle/Grain Size, Fines (Silt/Clay)	---	---	---	83.7	84.2	82.9	44.1	13.9	91.6	85.6	66.2	59.7	24.5	18.1	21.2	32.5	82.6	72.3	92	88.7	38.4	6
Particle/Grain Size, Phi Scale <-1	---	---	---	0.8	3.1	0.5	30.2	51.9	0.1	1.2	20.9	3.9	35.4	30.4	1.3	1.9	0.1	7.1	0.1	2.4	49.7	8.1
Particle/Grain Size, Phi Scale >10	---	---	---	15.8	11.6	14.8	7.4	2.9	9.4	12.9	11.1	11.6	2.7	2.8	3.4	7.2	14.5	12.9	18.1	18.1	2.1	1.5
Particle/Grain Size, Phi Scale 0 to 1	---	---	---	1.4	1.8	3.3	3.7	10.3	1.3	1.8	1.4	1.6	7.3	8.1	1.6	1.9	3	2.3	1.5	1.5	2.1	11.8
Particle/Grain Size, Phi Scale -1 to 0	---	---	---	3.1	4.5	2.7	4.9	11	2.2	1.8	2.7	2.7	6.1	8.1	1.6	1.9	3.8	3.6	2.5	2	4.4	6.6
Particle/Grain Size, Phi Scale 1 to 2	---	---	---	1.2	1.4	2	8.3	7.6	0.8	2	1.4	2.3	14.3	22.2	2.2	2.8	1.7	2.5	0.9	1.2	2.9	33.5
Particle/Grain Size, Phi Scale 2 to 3	---	---	---	1.7	1.6	2	5.3	2.9	1.1	2.6	2	7.4	8.8	10.3	38.4	29.4	1.8	3.1	0.6	1.1	1.7	28.5
Particle/Grain Size, Phi Scale 3 to 4	---	---	---	8.1	3.4	6.6	3.5	2.4	2.7	4.9	5.3	22.5	3.6	2.8	33.7	29.5	7.1	9	2.4	3.2	0.8	5.5
Particle/Grain Size, Phi Scale 4 to 5	---	---	---	11.9	6.7	9.6	2.5	1	16.7	9.4	5.7	9.7	3.9	4.6	3.7	5.1	8.2	10.2	8.8	7.5	3.6	0.3
Particle/Grain Size, Phi Scale 5 to 6	---	---	---	12.7	23.4	12.8	7.8	1.2	22.3	12.3	11.9	7.4	5.9	2.5	2.9	3.8	13.5	10.8	14.1	14	6	0.8
Particle/Grain Size, Phi Scale 6 to 7	---	---	---	13	18.9	14	8.9	2	18.2	17.4	10.9	9.5	4.5	2.8	3.2	4.3	19.2	11	15.7	14.7	15	0.9
Particle/Grain Size, Phi Scale 7 to 8	---	---	---	11.3	9.9	13	6.6	2.7	11.6	14.1	11.6	8.5	3.6	2.2	3.1	4.3	12	9.7	16	12.5	7.7	0.9
Particle/Grain Size, Phi Scale 8 to 9	---	---	---	10.3	7	10.3	5.5	2.3	7.3	7.4	7.4	7.3	2.1	1.7	2.5	4.3	7	8.6	9.1	11.7	2.7	0.7
Particle/Grain Size, Phi Scale 9 to 10	---	---	---	8.8	6.8	8.5	5.4	1.8	6.1	12	7.6	5.6	1.7	1.4	2.5	3.6	8.2	9	10.3	10.2	1.3	0.8
Total Volatile Solids %	---	---	---												4.41	6.15	9.35	13.6	9.25	12.42		
Ammonia (mg/kg)	---	---	---	75.5	8.26	19.2	10.3	1.48	10.1	62.9	10.4	44.6	4.28	10.4	4.72	26.7	22.4	49.3	6.83	1.02	1.35	6.75
Sulfide	---	---	---	201	955	468	685	36.3	908	54.7	255	54.8	204	255	363	129 J	1,110	311	823	28.6	0.01 UJ	4.18
Total organic carbon (%)	---	---	---	2.47	2.62	2.87	2.32	0.659	2.26	2.96	3.53	3.12	1.71	3.53	2.39	1.75	2.86	4.74	2.6	0.045	0.232	0.571
Total solids (%)	---	---	---	44.8	31.4	39.6	39.6	58.8	36.7	43.4	32.3	48.8	62.6	76.5	61	59.8	32.2	39.2	35.6	39.9	82.5	76.1
Metals (mg/kg dry weight)																						
Antimony	150	---	---		0.26 J		0.25 J		0.26 J		0.25 J		0.12 J		0.21 J	0.19 J	0.35 J	0.39 J	0.27 J	0.43 J		0.12 J
Arsenic	57	57	93		5.3		5.3		7.1		5.3		3.3		5	4.2	6.9	7.3	5.9	9		3.9
Cadmium	5.1	5.1	6.7		0.53		0.39 J		0.56		0.48 J		0.24 J		0.49	0.46	0.85	0.77	0.74	1		0.11 U
Chromium	260	260	270		36		34		45		41		34		24	28	48	45	36	50		28
Copper	390	390	390		31		26		34		33		21		19	22	46	50	34	50		12
Lead	450	450	530		10		9.2		13		12		5.1		5.5	4.9	13	17	11	20		2.9
Mercury	0.41	0.41	0.59		0.06		0.021 J		0.086		0.085		0.024 J		0.037	0.125 U	0.037 J	0.087	0.043	0.16		0.0075 U
Nickel	140	---	---		29		26		34		31		25		26	29	44	40	32	42		35
Silver	6.1	6.1	6.1		0.14 J		0.13 J		0.16 J		0.13 J		0.062 J		0.074 J	0.07 J	0.18 J	0.19 J	0.16 J	0.28 J		0.026 J
Zinc	410	410	960		70		57		79		75		43		50	41	99	74	73	87		28
Butyltins (ug/kg dry weight)																						
Butyltin Ion	---	---	---																			
Dibutyltin Ion	---	---	---																			
Tributyltin Ion	---	---	---																			
Aromatic Hydrocarbons (ug/kg dry weight or mg/kg OC)																						
LPAHs																						
2-Methylnaphthalene (dry)	670	---	---		8.2 U		8.1 U		8.1 U		8.1 U		8.0 U		7.9 U	8.0 U	8.1 U	8.2 U	8.1 U	8.1 U		8.1 U
2-Methylnaphthalene (OC)	---	38	64		0.31 U		0.35 U		0.36 U		0.23 U		0.47 U		0.33 U	0.46 U	0.28 U	0.17 U	0.31 U	18 U		1.4 U
Acenaphthene (dry)	500	---	---		8.2 U		8.1 U		8.1 U		8.1 U		8.0 U		7.9 U	8.0 U	8.1 U	8.2 U	8.1 U	8.1 U		8.1 U
Acenaphthene (OC)	---	16	57		0.31 U		0.35 U		0.36 U		0.23 U		0.47 U		0.33 U	0.46 U	0.28 U	0.17 U	0.31 U	18 U		1.4 U
Acenaphthylene (dry)	560	---	---		8.6 U		8.5 U		8.6 U		8.6 U		8.4 U		8.3 U	8.5 U	8.6 U	8.6 U	8.6 U	8.6 U		8.5 U
Acenaphthylene (OC)	---	66	66		0.33 U		0.37 U		0.38 U		0.24 U		0.49 U		0.35 U	0.49 U	0.30 U	0.18 U	0.33 U	19 U		1.5 U
Anthracene (dry)	960	---	---		7.7 U		7.6 U		7.7 U		7.7 U		7.5 U		7.5 U	7.6 U	7.7 U	7.7 U	7.6 U	7.7 U		7.6 U
Anthracene (OC)	---	220	1,200		0.29 U		0.33 U		0.34 U		0.22 U		0.44 U		0.31 U	0.43 U	0.27 U	0.16 U	0.29 U	17 U		1.3 U
Fluorene (dry)	540	---	---		8.9 U		8.8 U		8.9 U		8.9 U		8.7 U		8.6 U	8.8 U	8.9 U	8.9 U	8.8 U	8.9 U		8.8 U
Fluorene (OC)	---	23	79		0.34 U		0.38 U		0.39 U		0.25 U		0.51 U		0.36 U	0.50 U	0.31 U	0.19 U	0.34 U	20 U		1.5 U
Naphthalene (dry)	2,100	---	---		8.7 U		8.6 U		8.6 U		8.6 U		8.5 U		8.4 U	8.5 U	8.6 U	8.6 U	8.6 U	8.6 U		8.5 U
Naphthalene (OC)	---	99	170		0.33 U		0.37 U		0.38 U		0.24 U		0.50 U		0.35 U	0.49 U	0.30 U	0.18 U	0.33 U	19 U		1.5 U
Phenanthrene (dry)	1500	---	---		8.4 U		8.3 U		8.3 U		8.3 U		8.2 U		8.1 U	8.2 U	8.3 U	8.4 U	8.3 U	8.3 U		8.3 U
Phenanthrene (OC)	---	100	480		0.32 U		0.36 U		0.37 U		0.24 U		0.48 U		0.34 U	0.47 U	0.29 U	0.18 U	0.32 U	18 U		1.5 U
Total LPAHs (dry) [c]	5200	---	---		20 U		20 U		20 U		20 U		20 U		19 U	20 U	20 U	20 U	20 U	20 U		20 U
Total LPAHs (OC) [c]	---	370	780		0.76 U		0.86 U		0.88 U		0.57 U		1.2 U		0.79 U	1.1 U	0.70 U	0.42 U	0.77 U	44 U		3.5 U
HPAHs																						
Benzo(a)anthracene (dry)	1,300	---	---		5.9 U		5.8 U		5.9 U		5.9 U		5.8 U		5.7 U	5.8 U	5.9 U	5.9 U	5.8 U	5.9 U		5.8 U
Benzo(a)anthracene (OC)	---	110	270		0.23 U		0.25 U		0.26 U		0.17 U		0.34 U		0.24 U	0.33 U	0.21 U	0.12 U	0.22 U	13 U		1.0 U
Benzo(a)pyrene (dry)	1,600	---	---		8.1 U		8 U		8.1 U		8.1 U		8.0 U		7.9 U	8.0 U	8.1 U	8.1 U	8.1 U	21		8.0 U
Benzo(a)pyrene (OC)	---	99	210		0.31 U		0.34 U		0.36 U		0.23 U		0.47 U		0.33 U	0.46 U	0.28 U	0.17 U	0.31 U	47		1.4 U
Benzo(b)fluoranthene (dry)	---	---	---		9.5 U		9.4 U		9.4 U		9.4 U		9.3 U		9.2 U	9.3 U	9.4 U	9.5 U	9.4 U	9.4 U		9.4 U
Benzo(b)fluoranthene (OC)	---	---	---		0.36 U		0.41 U		0.42 U		0.27 U		0.54 U		0.38 U	0.53 U	0.33 U	0.20 U	0.36 U	21 U		1.6 U
Benzo(g,h,i)perylene (dry)	670	---	---		6.7 U		6.7 U		6.7 U		6.7 U		6.6 U		6.5 U	6.6 U	6.7 U	6.7 U	6.7 U	23		6.6 U
Benzo(g,h,i)perylene (OC)	---	31	78		0.26 U		0.29 U		0.30 U		0.19 U		0.39 U		0.27 U	0.38 U	0.23 U	0.14 U	0.26 U	51		1.2 U
Benzo(k)fluoranthene (dry)	---	---	---		9.2 U		9.1 U		9.2 U		9.2 U		9.0 U		8.9 U	9.1 U	9.2 U	9.2 U	9.1 U	9.2 U		9.1 U
Benzo(k)fluoranthene (OC)	---	---	---		0.35 U		0.39 U		0.41 U		0.26 U		0.53 U		0.37 U	0.52 U	0.32 U	0.19 U	0.35 U	20 U		1.6 U
Benzofluoranthenes, Total (b+k+j) (dry)	3,200	---	---		20 U		20 U		20 U		20 U		20 U		19 U	20 U	20 U	20 U	20 U	20 U		20 U
Benzofluoranthenes, Total (b+k+j) (OC)	---	230	450		0.76 U		0.86 U		0.88 U		0.57 U		1.17 U		0.79 U	1.1 U	0.70 U	0.42 U	0.77 U	44 U		3.5 U
Chrysene (dry)	1,400	---	---		6.6 U		6.5 U		11 J		6.6 U		6.5 U		6.4 U	6.5 U	6.6 U	6.6 U	6.6 U	6.6 U		6.5 U
Chrysene (OC)	---	110	460		0.25 U		0.28 U		0.5 J		0.19 U		0.38 U		0.27 U	0.37 U	0.23 U	0.14 U	0.25 U	15 U		1.1 U
Dibenz(a,h)anthracene (dry)	230	---	---		8.5 U		8.4 U		8.5 U		8.5 U		8.3 U		8.2 U	8.4 U	8.5 U	8.5 U	8.5 U	8.5 U		8.4 U
Dibenz(a,h)anthracene (OC)	---	12	33		0.32 U		0.36 U		0.38 U		0.24 U		0.49 U		0.34 U	0.48 U	0.30 U	0.18 U	0.33 U	19 U		1.5 U
Fluoranthene (dry)	1,700	---	---		7.9 U		7.8 U		7.8 U		11 J		7.7 U		7.6 U	7.8 U	7.8 U	11 J	7.8 U	7.8 U		7.8 U
Fluoranthene (OC)	---	160	1,200		0.30 U		0.34 U		0.35 U		0.31 J		0.45 U		0.32 U	0.45 U	0.27 U	0.23 J	0.30 U	17 U		1.4 U
Indeno(1,2,3-cd)pyrene (dry)	600	---	---		8.6 U		8.5 U		8.5 U		8.5 U		8.4 U		8.3 U	8.4 U	8.5 U	8.6 U	8.5 U	8.5 U		8.5 U
Indeno(1,2,3-cd)pyrene (OC)	---	34	88		0.33 U		0.37 U		0.38 U		0.24 U		0.49 U		0.35 U	0.48 U	0.30 U	0.18 U	0.33 U	19 U		1.5 U
Pyrene (dry)	2,600	---	---		7.7 U		7.6 U		7.7 U		7.7 U		7.6 U		19	7.6 U	7.7 U	13 J	7.7 U	7.7 U		7.6 U
Pyrene (OC)	---	1,000	1,400		0.29 U		0.33 U		0.34 U		0.22 U		0.44 U		0.79	0.43 U	0.27 U	0.27 J	0.30 U	17 U		1.3 U
Total HPAHs (dry) [c]	12,000	---	---		20 U		20 U		11 J		11 J		20 U		19	20 U	20 U	24 J	20 U	44		20 U
Total HPAHs (OC) [c]	---	960	5,300		0.76 U		0.86 U		0.49 J		0.31 J		1.17 U		0.79	1.1 U	0.70 U	0.51 J	0.77 U	98		3.5 U

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Oakland Bay																	Hammersley Inlet	
				OB-09-SC-12	OB-10-SS-00	OB-10-SC-12	OB-11-SS-00	OB-11-SC-12	OB-12-SS-00	OB-12-SC-12	OB-13-SS-00	OB-13-SC-12	OB-14-SS-00	OB-14-SC-12	OB-17-WS-00	OB-17-WC-12	OB-18-WS-00	OB-18-WC-12 [d]	OB-19-WS-00	OB-19-WC-12 [d]	HI-01-SC-12 [d]	HI-02-SS-00
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	1 to 2 ft	0 to 10 cm
Chlorinated Benzenes (ug/kg dry weight or mg/kg OC)																						
1,2,4-Trichlorobenzene (dry)	31	---	---		9.1 U		8.9 U		9.0 U		9.0 U		8.8 U		8.7 U	8.9 U	9.0 U	9.0 U	9.0 U	9.0 U		8.9 U
1,2,4-Trichlorobenzene (OC)	---	0.81	1.8		0.35 U		0.38 U		0.40 U		0.25 U		0.51 U		0.36 U	0.51 U	0.31 U	0.19 U	0.35 U	20 U		1.6 U
1,2-Dichlorobenzene (dry)	35	---	---		7.9 U		7.8 U		7.8 U		7.8 U		7.7 U		7.6 U	7.7 U	7.8 U	7.8 U	7.8 U	7.8 U		7.7 U
1,2-Dichlorobenzene (OC)	---	2.3	2.3		0.30 U		0.34 U		0.35 U		0.22 U		0.45 U		0.32 U	0.44 U	0.27 U	0.16 U	0.30 U	17 U		1.3 U
1,4-Dichlorobenzene (dry)	110	---	---		7.3 U		7.3 U		7.3 U		7.3 U		7.2 U		7.1 U	7.2 U	7.3 U	7.3 U	7.3 U	7.3 U		7.2 U
1,4-Dichlorobenzene (OC)	---	3.1	9		0.28 U		0.31 U		0.32 U		0.21 U		0.42 U		0.30 U	0.41 U	0.26 U	0.15 U	0.28 U	16 U		1.3 U
Phthalates (ug/kg dry weight or mg/kg OC)																						
bis(2-Ethylhexyl)phthalate (dry)	1,300	---	---		11 U		11 U		11 U		11 U		11 U		11 U	11 U	11 U	11 U	**44**	11 U		11 U
bis(2-Ethylhexyl)phthalate (OC)	---	47	78		0.42 U		0.47 U		0.49 U		0.31 U		0.64 U		0.46 U	0.63 U	0.38 U	0.23 U	**1.7**	24 U		1.9 U
Butylbenzylphthalate (dry)	63	---	---		11 U		11 U		11 U		11 U		11 U		11 U	11 U	11 U	11 U	11 U	11 U		11 U
Butylbenzylphthalate (OC)	---	4.9	64		0.42 U		0.47 U		0.49 U		0.31 U		0.64 U		0.46 U	0.63 U	0.38 U	0.23 U	0.42 U	24 U		1.9 U
Di-n-Butylphthalate (dry)	1400	---	---		12 U		12 U		12 U		12 U		12 U		12 U	12 U	12 U	12 U	12 U	12 U		12 U
Di-n-Butylphthalate (OC)	---	220	1,700		0.46 U		0.52 U		0.53 U		0.34 U		0.70 U		0.50 U	0.69 U	0.42 U	0.25 U	0.46 U	27 U		2.1 U
Di-n-Octyl phthalate (dry)	6200	---	---		8.3 U		8.2 U		8.3 U		8.2 U		8.1 U		8.0 U	8.2 U	8.3 U	8.3 U	8.2 U	8.3 U		8.2 U
Di-n-Octyl phthalate (OC)	---	58	4,500		0.32 U		0.35 U		0.37 U		0.23 U		0.47 U		0.33 U	0.47 U	0.29 U	0.18 U	0.32 U	18 U		1.4 U
Diethylphthalate (dry)	200	---	---		16 U		16 U		16 U		16 U		16 U		16 U	16 U	16 U	16 U	16 U	16 U		16 U
Diethylphthalate (OC)	---	61	110		0.61 U		0.69 U		0.71 U		0.45 U		0.94 U		0.67 U	0.91 U	0.56 U	0.34 U	0.62 U	36 U		2.8 U
Dimethylphthalate (dry)	71	---	---		7.7 U		7.6 U		7.7 U		7.7 U		7.6 U		7.5 U	7.6 U	7.7 U	7.7 U	7.7 U	7.7 U		7.6 U
Dimethylphthalate (OC)	---	53	53		0.29 U		0.33 U		0.34 U		0.22 U		0.44 U		0.31 U	0.43 U	0.27 U	0.16 U	0.30 U	17 U		1.3 U
Ionizable Organic Compounds (ug/kg dry weight)																						
2,4-Dimethylphenol	29	29	29		15 U		15 U		15 U		15 U		14 U		14 U	14 U	15 U	15 U	15 U	15 U		15 U
Benzoic Acid	650	650	650		110 U		110 U		110 U		110 U		110 U		110 U	110 U	110 U	110 U	110 U	110 U		110 U
Benzyl Alcohol	57	57	73		14 U		14 U		14 U		14 U		14 U		14 U	14 U	14 U	14 U	14 U	14 U		14 U
Pentachlorophenol	360	360	690		47 U		47 U		47 U		47 U		46 U		46 U	47 U	47 U	47 U	47 U	47 U		47 U
Phenol	420	420	1,200		**27**		14 U		14 U		14 U		13 U		13 U	13 U	14 U	14 U	14 U	**21**		**290**
Miscellaneous Extractables (ug/kg dry weight or mg/kg OC)																						
Dibenzofuran (dry)	540	---	---		7.5 U		7.4 U		7.5 U		7.5 U		7.4 U		7.3 U	7.4 U	7.5 U	7.5 U	7.5 U	7.5 U		7.4 U
Dibenzofuran (OC)	---	15	58		0.29 U		0.32 U		0.33 U		0.21 U		0.43 U		0.31 U	0.42 U	0.26 U	0.16 U	0.29 U	16.7 U		1.3 U
Hexachlorobenzene (dry)	22	---	---		8.0 U		7.9 U		7.9 U		7.9 U		7.8 U		7.7 U	7.9 U	7.9 U	8 U	7.9 U	7.9 U		7.9 U
Hexachlorobenzene (OC)	---	0.38	2.3		0.31 U		0.34 U		0.35 U		0.22 U		0.46 U		0.32 U	0.45 U	0.28 U	0.17 U	0.30 U	17.6 U		1.4 U
Hexachlorobutadiene (dry)	11	---	---		8.1 U		8.0 U		8.0 U		8.0 U		7.9 U		7.8 U	8.0 U	8.0 U	8.1 U	8.0 U	8.0 U		8.0 U
Hexachlorobutadiene (OC)	---	3.9	6.2		0.31 U		0.34 U		0.35 U		0.23 U		0.46 U		0.33 U	0.46 U	0.28 U	0.17 U	0.31 U	17.8 U		1.4 U
N-Nitrosodiphenylamine (dry)	28	---	---		8.7 U		8.6 U		8.6 U		8.6 U		8.5 U		8.4 U	8.5 U	8.6 U	8.6 U	8.6 U	8.6 U		8.5 U
N-Nitrosodiphenylamine (OC)	---	11	11		0.33 U		0.37 U		0.38 U		0.24 U		0.50 U		0.35 U	0.49 U	0.30 U	0.18 U	0.33 U	19.1 U		1.5 U
2-Methylphenol	---	63	63		14 U		14 U		14 U		14 U		14 U		14 U	14 U	14 U	14 U	14 U	14 U		14 U
4-Methylphenol	---	670	670		**53**		13 U		13 U		13 U		12 U		12 U	13 U	13 U	13 U	13 U	13 U		13 U
Polychlorinated Biphenyls (ug/kg dry weight or mg/kg OC)																						
Total PCBs (OC) [c]	---	12	65		0.15 UJ		0.16 UJ		0.18 UJ		0.11 UJ		0.23 UJ		0.16 UJ	0.23 U	0.14 UJ	0.084 UJ	0.15 UJ	9.11 UJ		0.61 UJ
Total PCBs (dry) [c]	130	---	---		3.9 UJ		3.8 UJ		4.0 UJ		3.9 UJ		3.9 UJ		3.8 UJ	4.0 U	4.0 UJ	4.0 UJ	3.9 UJ	4.1 UJ		3.5 UJ
Aroclor 1016	---	---	---		1.6 UJ		1.5 UJ		1.6 UJ		1.5 UJ		1.6 UJ		1.5 UJ	1.6 U	1.6 UJ	1.6 UJ	1.6 UJ	1.6 UJ		1.4 UJ
Aroclor 1221	---	---	---		3.9 UJ		3.8 UJ		4.0 UJ		3.9 UJ		3.9 UJ		3.8 UJ	4.0 U	4.0 UJ	4.0 UJ	3.9 UJ	4.1 UJ		3.5 UJ
Aroclor 1232	---	---	---		3.4 UJ		3.3 UJ		3.5 UJ		3.4 UJ		3.4 UJ		3.3 UJ	3.5 U	3.5 UJ	3.5 UJ	3.5 UJ	3.5 UJ		3.1 UJ
Aroclor 1242	---	---	---		1 UJ		0.99 UJ		1.0 UJ		1.0 UJ		1.0 UJ		1.0 UJ	1.0 U	1.1 UJ	1.1 UJ	1.0 UJ	1.1 UJ		0.93 UJ
Aroclor 1248	---	---	---		0.63 UJ		0.61 UJ		0.64 UJ		0.63 UJ		0.63 UJ		0.62 UJ	0.65 U	0.65 UJ	0.65 UJ	0.64 UJ	0.66 UJ		0.57 UJ
Aroclor 1254	---	---	---		1 UJ		0.99 UJ		1.0 UJ		1.0 UJ		1.0 UJ		1.0 UJ	1.0 U	1.1 UJ	1.1 UJ	1.0 UJ	1.1 UJ		0.93 UJ
Aroclor 1260	---	---	---		1.5 UJ		1.4 UJ		1.5 UJ		1.4 UJ		1.5 UJ		1.4 UJ	1.5 U	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ		1.3 UJ
Chlorinated Pesticides (ug/kg dry weight)																						
4,4'-DDD	16	---	---		0.14 U		0.14 U		0.14 U		0.14 U		0.14 U		0.14 U	0.14 U	0.15 U	**1.0 J**	0.15 U	0.15 UJ		0.13 U
4,4'-DDE	9	---	---		0.14 U		0.14 U		0.14 U		0.14 U		0.14 U		0.13 U	**0.3 J**	0.14 U	0.14 U	0.14 U	**0.33 J**		0.13 U
4,4'-DDT	34	---	---		0.15 U		0.15 U		**0.54 J**		0.15 U		**0.29 J**		0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	**1.6 J**		**0.96 J**
Aldrin	---	---	---		0.22 U		0.21 U		0.22 U		0.22 U		0.22 U		0.21 U	0.22 U	0.22 U	0.23 U	0.22 U	0.22 UJ		0.2 U
alpha-Chlordane	---	---	---		0.13 U		0.13 U		0.13 U		0.28 U		0.26 U		0.13 U	0.13 U	0.13 U	0.14 U	0.13 U	**0.28 J**		0.12 U
Dieldrin	---	---	---		0.12 U		0.11 U		0.12 U		0.11 U		0.11 U		0.11 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 UJ		0.11 U
gamma-BHC	---	---	---		0.077 U		0.075 U		0.077 U		**0.11 J**		0.076 U		0.073 U	**0.34 J**	0.078 U	0.079 U	0.078 U	0.078 UJ		0.071 U
Heptachlor	---	---	---		0.46 U		0.45 U		0.46 U		0.45 U		0.45 U		0.44 U	0.46 U	0.47 U	0.47 U	0.46 U	0.46 UJ		0.42 U
Petroleum Hydrocarbons (mg/kg dry weight)																						
Gasoline	---	---	---						51 U		54 UJ											
Diesel Range	---	---	---						130 U		140 UJ											
Motor Oil	---	---	---						260 U		270 UJ											
Dioxins/Furans (ng/kg dry weight)																						
DX TOTAL (TEQ ND=1/2 DL)	---	---	---	**52.4**	**53.6**	**104**	**43.8**		**54.4**	**70.8**	**48.3**		**21.9**		**13.4**		**33**		**45.5**			**3.19**
1,2,3,4,6,7,8-HPCDD	---	---	---	**1,410 B**	**1,250 B**	**2,730 B**	**982 B**		**1,210 B**	**1,840 B**	**1070 B**		**478 B**		**280 B**		**768 B**		**1,040 B**			**72.1 B**
1,2,3,4,6,7,8-HPCDF	---	---	---	**644**	**455 B**	**1270**	**397 B**		**502 B**	**803**	**427 B**		**182 B**		**95.6 B**		**290 B**		**379 B**			**24.2 B**
1,2,3,4,7,8,9-HPCDF	---	---	---	**30.1 B**	**26.3**	**70.1 B**	**21.9**		**28.2**	**39.1 B**	**28.1**		**11**		**5.36**		**15.7**		**21.6**			**1.53**
1,2,3,4,7,8-HXCDD	---	---	---	**10.2**	**17**	**22.3**	**13.8**		**18.1**	**15.7**	**15.5**		**6.69**		**3.96**		**9.86**		**13.6**			**0.954**
1,2,3,4,7,8-HXCDF	---	---	---	**52.9**	**43.5**	**99.4**	**35.9**		**41.9**	**85.7**	**41.6**		**18.1**		**10.9**		**24.8**		**34.4**			**2.39**
1,2,3,6,7,8-HXCDD	---	---	---	**66.2**	**64**	**132**	**55.8**		**68**	**91.5**	**57.3**		**27.5**		**17.5**		**42.9**		**60.7**			**4.29**
1,2,3,6,7,8-HXCDF	---	---	---	**15.2**	**15.3**	**31**	**13.7**		**16.8**	**22.2**	**14.6**		**6.7**		**3.48**		**8.82**		**12.4**			**0.789**
1,2,3,7,8,9-HXCDD	---	---	---	**32.5**	**47.5**	**65.4**	**40.5**		**53.8**	**44.9**	**48.8**		**19.8**		**11.8**		**28.7**		**40.6**			**2.87**
1,2,3,7,8,9-HXCDF	---	---	---	**1.18**	**1.28**	**2.91**	**1.07**		**1.47**	**1.11**	**1.06**		**0.645**		**0.34 J**		**0.72**		**1.09**			**0.079 J**
1,2,3,7,8-PECDD	---	---	---	**5.48**	**8.66**	**11.4**	**7.03**		**8.44**	**7.57**	**8.01**		**3.75**		**2.48**		**5.21**		**7.3**			**0.574**
1,2,3,7,8-PECDF	---	---	---	**4.15**	**5.23**	**8.34**	**4.22**		**5.24**	**4.52**	**4.58**		**2.07**		**1.61**		**3.12**		**4.22**			**0.304 J**
2,3,4,6,7,8-HXCDF	---	---	---	**12.1**	**13.5**	**22.1**	**11.9**		**15.2**	**18.7**	**13.9**		**5.93**		**3.15**		**8.46**		**10.8**			**0.728**
2,3,4,7,8-PECDF	---	---	---	**6.94 B**	**6.75 B**	**12.9 B**	**5.27**		**6.81 B**	**9.46 B**	**5.47**		**2.95 B**		**2.37**		**4.16**		**5.78 B**			**0.477 B**
2,3,7,8-TCDD	---	---	---	**0.707 B**	**1.07**	**1.25 B**	**0.84**		**1.21**	**0.818 B**	**1.16**		**0.473**		**0.519**		**0.793**		**0.984**			**0.085 J**
2,3,7,8-TCDF	---	---	---	**3.2**	**3.6**	**5.41**	**2.64**		**3.68**	**2.42**	**3.18**		**1.59**		**1.57**		**2.68**		**3.49**			**0.301 J**
OCDD	---	---	---	**11,100 B**	**11,600 B**	**23,500 B**	**7,890 B**		**9,710 B**	**13,000 B**	**7,220 B**		**4,060 B**		**1,580 B**		**6,490 B**		**9,640 B**			**629 B**
OCDF	---	---	---	**1,760 B**	**1,180 B**	**4,020 B**	**1,060 B**		**1,180 B**	**1,740 B**	**1,220 B**		**412 B**		**268 B**		**867 B**		**1130 B**			**66.9 B**

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Oakland Bay																	Hammersley Inlet	
				OB-09-SC-12	OB-10-SS-00	OB-10-SC-12	OB-11-SS-00	OB-11-SC-12	OB-12-SS-00	OB-12-SC-12	OB-13-SS-00	OB-13-SC-12	OB-14-SS-00	OB-14-SC-12	OB-17-WS-00	OB-17-WC-12	OB-18-WS-00	OB-18-WC-12 [d]	OB-19-WS-00	OB-19-WC-12 [d]	HI-01-SC-12 [d]	HI-02-SS-00
Parameter	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	1 to 2 ft	0 to 10 cm
TOTAL HEPTA-DIOXINS	---	---	---	**3,230**	**3,110** B	**6,040**	**2,350** B		**3,150** B	**4,430**	**2,570** B		**1,220** B		**677** B		**1,900** B		**2,680** B			**194** B
TOTAL HEPTA-FURANS	---	---	---	**2,570**	**1,610**	**5,640**	**1,350** B		**1,820**	**2,590**	**1,510**		**596**		**322** B		**1,040** B		**1,490**			**93.2**
TOTAL HEXA-DIOXINS	---	---	---	**1,010**	**1,190**	**2,060**	**970**		**1240**	**774**	**953**		**460**		**287**		**666**		**1,030**			**61.4**
TOTAL HEXA-FURANS	---	---	---	**829**	**658**	**1640**	**556**		**711**	**1,060**	**577**		**271**		**154**		**382**		**546**			**35.1**
TOTAL PENTA-DIOXINS	---	---	---	**254**	**341**	**581**	**293**		**430**	**116**	**318**		**155**		**120**		**225**		**409**			**18.3**
TOTAL PENTA-FURANS	---	---	---	**203**	**188**	**376**	**160**		**208**	**272**	**171**		**86.6**		**56.3**		**110**		**147**			**11.3**
TOTAL TETRA-DIOXINS	---	---	---	**202**	**273**	**378**	**191**		**318**	**62.7**	**204**		**117**		**97.8**		**163**		**317**			**13.1**
TOTAL TETRA-FURANS	---	---	---	**91.6**	**89.9**	**176**	**70.7**		**99.5**	**87.4**	**78.2**		**41.8**		**38.2**		**58.5**		**83.8**			**5.77**
Guaicols and Resin Acids (ug/kg dry weight)																						
12-Chlorodehydroabietic Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		98 U
14-Chlorodehydroabietic Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		98 U
3,4,5-Trichloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
3,4,6-Trichloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
3,4-Dichloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
4,5,6-Trichloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
4,5-Dichloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
4,6-Dichloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
4-Chloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
9,10-Dichlorostearic Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		98 U
Abietic Acid	---	---	---		100 U				**130**		99 U				**920**	**610**	**450**	**1,700**	**560**	**5,900**		98 U
Dehydroabietic Acid	---	---	---		100 U				**170**		99 U				**710**	**530**	**290** J	**1,000**	**300**	**2,000**		98 U
Dichlorodehydroabietic Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		98 U
Guaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
Isopimaric Acid	---	---	---		100 U				99 U		99 U				**170**	**110**	300 U	**290**	300 U	**870**		98 U
Linolenic Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		**130**
Neoabietic Acid	---	---	---		100 U				99 U		99 U				97 UJ	97 UJ	300 UJ	99 UJ	300 UJ	300 UJ		98 U
Oleic Acid	---	---	---		**920**				**1,500**		**1,100**				97 U	97 U	300 U	99 U	**610**	300 U		**1,300**
Palustric Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		98 U
Pimaric Acid	---	---	---		100 U				99 U		99 U				**99**	97 U	300 U	99 U	300 U	300 U		98 U
Retene	---	---	---												19 U	**430**	20 U	**48**	20 U	**160**		
Sandaracopimaric Acid	---	---	---		100 U				99 U		99 U				97 U	97 U	300 U	99 U	300 U	300 U		110 U
Tetrachloroguaiacol	---	---	---												19 U	20 U	20 U	20 U	20 U	20 U		
Total resin acids [c]	---	---	---		**920**				**1,800**		**1,100**				**1,900**	**1,700**	**740**	**3,000**	**1,500**	**8,900**		**1,400**

[a] Lowest and second lowest apparent effects thresholds for freshwater sediments in Washington State 2003).

[b] Washington State Marine Sediment Management Standards, Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) (WAC Chapter 173-204).

[c] Totals only include detected and estimated values

[d] Sample has organic carbon content less than 0.5 percent or greater than 4.0 percent and should be compared to LAET criteria rather than organic-carbon normalized SMS criteria.

ng/kg nanograms per kilogram

µg/kg micrograms per kilogram.

mg/kg milligrams per kilogram.

PCBs polychlorinated biphenyls.

Bold type indicates the sample result is greater than the laboratory detection limit.

Underlined value indicates the sample result or detection limit is greater than the LAET or SQS value.

Shaded value indicates the sample result or detection limit is greater than the CSL value.

U The material was analyzed for, but was not detected. The associated numerical value is the detection limit. For petroleum hydrocarbons, guaiacols and resin acids, the associated numerical value is the reporting limit.

J The associated numerical value is considered an estimated concentration.

G Bias is high.

B Specifyied compound was detected in the associated method blank.

LPAH represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH sum.

HPAH represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total benzofluoranthenes represents the sum of the concentrations of the "b" and "k" isomers.

Total PAHs (carcinogenic) represents the sum of the following PAH compounds: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene.

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Hammersley Inlet										Reference		
				HI-02-SC-12	HI-03-SS-00	HI-03-SC-12 [d]	HI-04-SS-00	HI-04-SC-12	HI-05-SS-00	HI-06-SS-00	HI-06-SC-12	HI-07-SS-00	HI-07-SC-12 [d]	RF-01-SS-00	RF-02-SS-00	RF-03-SS-00 [d]
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	0 to 10 cm
Conventional Parameters																
Particle/Grain Size, Fines (Silt/Clay)	---	---	---	23.9	13.7	62.9	4.3	7.8	6.9	16.7	4.3	6.8	7.4	81.2	51.5	13.1
Particle/Grain Size, Phi Scale <-1	---	---	---	14.4	0.1	33.8	0.1	0.8	1.6	3.6	70.3	4.8	2.9	0.1	0.1	0.1
Particle/Grain Size, Phi Scale >10	---	---	---	2.2	3.1	2.8	1.4	1.5	1.8	2.3	0.4	1.4	1.3	4.5	3.6	1.9
Particle/Grain Size, Phi Scale 0 to 1	---	---	---	11.1	1.8	0.2	0.9	0.4	8.9	7.4	3.7	4.2	2	0.4	0.6	4.6
Particle/Grain Size, Phi Scale -1 to 0	---	---	---	9.7	0.7	0.2	0.2	0.3	3.7	3.6	4	3.1	1.8	0.1	0.1	0.3
Particle/Grain Size, Phi Scale 1 to 2	---	---	---	23.5	6.5	0.6	40.8	16.3	31.8	20.4	7.7	44.6	25.1	0.7	1.4	14.6
Particle/Grain Size, Phi Scale 2 to 3	---	---	---	14.7	36.9	1	52.5	69.4	44.5	35.7	7.1	34.6	57	1.1	6.8	40.7
Particle/Grain Size, Phi Scale 3 to 4	---	---	---	2.6	40.2	1.2	1.2	5.1	2.6	12.6	2.7	1.9	3.8	16.4	39.5	26.6
Particle/Grain Size, Phi Scale 4 to 5	---	---	---	3.5	2.9	6.6	0.6	2.1	0.6	3.3	0.2	2.2	1.1	43.1	27.8	6.7
Particle/Grain Size, Phi Scale 5 to 6	---	---	---	5	2	21.3	0.3	0.6	0.6	5.1	1.1	0.5	0.8	20.6	10.5	1.8
Particle/Grain Size, Phi Scale 6 to 7	---	---	---	5.6	1.8	19.1	0.5	0.8	0.8	2.1	1.2	0.6	1.1	7.4	4.2	0.8
Particle/Grain Size, Phi Scale 7 to 8	---	---	---	4	1.2	8.2	0.5	0.9	1.2	1.3	0.5	0.7	1.3	2.1	1.7	0.5
Particle/Grain Size, Phi Scale 8 to 9	---	---	---	2.2	1.4	3.1	0.6	0.9	1	1.2	0.6	0.7	0.9	1.8	1.7	0.6
Particle/Grain Size, Phi Scale 9 to 10	---	---	---	1.5	1.4	1.8	0.6	0.9	1	1.3	0.4	0.7	0.9	1.7	2	0.7
Total Volatile Solids %	---	---	---											2.6	2.26	1.13
Ammonia (mg/kg)	---	---	---	1.07	6.55	7.75	10.1	0.77	7.82	5.68	0.99	5.83	3.24	11.9	9.95	14.4
Sulfide	---	---	---	3.41	203	5.19	17.7	0.01 U	9.65	258	179	1.3	4.49	320	166	16.7
Total organic carbon (%)	---	---	---	0.829	1.45	0.206	0.625	0.622	0.799	2.43	0.657	0.68	0.456	0.639	0.589	0.273
Total solids (%)	---	---	---	80.1	68.2	70.6	72.7	73.5	74.2	67.5	84.8	74.1	77.4	60	65.3	72.2
Metals (mg/kg dry weight)																
Antimony	150	---	---		0.16 J		0.074 J		0.14 J	0.15 J		0.13 J		0.16 J	0.16 J	0.1 J
Arsenic	57	57	93		5.1		2.2		3.2	6.3		2.4		3.1	3.2	1.5
Cadmium	5.1	5.1	6.7		0.63		0.12 J		0.14 J	0.43		0.16 J		0.41	0.42	0.098 J
Chromium	260	260	270		29		17		25	24		21		26	23	12
Copper	390	390	390		18		9.9		15	16		14		16	14	4.3
Lead	450	450	530		14		2.2		3.2	4		2.6		4.6	4.5	2.6
Mercury	0.41	0.41	0.59		0.037		0.0075 J		0.02 J	0.02 J		0.01 J		0.012 J	0.016 J	0.0081 J
Nickel	140	---	---		29		20		24	23		24		28	25	11
Silver	6.1	6.1	6.1		0.06 J		0.022 J		0.024 J	0.054 J		0.024 J		0.075 J	0.064 J	0.023 J
Zinc	410	410	960		55		28		36	42		32		36	32	14
Butyltins (ug/kg dry weight)																
Butyltin Ion	---	---	---											3.6 U	3.5 U	3.4 U
Dibutyltin Ion	---	---	---											2.8 U	2.7 U	2.6 U
Tributyltin Ion	---	---	---											1.6 U	1.5 U	1.5 U
Aromatic Hydrocarbons (ug/kg dry weight or mg/kg OC)																
LPAHs																
2-Methylnaphthalene (dry)	670	---	---		7.9 U		8.0 U		8.0 U	7.9 U		7.9 U		8.1 U	8.0 U	8.0 U
2-Methylnaphthalene (OC)	---	38	64		0.54 U		1.3 U		1.0 U	0.33 U		1.2 U		1.3 U	1.4 U	2.9 U
Acenaphthene (dry)	500	---	---		7.9 U		8.0 U		8.0 U	7.9 U		8.0 U		8.1 U	8.0 U	8.0 U
Acenaphthene (OC)	---	16	57		0.54 U		1.3 U		1.0 U	0.33 U		1.2 U		1.3 U	1.4 U	2.9 U
Acenaphthylene (dry)	560	---	---		8.4 U		8.4 U		8.5 U	8.4 U		8.4 U		8.6 U	8.4 U	8.4 U
Acenaphthylene (OC)	---	66	66		0.58 U		1.3 U		1.1 U	0.35 U		1.2 U		1.3 U	1.4 U	3.1 U
Anthracene (dry)	960	---	---		7.5 U		7.5 U		7.6 U	7.5 U		7.5 U		7.7 U	7.5 U	7.5 U
Anthracene (OC)	---	220	1,200		0.52 U		1.2 U		1.0 U	0.31 U		1.1 U		1.2 U	1.3 U	2.7 U
Fluorene (dry)	540	---	---		8.7 U		8.7 U		8.7 U	8.7 U		8.7 U		8.9 U	8.7 U	8.7 U
Fluorene (OC)	---	23	79		0.60 U		1.4 U		1.1 U	0.36 U		1.3 U		1.4 U	1.5 U	3.2 U
Naphthalene (dry)	2,100	---	---		8.4 U		8.5 U		8.5 U	8.4 U		8.4 U		8.6 U	8.5 U	8.5 U
Naphthalene (OC)	---	99	170		0.58 U		1.4 U		1.1 U	0.35 U		1.2 U		1.3 U	1.4 U	3.1 U
Phenanthrene (dry)	1500	---	---		8.1 U		8.2 U		8.2 U	8.1 U		8.1 U		8.3 U	8.2 U	8.2 U
Phenanthrene (OC)	---	100	480		0.56 U		1.3 U		1.0 U	0.33 U		1.2 U		1.3 U	1.4 U	3.0 U
Total LPAHs (dry) [c]	5200	---	---		19 U		20 U		20 U	19 U		19 U		20 U	20 U	20 U
Total LPAHs (OC) [c]	---	370	780		1.3 U		3.2 U		2.5 U	0.78 U		2.8 U		3.1 U	3.4 U	7.3 U
HPAHs																
Benzo(a)anthracene (dry)	1,300	---	---		5.7 U		5.8 U		5.8 U	5.7 U		5.7 U		5.9 U	5.8 U	5.8 U
Benzo(a)anthracene (OC)	---	110	270		0.4 U		0.93 U		0.73 U	0.23 U		0.84 U		0.92 U	1.0 U	2.1 U
Benzo(a)pyrene (dry)	1,600	---	---		7.9 U		8.0 U		8.0 U	7.9 U		7.9 U		8.1 U	7.9 U	7.9 U
Benzo(a)pyrene (OC)	---	99	210		0.5 U		1.3 U		1.0 U	0.33 U		1.2 U		1.3 U	1.3 U	2.9 U
Benzo(b)fluoranthene (dry)	---	---	---		9.2 U		9.3 U		9.3 U	9.2 U		9.2 U		9.4 U	9.3 U	9.3 U
Benzo(b)fluoranthene (OC)	---	---	---		0.6 U		1.5 U		1.2 U	0.38 U		1.4 U		1.5 U	1.6 U	3.4 U
Benzo(g,h,i)perylene (dry)	670	---	---		6.5 U		6.6 U		6.6 U	6.5 U		6.5 U		6.7 U	6.6 U	6.6 U
Benzo(g,h,i)perylene (OC)	---	31	78		0.4 U		1.1 U		0.83 U	0.27 U		1.0 U		1.0 U	1.1 U	2.4 U
Benzo(k)fluoranthene (dry)	---	---	---		9 U		9.0 U		9.0 U	8.9 U		9.0 U		9.2 U	9.0 U	9.0 U
Benzo(k)fluoranthene (OC)	---	---	---		0.6 U		1.4 U		1.1 U	0.37 U		1.3 U		1.4 U	1.5 U	3.3 U
Benzofluoranthenes, Total (b+k+j) (dry)	3,200	---	---		19 U		20 U		20 U	19 U		19 U		20 U	20 U	20 U
Benzofluoranthenes, Total (b+k+j) (OC)	---	230	450		1.3 U		3.2 U		2.5 U	0.78 U		2.8 U		3.1 U	3.4 U	7.3 U
Chrysene (dry)	1,400	---	---		12 J		6.5 U		6.5 U	6.4 U		6.4 U		6.6 U	6.5 U	6.5 U
Chrysene (OC)	---	110	460		0.8 J		1.0 U		0.81 U	0.26 U		0.94 U		1.0 U	1.1 U	2.4 U
Dibenz(a,h)anthracene (dry)	230	---	---		8.3 U		8.3 U		8.4 U	8.3 U		8.3 U		8.5 U	8.3 U	8.3 U
Dibenz(a,h)anthracene (OC)	---	12	33		0.6 U		1.3 U		1.1 U	0.34 U		1.2 U		1.3 U	1.4 U	3.0 U
Fluoranthene (dry)	1,700	---	---		16 J		7.7 U		7.7 U	7.6 U		7.7 U		7.8 U	7.7 U	7.7 U
Fluoranthene (OC)	---	160	1,200		1.1 J		1.2 U		1.0 U	0.31 U		1.1 U		1.2 U	1.3 U	2.8 U
Indeno(1,2,3-cd)pyrene (dry)	600	---	---		8.3 U		8.4 U		8.4 U	8.3 U		8.3 U		8.5 U	8.4 U	8.4 U
Indeno(1,2,3-cd)pyrene (OC)	---	34	88		0.6 U		1.3 U		1.1 U	0.3 U		1.2 U		1.3 U	1.4 U	3.1 U
Pyrene (dry)	2,600	---	---		16 J		7.6 U		7.6 U	7.5 U		7.5 U		7.7 U	7.6 U	7.6 U
Pyrene (OC)	---	1,000	1,400		1.1 J		1.2 U		1.0 U	0.31 U		1.1 U		1.2 U	1.3 U	2.8 U
Total HPAHs (dry) [c]	12,000	---	---		44 J		20 U		20 U	19 U		19 U		20 U	20 U	20 U
Total HPAHs (OC) [c]	---	960	5,300		3 J		3.2 U		2.5 U	0.78 U		2.8 U		3.1 U	3.4 U	7.3 U

Parameter	Freshwater Sediment Apparent Effects Threshold[a]	Marine Sediment Management Standard[b]		Hammersley Inlet										Reference		
				HI-02-SC-12	HI-03-SS-00	HI-03-SC-12 [d]	HI-04-SS-00	HI-04-SC-12	HI-05-SS-00	HI-06-SS-00	HI-06-SC-12	HI-07-SS-00	HI-07-SC-12 [d]	RF-01-SS-00	RF-02-SS-00	RF-03-SS-00 [d]
	LAET	SQS	CSL	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	1 to 2 ft	0 to 10 cm	1 to 2 ft	0 to 10 cm	0 to 10 cm	0 to 10 cm
Chlorinated Benzenes (ug/kg dry weight or mg/kg OC)																
1,2,4-Trichlorobenzene (dry)	31	---	---		8.8 U		8.8 U		8.9 U	8.8 U		8.8 U		9 U	8.8 U	8.8 U
1,2,4-Trichlorobenzene (OC)	---	0.81	1.8		0.61 U		1.4 U		1.1 U	0.36 U		1.3 U		1.4 U	1.5 U	3.2 U
1,2-Dichlorobenzene (dry)	35	---	---		7.6 U		7.7 U		7.7 U	7.6 U		7.6 U		7.8 U	7.7 U	7.7 U
1,2-Dichlorobenzene (OC)	---	2.3	2.3		0.52 U		1.2 U		1.0 U	0.31 U		1.1 U		1.2 U	1.3 U	2.8 U
1,4-Dichlorobenzene (dry)	110	---	---		7.1 U		7.2 U		7.2 U	7.1 U		7.1 U		7.3 U	7.2 U	7.2 U
1,4-Dichlorobenzene (OC)	---	3.1	9		0.49 U		1.2 U		0.90 U	0.29 U		1.0 U		1.1 U	1.2 U	2.6 U
Phthalates (ug/kg dry weight or mg/kg OC)																
bis(2-Ethylhexyl)phthalate (dry)	1,300	---	---		11 U		11 U		11 U	11 U		11 U		**25**	11 U	11 U
bis(2-Ethylhexyl)phthalate (OC)	---	47	78		0.76 U		1.8 U		1.4 U	0.45 U		1.6 U		**3.9**	1.9 U	4.0 U
Butylbenzylphthalate (dry)	63	---	---		11 U		11 U		11 U	11 U		11 U		11 U	11 U	11 U
Butylbenzylphthalate (OC)	---	4.9	64		0.76 U		1.8 U		1.4 U	0.45 U		1.6 U		1.7 U	1.9 U	4.0 U
Di-n-Butylphthalate (dry)	1400	---	---		12 U		12 U		12 U	12 U		12 U		12 U	12 U	12 U
Di-n-Butylphthalate (OC)	---	220	1,700		0.83 U		1.9 U		1.5 U	0.49 U		1.8 U		1.9 U	2.0 U	4.4 U
Di-n-Octyl phthalate (dry)	6200	---	---		8.1 U		8.1 U		8.1 U	8.1 U		8.1 U		8.3 U	8.1 U	8.1 U
Di-n-Octyl phthalate (OC)	---	58	4,500		0.6 U		1.3 U		1.0 U	0.33 U		1.2 U		1.3 U	1.4 U	3.0 U
Diethylphthalate (dry)	200	---	---		16 U		16 U		16 U	16 U		16 U		16 U	16 U	16 U
Diethylphthalate (OC)	---	61	110		1.1 U		2.6 U		2.0 U	0.66 U		2.4 U		2.5 U	2.7 U	5.9 U
Dimethylphthalate (dry)	71	---	---		7.5 U		7.6 U		7.6 U	7.5 U		7.5 U		7.7 U	7.6 U	7.6 U
Dimethylphthalate (OC)	---	53	53		0.52 U		1.2 U		1.0 U	0.31 U		1.1 U		1.2 U	1.3 U	2.8 U
Ionizable Organic Compounds (ug/kg dry weight)																
2,4-Dimethylphenol	29	29	29		14 U		14 U		14 U	14 U		14 U		15 U	14 U	14 U
Benzoic Acid	650	650	650		110 U		110 U		110 U	110 U		110 U		110 U	110 U	110 U
Benzyl Alcohol	57	57	73		14 U		14 U		14 U	14 U		14 U		14 U	14 U	14 U
Pentachlorophenol	360	360	690		46 U		46 U		46 U	46 U		46 U		47 U	46 U	46 U
Phenol	420	420	1,200		13 U		**200**		13 U	**30**		13 U		14 U	13 U	**140**
Miscellaneous Extractables (ug/kg dry weight or mg/kg OC)																
Dibenzofuran (dry)	540	---	---		7.3 U		7.4 U		7.4 U	7.3 U		7.3 U		7.5 U	7.4 U	7.4 U
Dibenzofuran (OC)	---	15	58		0.50 U		1.2 U		0.93 U	0.30 U		1.1 U		1.2 U	1.3 U	2.7 U
Hexachlorobenzene (dry)	22	---	---		7.8 U		7.8 U		7.8 U	7.7 U		7.8 U		7.9 U	7.8 U	7.8 U
Hexachlorobenzene (OC)	---	0.38	2.3		0.54 U		1.2 U		1.0 U	0.32 U		1.1 U		1.2 U	1.3 U	2.9 U
Hexachlorobutadiene (dry)	11	---	---		7.9 U		7.9 U		7.9 U	7.8 U		7.9 U		8.0 U	7.9 U	7.9 U
Hexachlorobutadiene (OC)	---	3.9	6.2		0.54 U		1.3 U		1.0 U	0.32 U		1.2 U		1.3 U	1.3 U	2.9 U
N-Nitrosodiphenylamine (dry)	28	---	---		8.4 U		8.5 U		8.5 U	8.4 U		8.4 U		8.6 U	8.5 U	8.5 U
N-Nitrosodiphenylamine (OC)	---	11	11		0.58 U		1.4 U		1.1 U	0.35 U		1.2 U		1.3 U	1.4 U	3.1 U
2-Methylphenol	---	63	63		14 U		14 U		14 U	14 U		14 U		14 U	14 U	14 U
4-Methylphenol	---	670	670		12 U		12 U		12 U	**140**		12 U		13 U	12 U	12 U
Polychlorinated Biphenyls (ug/kg dry weight or mg/kg OC)																
Total PCBs (OC) [c]	---	12	65		0.27 UJ		0.56 UJ		0.5 U	**2.5 J**		0.57 U		0.59 U	0.68 U	1.4 U
Total PCBs (dry) [c]	130	---	---		3.9 UJ		3.5 UJ		4.0 U	**60 J**		3.9 U		3.8 U	4.0 U	3.8 U
Aroclor 1016	---	---	---		1.6 UJ		1.6 UJ		1.6 U	**50 J**		1.5 U		1.5 U	1.6 U	1.5 U
Aroclor 1221	---	---	---		3.9 UJ		4.0 UJ		4.0 U	4.0 UJ		3.9 U		3.8 U	4.0 U	3.8 U
Aroclor 1232	---	---	---		3.4 UJ		3.5 UJ		3.5 U	3.5 UJ		3.4 U		3.3 U	3.5 U	3.3 U
Aroclor 1242	---	---	---		1.0 UJ		1.0 UJ		1.0 U	1.1 UJ		1.0 U		1.0 U	1.1 U	0.99 U
Aroclor 1248	---	---	---		0.63 UJ		0.64 UJ		0.65 U	0.65 UJ		0.63 U		0.62 U	0.65 U	0.61 U
Aroclor 1254	---	---	---		1.0 UJ		1.0 UJ		1.0 U	1.1 UJ		1.0 U		1.0 U	1.1 U	0.99 U
Aroclor 1260	---	---	---		1.5 UJ		1.5 UJ		1.5 U	**9.9 J**		1.4 U		1.4 U	1.5 U	1.4 U
Chlorinated Pesticides (ug/kg dry weight)																
4,4'-DDD	16	---	---		0.14 U		**0.19 J**		0.15 U	0.14 U		**0.33 J**		0.14 U	**0.15 J**	0.13 U
4,4'-DDE	9	---	---		0.14 U		0.14 U		0.14 U	0.14 U		**1.2 J**		0.14 U	0.14 U	0.13 U
4,4'-DDT	34	---	---		0.15 U		**4.5**		0.15 U	0.15 U		0.15 U		**0.57 J**	0.15 U	0.14 U
Aldrin	---	---	---		0.22 U		0.22 U		0.22 U	0.22 U		0.21 U		0.22 U	0.22 U	0.2 U
alpha-Chlordane	---	---	---		0.13 U		0.13 U		0.13 U	0.13 U		0.13 U		**0.49 J**	0.13 U	**0.19 J**
Dieldrin	---	---	---		0.12 U		0.12 U		0.12 U	0.12 U		**0.13 J**		0.12 U	0.12 U	0.11 U
gamma-BHC	---	---	---		0.077 U		0.077 U		0.077 U	0.077 U		**0.25 J**		0.076 U	0.077 U	0.072 U
Heptachlor	---	---	---		0.46 U		0.46 U		0.46 U	0.46 U		0.45 U		0.45 U	0.46 U	0.43 U
Petroleum Hydrocarbons (mg/kg dry weight)																
Gasoline	---	---	---											31 UJ	29 UJ	25 U
Diesel Range	---	---	---											76 UJ	72 UJ	63 U
Motor Oil	---	---	---											150 UJ	140 UJ	130 U
Dioxins/Furans (ng/kg dry weight)																
DX TOTAL (TEQ ND=1/2 DL)	---	---	---		**13**		**1.77**		**2.09**	**9.74**		**2.71**		**0.692**	**0.508**	**0.245**
1,2,3,4,6,7,8-HPCDD	---	---	---		**224 B**		**40 B**		**48.8 B**	**184 B**		**64.2 B**		**15.9 B**	**10.3 B**	**4.17 B**
1,2,3,4,6,7,8-HPCDF	---	---	---		**71.7 B**		**14.2 B**		**18.3 B**	**64.1 B**		**24.7 B**		**3.36 B**	**2.4 B**	**0.96 B**
1,2,3,4,7,8,9-HPCDF	---	---	---		**4.96**		**0.911**		**1.15**	**3.98**		**1.59**		**0.23 J**	**0.148 J**	**0.071 J**
1,2,3,4,7,8-HXCDD	---	---	---		**3.51**		**0.538**		**0.684**	**2.85**		**0.708**		**0.31 J**	**0.225 J**	**0.081 J**
1,2,3,4,7,8-HXCDF	---	---	---		**9.8**		**1.37**		**1.64**	**7.96**		**2.31**		**0.412 J**	**0.352 J**	**0.145 J**
1,2,3,6,7,8-HXCDD	---	---	---		**18.5**		**2.41**		**2.63**	**13.4**		**3.44**		**1.11**	**0.841**	**0.289 J**
1,2,3,6,7,8-HXCDF	---	---	---		**3.27**		**0.457**		**0.523**	**2.59**		**0.717**		**0.174 J**	**0.137 J**	**0.043 J**
1,2,3,7,8,9-HXCDD	---	---	---		**12.4**		**1.59**		**1.8**	**9.59**		**2.22**		**1**	**0.683**	**0.229 J**
1,2,3,7,8,9-HXCDF	---	---	---		**0.318 J**		**0.048 J**		**0.048 J**	**0.229 J**		**0.078 J**		0.0256 U	0.0243 U	0.0244 U
1,2,3,7,8-PECDD	---	---	---		**2.65**		**0.305 J**		**0.34 J**	**1.86**		**0.377 J**		**0.261 J**	**0.165 J**	**0.078 J**
1,2,3,7,8-PECDF	---	---	---		**1.79**		**0.183 J**		**0.213 J**	**1.12**		**0.23 J**		**0.173 J**	**0.123 J**	**0.057 J**
2,3,4,6,7,8-HXCDF	---	---	---		**2.9**		**0.442 J**		**0.55**	**2.24**		**0.684**		**0.19 J**	**0.134 J**	**0.054 J**
2,3,4,7,8-PECDF	---	---	---		**3.22 B**		**0.279 BJ**		**0.358 J**	**1.96**		**0.369 J**		**0.225 BJ**	**0.193 BJ**	**0.080 BJ**
2,3,7,8-TCDD	---	---	---		**0.515**		**0.068 J**		**0.068 J**	**0.277**		**0.082 J**		**0.091 J**	**0.052 J**	**0.033 J**
2,3,7,8-TCDF	---	---	---		**1.86**		**0.19**		**0.199**	**1.2**		**0.197**		**0.366**	**0.342**	**0.161**
OCDD	---	---	---		**1,790 B**		**330 B**		**420 B**	**1370 B**		**577 B**		**129 B**	**74.1 B**	**28.9 B**
OCDF	---	---	---		**193 B**		**41.4 B**		**53.1 B**	**152 B**		**73.8 B**		**8.07 B**	**5.63 B**	**1.98 B**

Parameter	Freshwater Sediment Apparent Effects Threshold[a] LAET	Marine Sediment Management Standard[b] SQS	CSL	Hammersley Inlet HI-02-SC-12 (1 to 2 ft)	HI-03-SS-00 (0 to 10 cm)	HI-03-SC-12 [d] (1 to 2 ft)	HI-04-SS-00 (0 to 10 cm)	HI-04-SC-12 (1 to 2 ft)	HI-05-SS-00 (0 to 10 cm)	HI-06-SS-00 (0 to 10 cm)	HI-06-SC-12 (1 to 2 ft)	HI-07-SS-00 (0 to 10 cm)	HI-07-SC-12 [d] (1 to 2 ft)	Reference RF-01-SS-00 (0 to 10 cm)	RF-02-SS-00 (0 to 10 cm)	RF-03-SS-00 [d] (0 to 10 cm)
TOTAL HEPTA-DIOXINS	---	---	---		**787 B**		**95.5 B**		**123 B**	**529 B**		**150 B**		**46.6 B**	**29.2 B**	**10.5 B**
TOTAL HEPTA-FURANS	---	---	---		**285**		**45.7**		**68.2 B**	**278 B**		**88.7 B**		**11.2**	**7.68**	**2.41**
TOTAL HEXA-DIOXINS	---	---	---		**322**		**35.6**		**43.5**	**227**		**53.7**		**12.5**	**8.92**	**3.27**
TOTAL HEXA-FURANS	---	---	---		**162**		**20.4**		**24.1**	**112**		**35.1**		**4.84**	**3.71**	**1.04**
TOTAL PENTA-DIOXINS	---	---	---		**101**		**10.5**		**15.5**	**83.8**		**16.9**		**2.33**	**1.9**	**0.41**
TOTAL PENTA-FURANS	---	---	---		**81.9**		**6**		**7.32**	**49.3**		**9.71**		**3.52**	**2.49**	**0.5**
TOTAL TETRA-DIOXINS	---	---	---		**91.3**		**6.51**		**10.2**	**65.5**		**10.5**		**2.26**	**1.53**	**0.359**
TOTAL TETRA-FURANS	---	---	---		**55.5**		**3.4**		**4.22**	**35.6**		**4.22**		**4.33**	**3.38**	**0.591**
Guaicols and Resin Acids (ug/kg dry weight)																
12-Chlorodehydroabietic Acid	---	---	---				98 U							99 U	98 U	98 U
14-Chlorodehydroabietic Acid	---	---	---				98 U							99 U	98 U	98 U
3,4,5-Trichloroguaiacol	---	---	---											20 U	20 U	20 U
3,4,6-Trichloroguaiacol	---	---	---											20 U	20 U	20 U
3,4-Dichloroguaiacol	---	---	---											20 U	20 U	20 U
4,5,6-Trichloroguaiacol	---	---	---											20 U	20 U	20 U
4,5-Dichloroguaiacol	---	---	---											20 U	20 U	20 U
4,6-Dichloroguaiacol	---	---	---											20 U	20 U	20 U
4-Chloroguaiacol	---	---	---											20 U	20 U	20 U
9,10-Dichlorostearic Acid	---	---	---				98 U							99 U	98 U	98 U
Abietic Acid	---	---	---				98 U							99 U	**730 J**	98 U
Dehydroabietic Acid	---	---	---				98 U							99 U	98 U	98 U
Dichlorodehydroabietic Acid	---	---	---				98 U							99 U	98 U	98 U
Guaiacol	---	---	---											20 U	20 U	20 U
Isopimaric Acid	---	---	---				98 U							99 U	98 U	98 U
Linolenic Acid	---	---	---				**290**							99 U	98 U	98 U
Neoabietic Acid	---	---	---				98 U							99 UJ	98 UJ	98 UJ
Oleic Acid	---	---	---				**2,500**							**120**	98 U	98 U
Palustric Acid	---	---	---				98 U							99 U	98 U	98 U
Pimaric Acid	---	---	---				98 U							99 U	98 U	98 U
Retene	---	---	---											20 U	20 U	20 U
Sandaracopimaric Acid	---	---	---				160 U							99 U	98 U	98 U
Tetrachloroguaiacol	---	---	---											20 U	20 U	20 U
Total resin acids [c]	---	---	---				**2,800**							**120**	**730 J**	98 U

[a] Lowest and second lowest apparent effects thresholds for freshwater sediments in Washington State 2003).

[b] Washington State Marine Sediment Management Standards, Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) (WAC Chapter 173-204).

[c] Totals only include detected and estimated values

[d] Sample has organic carbon content less than 0.5 percent or greater than 4.0 percent and should be compared to LAET criteria rather than organic-carbon normalized SMS criteria.

ng/kg	nanograms per kilogram
µg/kg	micrograms per kilogram.
mg/kg	milligrams per kilogram.
PCBs	polychlorinated biphenyls.

Bold type indicates the sample result is greater than the laboratory detection limit.

Underlined	value indicates the sample result or detection limit is greater than the LAET or SQS value.
Shaded	value indicates the sample result or detection limit is greater than the CSL value.
U	The material was analyzed for, but was not detected. The associated numerical value is the detection limit. For petroleum hydrocarbons, guaiacols and resin acids, the associated numerical value is the reporting limit.
J	The associated numerical value is considered an estimated concentration.
G	Bias is high.
B	Specifyied compound was detected in the associated method blank.

LPAH represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH sum.

HPAH represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total benzofluoranthenes represents the sum of the concentrations of the "b" and "k" isomers.

Total PAHs (carcinogenic) represents the sum of the following PAH compounds: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene.

APPENDIX I

Summary Radiological Analytical Results

Table I-1. Radiological results for the Oakland Bay sediment study.

Station ID	Sample Depth Interval (cm)	Parameter	Result (pci/g)
OB-15	0-3	Pb-210	1.57E+00
OB-15	7-9	Cs-137	6.03E-02 U
OB-15	10-12	Pb-210	1.03E+00
OB-15	16-18	Cs-137	1.37E-01
OB-15	19-21	Pb-210	1.22E+00
OB-15	28-30	Pb-210	8.12E-01
OB-15	31-33	Cs-137	1.01E-01 U
OB-15	37-39	Pb-210	1.13E+00
OB-15	46-48	Pb-210	3.04E-01 U
OB-15	55-57	Pb-210	6.45E-01
OB-15	64-66	Pb-210	4.49E-01
OB-15	73-75	Pb-210	6.24E-01
OB-15	82-84	Pb-210	2.38E-01 U
OB-15	91-93	Pb-210	6.44E-01
OB-15	100-102	Pb-210	3.20E-01
OB-15	109-111	Pb-210	6.46E-01
OB-15	118-120	Pb-210	3.69E-01
OB-16	0-3	Pb-210	2.09E+00
OB-16	7-9	Cs-137	1.84E-01
OB-16	10-12	Pb-210	1.26E+00
OB-16	16-18	Cs-137	1.54E-01
OB-16	19-21	Pb-210	1.22E+00
OB-16	25-27	Cs-137	1.93E-01
OB-16	28-30	Pb-210	1.30E+00
OB-16	37-39	Pb-210	4.88E-01
OB-16	40-42	Cs-137	6.70E-02 U
OB-16	46-48	Pb-210	7.70E-01
OB-16	55-57	Pb-210	7.07E-01
OB-16	64-66	Pb-210	8.27E-01
OB-16	73-75	Pb-210	6.12E-01
OB-16	82-84	Pb-210	4.08E-01
OB-16	91-93	Pb-210	6.13E-01
OB-16	100-102	Pb-210	9.27E-01
OB-16	103-105	Cs-137	1.39E-02 U
OB-16	109-111	Pb-210	4.28E-01
OB-16	118-120	Pb-210	2.88E-01 U
SH-17	0-3	Pb-210	8.84E-01
SH-17	10-12	Pb-210	5.20E-01
SH-17	19-21	Pb-210	4.81E-01
SH-17	28-30	Pb-210	3.82E-01
SH-17	37-39	Pb-210	2.50E-01
SH-17	46-48	Pb-210	2.44E-01
SH-17	55-57	Pb-210	5.15E-02 U
SH-17	64-66	Pb-210	1.43E-01 U
SH-17	73-75	Pb-210	1.13E-01 U
SH-17	82-84	Pb-210	3.00E-01
SH-17	91-93	Pb-210	5.45E-02 U
SH-17	100-102	Pb-210	5.20E-02 U
SH-17	109-111	Pb-210	3.97E-01
SH-17	118-120	Pb-210	1.37E-01 U

APPENDIX J

QA1 Data Validation Memos

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 8, 2008	**Review Completed by: Gina Catarra**
Laboratory: Test America Tacoma	**Laboratory Work Order : 11422**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-01-SS-00	9/29/08 ; 18:05	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-02-SS-00	9/30/08 ; 10:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-10-SS-00	9/30/08 ; 13:40	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-14-SS-00	9/30/08 ; 15:05	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-22-WS-00	9/30/08 ; 16:48	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-23-WS-00	9/30/08 ; 15:43	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-26-WS-00	9/30/08 ; 12:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-27-WS-00	9/30/08 ; 11:55	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-28-WS-00	9/30/08 ; 14:29	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-10-SC-12	9/30/08 ; 14:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-14-SC-12	9/30/08 ; 17:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-23-WC-12	9/30/08 ; 18:20	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-28-WC-12	9/30/08 ; 19:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls

Analytical methods

Analysis	Analytical Method	Number of Samples
Metals	EPA method 6020	13
Mercury	EPA method 7471A	13
Pesticides	EPA method 8081A	13
Polychlorinated biphenyls (PCBs)	EPA method 8082	13
Petroleum hydrocarbons	Ecology's NWTPH-HCID	2

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 8, 2008	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11422

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	No

Pesticides and PCBs Checklist

Any compounds present in method blanks?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, refer to table below. Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on surrogate recoveries.
MS/MSD percent recovery values within laboratory QC criteria?	No, refer to table below. The sample results were qualified as estimated.
MS/MSD relative percent difference values within QC criteria of <35%?	Yes, refer to table below. RPD for 4,4-DDT was 45 percent. No data qualified.
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	No, refer to table below. Beta-BHC recovery was high. All detected values for beta-BHC were qualified as estimated (J).
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes, methoxychlor exceeded the linear range for sample SH-22-WS-00. Only the dilution was reported
Spot check retention time windows and second column confirmations as complete.	Sample results that exceeded a relative percent difference of 40% between columns were qualified as estimated bias low (JG or JTG).

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Petroleum Hydrocarbons Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
Laboratory QC frequency of one blank with each batch and one duplicate per 20 samples?	Yes
Duplicate relative percent difference values less than 35 percent?	Yes

Metals Checklist

Any compounds present in method blank?	Yes, see table below.
For samples, if results are <5 times the blank then "U" flag data.	All results for copper, nickel, and zinc were greater than 5 times the blank result. No data were qualified.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Copper, nickel, and zinc were detected in the method blank. No samples were qualified because all sample results for copper, nickel, and zinc were greater than 5 times the method blank results.

- Surrogate recoveries for pesticide and PCB analyses were below the lower laboratory control limits as shown in the table below. Data were qualified as estimated bias low (JG, JTG, or UJG) if the surrogate recovery values were below the EPA CLP limits of 30 to 150 percent.

- The relative percent difference (RPD) value in the MS/MSD analysis for 4,4’-DDT (45 percent) was outside of the control limit of less than 35 percent. No data were qualified because the RPD value met the QA1 Action Limit of 50 percent.

- Percent recovery values for methoxychlor (36 percent) in the MSD, and Aroclor 1016 (32 and 24 percent) and Aroclor 1260 (35 and 26 percent) in both the MS and MSD analyses of sample SH-28-WC-12 exceeded the laboratory control limits (46 to 154 percent for methoxychlor, 40 to 140 percent for Aroclor 1016, and 60 to 130 percent for Aroclor 1260). No results for methoxychlor were qualified because the percent recovery for the MS was within control limits. The PCB results for sample SH-28-WC-12 were qualified as estimated bias low (UJG) due to matrix spike recovery exceedance.

- The percent recovery for beta-BHC (127 percent) in the laboratory control sample exceeded the control limits of 48 to 121 percent. Only samples with a detected result for beta-BHC (SH-14-SS-00, SH-14-SC-12, and SH-23-WC-12) were qualified as estimated.

- Several chlorinated pesticides compounds were identified with a RPD value between the primary and secondary columns greater than the 40 percent method limit. The lower of the two values were reported by the laboratory for all samples. As shown in the table below, compounds with a RPD between columns of greater than 40 percent were qualified as estimated bias low.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 8, 2008	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11422

Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
6020	MB-580-36868	Method	Copper	0.025	J	mg/kg	0.20
6020	MB-580-36868	Method	Nickel	0.0064	J	mg/kg	0.20
6020	MB-580-36868	Method	Zinc	0.63	J	mg/kg	0.70

Samples Qualified for Positive Method Blank Results

No samples qualified for positive method blank results

Samples Qualified for Surrogate Recoveries Outside Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8081A	SH-01-SS-00	Tetrachloro-m-xylene	36	49-123	30-150	None
8081A	SH-01-SS-00	Decachlorobiphenyl	16	40-158	30-150	JTG or UJG
8081A	SH-02-SS-00	Decachlorobiphenyl	30	40-158	30-150	None
8081A	SH-10-SS-00	Tetrachloro-m-xylene	44	49-123	30-150	None
8081A	SH-10-SS-00	Decachlorobiphenyl	21	40-158	30-150	JTG or UJG
8081A	SH-14-SS-00	Tetrachloro-m-xylene	25	49-123	30-150	JG, JTG, or UJG
8081A	SH-14-SS-00	Decachlorobiphenyl	11	40-158	30-150	JG, JTG, or UJG
8081A	SH-22-WS-00	Tetrachloro-m-xylene	44	49-123	30-150	None
8081A	SH-23-WS-00	Tetrachloro-m-xylene	43	49-123	30-150	None
8081A	SH-27-WS-00	Decachlorobiphenyl	35	40-158	30-150	None
8081A	SH-28-WS-00	Decachlorobiphenyl	33	40-158	30-150	None
8081A	SH-10-SC-12	Decachlorobiphenyl	36	40-158	30-150	None
8082	SH-01-SS-00	Tetrachloro-m-xylene	24	45-155	30-150	JG of UJG
8082	SH-01-SS-00	Decachlorobiphenyl	21	60-125	30-150	JG of UJG
8082	SH-02-SS-00	Tetrachloro-m-xylene	30	45-155	30-150	None
8082	SH-02-SS-00	Decachlorobiphenyl	26	60-125	30-150	UJG
8082	SH-10-SS-00	Tetrachloro-m-xylene	25	45-155	30-150	UJG
8082	SH-10-SS-00	Decachlorobiphenyl	20	60-125	30-150	UJG
8082	SH-14-SS-00	Tetrachloro-m-xylene	32	45-155	30-150	None
8082	SH-14-SS-00	Decachlorobiphenyl	31	60-125	30-150	None
8082	SH-22-WS-00	Tetrachloro-m-xylene	20	45-155	30-150	UJG
8082	SH-22-WS-00	Decachlorobiphenyl	25	60-125	30-150	UJG
8082	SH-23-WS-00	Tetrachloro-m-xylene	30	45-155	30-150	None
8082	SH-23-WS-00	Decachlorobiphenyl	29	60-125	30-150	UJG
8082	SH-27-WS-00	Tetrachloro-m-xylene	42	45-155	30-150	None
8082	SH-27-WS-00	Decachlorobiphenyl	34	60-125	30-150	None
8082	SH-28-WS-00	Tetrachloro-m-xylene	22	45-155	30-150	UJG
8082	SH-28-WS-00	Decachlorobiphenyl	22	60-125	30-150	UJG
8082	SH-10-SC-12	Decachlorobiphenyl	52	60-125	30-150	None
8082	SH-10-SC-12	Decachlorobiphenyl	34	60-125	30-150	None
8082	SH-23-WC-12	Tetrachloro-m-xylene	23	45-155	30-150	UJG
8082	SH-23-WC-12	Decachlorobiphenyl	22	60-125	30-150	UJG
8082	SH-28-WC-12	Tetrachloro-m-xylene	25	45-155	30-150	UJG
8082	SH-28-WC-12	Decachlorobiphenyl	21	60-125	30-150	UJG

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
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Laboratory: Test America Tacoma	Laboratory Work Order : 11422

Duplicate or Triplicate Results Outside Control Limits

Method	Sample ID	Type	Compound	% RPD	Limits	Qualifier
8081A	SH-28-WC-12	MS/MSD	4,4’-DDT	45	0-35	None

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Type	Compound	% Rec	Limits	Qualifier
8081A	SH-28-WC-12	MSD	Methoxychlor	36	46-154	None
8082	SH-28-WC-12	MS	Aroclor 1016	32	40-140	UJG
8082	SH-28-WC-12	MSD	Aroclor 1260	35	60-130	UJG
8082	SH-28-WC-12	MS	Aroclor 1016	24	40-140	UJG
8082	SH-28-WC-12	MSD	Aroclor 1260	26	60-130	UJG

Samples Qualified for Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
8081A	SH-14-SS-00	beta-BHC	127	48-121	J
8081A	SH-14-SC-12	beta-BHC	127	48-121	J
8081A	SH-23-WC-12	beta-BHC	127	48-121	J

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

Sample ID	Compound	Reason for reanalysis
SH-22-WS-00	Methoxychlor	Result exceeded linear range. Analyzed at a 10x dilution.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
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Laboratory: Test America Tacoma	Laboratory Work Order : 11422

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

Method	Sample ID	Compound	Limits	Qualifier
8081A	SH-01-SS-00	alpha-BHC	< 40 percent	JTG
8081A	SH-02-SS-00	alpha-BHC	< 40 percent	JTG
8081A	SH-02-SS-00	gamma-BHC	< 40 percent	JTG
8081A	SH-02-SS-00	Methoxychlor	< 40 percent	JTG
8081A	SH-10-SS-00	alpha-BHC	< 40 percent	JTG
8081A	SH-10-SS-00	Heptachlor	< 40 percent	JTG
8081A	SH-14-SS-00	4,4’-DDD	< 40 percent	JG
8081A	SH-14-SS-00	Endosulfan I	< 40 percent	JG
8081A	SH-22-WS-00	Aldrin	< 40 percent	JTG
8081A	SH-22-WS-00	Endosulfan I	< 40 percent	JG
8081A	SH-23-WS-00	alpha-BHC	< 40 percent	JTG
8081A	SH-23-WS-00	Dieldrin	< 40 percent	JTG
8081A	SH-27-WS-00	delta-BHC	< 40 percent	JTG
8081A	SH-27-WS-00	Heptachlor	< 40 percent	JTG
8081A	SH-28-WS-00	alpha-BHC	< 40 percent	JTG
8081A	SH-28-WS-00	delta-BHC	< 40 percent	JTG
8081A	SH-10-SC-12	4,4’-DDD	< 40 percent	JTG
8081A	SH-14-SC-12	Aldrin	< 40 percent	JTG
8081A	SH-14-SC-12	alpha-BHC	< 40 percent	JTG
8081A	SH-14-SC-12	4,4’-DDD	< 40 percent	JTG
8081A	SH-14-SC-12	4,4’-DDT	< 40 percent	JG
8081A	SH-14-SC-12	Endosulfan I	< 40 percent	JTG
8081A	SH-14-SC-12	Endosulfan II	< 40 percent	JTG
8081A	SH-14-SC-12	Heptachlor epoxide	< 40 percent	JTG
8081A	SH-14-SC-12	Methoxychlor	< 40 percent	JTG
8081A	SH-14-SC-12	Endrin ketone	< 40 percent	JG
8081A	SH-23-WC-12	Endosulfan I	< 40 percent	JTG
8081A	SH-28-WC-12	alpha-BHC	< 40 percent	JTG
8081A	SH-28-WC-12	Endosulfan II	< 40 percent	JTG
8081A	SH-28-WC-12	gamma-Chlordane	< 40 percent	JTG

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 8, 2008	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11422

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
UJG	Analyte was not detected at or above the reported estimate with likely low bias.

Quality Assurance Review Level 1 Report	**Project: Ecology – Oakland Bay**
Date Completed: January 14, 2009	**Review Completed by: Gina Catarra**
Laboratory: Test America Tacoma	**Laboratory Work Order : 11469**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 14, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11469

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-05-SS-00	10/01/08 ; 09:11	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-04-SS-00	10/01/08 ; 09:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-09-SS-00	10/01/08 ; 11:21	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-21-WS-00	10/01/08 ; 11:45	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-20-WS-00	10/01/08 ; 12:28	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-19-WS-00	10/01/08 ; 12:52	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-24-WS-00	10/01/08 ; 13:32	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-15-SS-00	10/01/08 ; 15:44	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-29-WS-00	10/01/08 ; 16:19	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-16-SS-00	10/01/08 ; 16:54	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-30-WS-00	10/01/08 ; 17:15	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-03-SS-00	10/01/08 ; 10:20	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-15-SC-12	10/01/08 ; 16:20	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-01-SC-12	10/01/08 ; 12:35	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-09-SC-12	10/01/08 ; 18:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
HI-07-SS-00	10/02/08 ; 08:48	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-12-SS-00	10/02/08 ; 09:40	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-11-SS-00	10/02/08 ; 10:32	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-18-WS-00	10/02/08 ; 11:15	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-25-WS-00	10/02/08 ; 12:05	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
HI-05-SS-00	10/02/08 ; 13:24	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-02-SS-00	10/02/08 ; 14:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-01-SS-00	10/02/08 ; 15:23	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
OB-03-SS-00	10/02/08 ; 16:10	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-21-WC-12	10/02/08 ; 09:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-16-SC-12	10/02/08 ; 12:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-30-WC-12	10/02/08 ; 13:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-12-SC-12	10/02/08 ; 15:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-18-WC-12	10/02/08 ; 16:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 14, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11469

Analytical methods

Analysis	Analytical Method	Number of Samples
Metals	EPA method 6020	29
Mercury	EPA method 7471A	29
Pesticides	EPA method 8081A	29
Polychlorinated biphenyls (PCBs)	EPA method 8082	29
Petroleum hydrocarbons	Ecology's NWTPH-HCID	4

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	Yes. Twenty-one samples prepared outside of holding time for PCBs analysis because samples required extensive clean-up due to interferences. Originally prepared within holding time, but needed to be re-extracted due to matrix interferences.

Pesticides and PCBs Checklist

Any compounds present in method blanks?	Yes
For samples, if results are <5 times the blank then "U" flag data.	See table below.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	No, see table below.
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
MS/MSD percent recovery values within laboratory QC criteria?	No, see table below
MS/MSD relative percent difference values within QC criteria of <35%?	No, see table below.
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	No, see table below.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes

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Pesticides and PCBs Checklist

Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	See table below. Sample results that exceeded a relative percent difference of 40% between columns were qualified as estimated bias low (JG,UJG, or JTG).

Petroleum Hydrocarbons Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
Laboratory QC frequency of one blank with each batch and one duplicate per 20 samples?	Yes
Duplicate relative percent difference values less than 35 percent?	Yes

Metals Checklist

Any compounds present in method blank?	Yes, see table below.
For samples, if results are <5 times the blank then "U" flag data.	None less than 5 times blank result.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	No, mercury result for duplicate analysis of sample SH-21-WS-00 was 43%.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Twenty-one samples were extracted outside of holding time (1, 2, or 5 days) for PCB analysis. These 21 samples were originally extracted within holding time (14 days from collection), but after initial analysis it was determined that the samples needed extensive cleanup due to matrix interferences. PCBs were not detected in any of the 21 samples, so all results were qualified as estimated at the detection limit (UJ), as shown in the table below.

- Endrin and heptachlor epoxide were detected in the method blank for sample batch 36847. Samples with detected concentrations of endrin or heptachlor epoxide that were less than 5 times the method blank concentration were qualified as undetected (U), as shown in the table below.

- Several metals were detected in each of the three method blanks, as shown in the table below. No samples were qualified because all sample results for all analytes were greater than 5 times the method blank results.

- Surrogate recoveries for pesticides and PCB analyses of several samples were below the lower laboratory control limits as shown in the table below. Data were qualified because of surrogate recovery value criteria if the recovery value did not meet the EPA CLP limits of 30 to 150 percent, as shown in the table below.

- RPD values for all pesticide compounds for the MS/MSD analysis of sample SH-21-WS-00 exceeded the less than 35 percent criterion. Results for sample SH-21-WS-00 were qualified as estimated (UJG of JG), as shown in the table below.

- The RPD value for Aroclor 1016 for the MS/MSD analysis of sample SH-04-SS-00 exceeded the less than 35 percent criterion. Results for sample SH-04-SS-00 were qualified as estimated (UJG), as shown in the table below.

- The RPD value for mercury for the laboratory duplicate analysis of sample SH-21-WS-00 exceeded the less than 20 percent criterion. The mercury result for sample SH-21-WS-00 was qualified as estimated (J), as shown in the table below.

- The percent recovery values for all pesticide and PCB compounds for the MS/MSD analysis of sample SH-21-WS-00 exceeded the laboratory control limits. Results for sample SH-21-WS-00 were qualified as estimated (UJG or JG), as shown in the table below.

- The percent recovery values for alpha-chlordane, gamma-chlordane, and aldrin for the LCS analyses exceeded the upper control limits. All associated samples with reported results of alpha-chlordane, gamma-chlordane, and aldrin above the detection limit were qualified as estimated (J), as shown in the table below.

- Several chlorinated pesticides compounds were identified with a RPD value between the primary and secondary columns greater than the 40 percent method limit. As shown in the table below, compounds with a RPD between columns of greater than 40 percent were qualified as estimated.

Samples Analyzed Outside of Holding Time

Method	Sample ID	Analyses	Holding Time	Day Outside of Holding Time	Qualifier
8082	SH-04-SS-00	PCBs	14 days	2	UJG
8082	SH-09-SS-00	PCBs	14 days	2	UJ
8082	SH-20-WS-00	PCBs	14 days	2	UJ
8082	SH-19-WS-00	PCBs	14 days	2	UJ
8082	SH-24-WS-00	PCBs	14 days	2	UJ
8082	SH-30-WS-00	PCBs	14 days	2	UJ
8082	SH-03-SS-00	PCBs	14 days	2	UJ
8082	SH-15-SC-12	PCBs	14 days	2	UJ
8082	SH-01-SC-12	PCBs	14 days	2	UJ
8082	SH-09-SC-12	PCBs	14 days	2	UJ
8082	SH-12-SS-00	PCBs	14 days	1	UJ
8082	SH-18-WS-00	PCBs	14 days	1	UJ
8082	SH-25-WS-00	PCBs	14 days	1	UJ
8082	OB-02-SS-00	PCBs	14 days	1	UJ
8082	OB-01-SS-00	PCBs	14 days	1	UJ
8082	OB-03-SS-00	PCBs	14 days	1	UJ
8082	SH-21-WC-12	PCBs	14 days	1	UJ
8082	SH-16-SC-12	PCBs	14 days	1	UJ
8082	SH-30-WC-12	PCBs	14 days	1	UJ
8082	SH-12-SC-12	PCBs	14 days	5	UJ
8082	SH-18-WC-12	PCBs	14 days	5	UJ

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Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
8081A	MB-580-36847	Method	Endrin	0.21	J	ug/L	2.0
8081A	MB-580-36847	Method	Heptachlor epoxide	0.016	J	ug/L	1.0
6020	MB-580-36868	Method	Copper	0.025	J	mg/kg	0.20
6020	MB-580-36868	Method	Nickel	0.0064	J	mg/kg	0.20
6020	MB-580-36868	Method	Zinc	0.63	J	mg/kg	0.70
6020	MB-580-36872	Method	Cadmium	0.0023	J	mg/kg	0.20
6020	MB-580-36872	Method	Chromium	0.0097	J	mg/kg	0.20
6020	MB-580-36872	Method	Lead	0.0023	J	mg/kg	0.20
6020	MB-580-36872	Method	Silver	0.0011	J	mg/kg	0.20
6020	MB-580-36872	Method	Zinc	0.033	J	mg/kg	0.70
6020	MB-580-36873	Method	Cadmium	0.0026	J	mg/kg	0.20
6020	MB-580-36873	Method	Chromium	0.017	J	mg/kg	0.20
6020	MB-580-36873	Method	Copper	0.0044	J	mg/kg	0.20
6020	MB-580-36873	Method	Lead	0.0057	J	mg/kg	0.20
6020	MB-580-36873	Method	Nickel	0.019	J	mg/kg	0.20
6020	MB-580-36873	Method	Silver	0.0038	J	mg/kg	0.20
6020	MB-580-36873	Method	Zinc	0.030	J	mg/kg	0.70

Samples Qualified for Positive Method Blank Results

Method	Sample ID	Compound	Result	Units	Qualifier
8081A	SH-11-SS-00	Endrin	0.44	ug/kg	U
8081A	SH-09-SC-12	Endrin	0.91	ug/kg	U
8081A	SH-01-SC-12	Endrin	0.44	ug/kg	U
8081A	SH-03-SS-00	Heptachlor epoxide	0.042	ug/kg	U
8081A	SH-20-WS-00	Heptachlor epoxide	0.054	ug/kg	U
8081A	SH-16-SS-00	Heptachlor epoxide	0.069	ug/kg	U
8081A	SH-16-SS-00	Endrin	0.22	ug/kg	U

Samples with Surrogate Recoveries Outside Laboratory Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8081A	Method Blank	Tetrachloro-m-xylene	128	49-123	30-150	None
8081A	SH-05-SS-00	Decachlorobiphenyl	39	40-158	30-150	None
8081A	SH-04-SS-00	Decachlorobiphenyl	30	40-158	30-150	None
8081A	SH-21-WS-00	Tetrachloro-m-xylene	45	49-123	30-150	None
8081A	SH-21-WS-00	Decachlorobiphenyl	31	40-158	30-150	None
8081A	SH-20-WS-00	Tetrachloro-m-xylene	45	49-123	30-150	None
8081A	SH-20-WS-00	Decachlorobiphenyl	35	40-158	30-150	None
8081A	SH-19-WS-00	Tetrachloro-m-xylene	41	49-123	30-150	None
8081A	SH-19-WS-00	Decachlorobiphenyl	23	40-158	30-150	UJG or JTG
8081A	SH-24-WS-00	Decachlorobiphenyl	32	40-158	30-150	None
8081A	SH-16-SS-00	Decachlorobiphenyl	26	40-158	30-150	UJG or JTG
8081A	SH-15-SC-12	Decachlorobiphenyl	20	40-158	30-150	UJG
8081A	SH-01-SC-12	Decachlorobiphenyl	31	40-158	30-150	None
8081A	SH-09-SC-12	Decachlorobiphenyl	38	40-158	30-150	None
8081A	HI-07-SS-00	Decachlorobiphenyl	38	40-158	30-150	None
8081A	SH-18-WS-00	Tetrachloro-m-xylene	44	49-123	30-150	None
8081A	SH-18-WS-00	Decachlorobiphenyl	39	40-158	30-150	None
8081A	SH-25-WS-00	Tetrachloro-m-xylene	36	49-123	30-150	None
8081A	SH-25-WS-00	Decachlorobiphenyl	27	40-158	30-150	UJG or JTG
8081A	HI-05-SS-00	Decachlorobiphenyl	30	40-158	30-150	None
8081A	OB-01-SS-00	Decachlorobiphenyl	32	40-158	30-150	None
8081A	SH-18-WC-12	Tetrachloro-m-xylene	46	49-123	30-150	None
8081A	SH-18-WC-12	Decachlorobiphenyl	36	40-158	30-150	None
8082	SH-05-SS-00	Decachlorobiphenyl	54	60-125	30-150	None
8082	SH-04-SS-00	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	SH-04-SS-00	Decachlorobiphenyl	44	60-125	30-150	None
8082	SH-09-SS-00	Decachlorobiphenyl	55	60-125	30-150	None
8082	SH-21-WS-00	Tetrachloro-m-xylene	16	45-155	30-150	UJG
8082	SH-21-WS-00	Decachlorobiphenyl	14	60-125	30-150	UJG
8082	SH-20-WS-00	Tetrachloro-m-xylene	26	45-155	30-150	UJG
8082	SH-20-WS-00	Decachlorobiphenyl	27	60-125	30-150	UJG
8082	SH-19-WS-00	Tetrachloro-m-xylene	23	45-155	30-150	UJG
8082	SH-19-WS-00	Decachlorobiphenyl	23	60-125	30-150	UJG
8082	SH-24-WS-00	Tetrachloro-m-xylene	26	45-155	30-150	UJG
8082	SH-24-WS-00	Decachlorobiphenyl	21	60-125	30-150	UJG
8082	SH-15-SS-00	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	SH-15-SS-00	Decachlorobiphenyl	56	60-125	30-150	None
8082	SH-29-WS-00	Tetrachloro-m-xylene	37	45-155	30-150	None

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Samples with Surrogate Recoveries Outside Laboratory Control Limits (continued)

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8082	SH-29-WS-00	Decachlorobiphenyl	42	60-125	30-150	None
8082	SH-16-SS-00	Tetrachloro-m-xylene	34	45-155	30-150	None
8082	SH-16-SS-00	Decachlorobiphenyl	29	60-125	30-150	UJG
8082	SH-30-WS-00	Tetrachloro-m-xylene	36	45-155	30-150	None
8082	SH-30-WS-00	Decachlorobiphenyl	32	60-125	30-150	None
8082	SH-03-SS-00	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	SH-03-SS-00	Decachlorobiphenyl	38	60-125	30-150	None
8082	SH-15-SC-12	Decachlorobiphenyl	57	60-125	30-150	None
8082	SH-01-SC-12	Decachlorobiphenyl	45	60-125	30-150	None
8082	SH-09-SC-12	Decachlorobiphenyl	57	60-125	30-150	None
8082	HI-07-SS-00	Decachlorobiphenyl	45	60-125	30-150	None
8082	SH-12-SS-00	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	SH-12-SS-00	Decachlorobiphenyl	42	60-125	30-150	None
8082	SH-11-SS-00	Tetrachloro-m-xylene	42	45-155	30-150	None
8082	SH-11-SS-00	Decachlorobiphenyl	49	60-125	30-150	None
8082	SH-18-WS-00	Tetrachloro-m-xylene	36	45-155	30-150	None
8082	SH-18-WS-00	Decachlorobiphenyl	37	60-125	30-150	None
8082	SH-25-WS-00	Tetrachloro-m-xylene	32	45-155	30-150	None
8082	SH-25-WS-00	Decachlorobiphenyl	30	60-125	30-150	None
8082	HI-05-SS-00	Decachlorobiphenyl	33	60-125	30-150	None
8082	OB-02-SS-00	Tetrachloro-m-xylene	40	45-155	30-150	None
8082	OB-02-SS-00	Decachlorobiphenyl	34	60-125	30-150	None
8082	OB-01-SS-00	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	OB-01-SS-00	Decachlorobiphenyl	38	60-125	30-150	None
8082	OB-03-SS-00	Tetrachloro-m-xylene	38	45-155	30-150	None
8082	OB-03-SS-00	Decachlorobiphenyl	43	60-125	30-150	None
8082	SH-21-WC-12	Tetrachloro-m-xylene	37	45-155	30-150	None
8082	SH-21-WC-12	Decachlorobiphenyl	38	60-125	30-150	None
8082	SH-16-SC-12	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	SH-16-SC-12	Decachlorobiphenyl	42	60-125	30-150	None
8082	SH-30-WC-12	Decachlorobiphenyl	39	60-125	30-150	None
8082	SH-12-SC-12	Tetrachloro-m-xylene	38	45-155	30-150	None
8082	SH-12-SC-12	Decachlorobiphenyl	24	60-125	30-150	UJG
8082	SH-18-WC-12	Tetrachloro-m-xylene	39	45-155	30-150	None
8082	SH-18-WC-12	Decachlorobiphenyl	29	60-125	30-150	UJG
8082	MB 580-37093	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	MB 580-37093	Decachlorobiphenyl	49	60-125	30-150	None
8082	LCS 580-36850	Decachlorobiphenyl	132	60-125	30-150	None
HCID	OB-01-SS-00	o-Terphenyl	47	50-150	NA	UJG

Duplicate or Triplicate Results Outside Control Limits

Method	Sample ID	Compound	RPD	QC Limits	Qualifier
8081A	SH-21-WS-00	alpha-BHC	43	0-35	UJG
8081A	SH-21-WS-00	delta-BHC	52	0-35	UJG
8081A	SH-21-WS-00	gamma-BHC	49	0-35	UJG
8081A	SH-21-WS-00	4,4’-DDE	40	0-35	UJG
8081A	SH-21-WS-00	4,4’-DDT	57	0-35	UJG
8081A	SH-21-WS-00	Dieldrin	37	0-35	UJG
8081A	SH-21-WS-00	Endosulfan II	55	0-35	UJG
8081A	SH-21-WS-00	Endosulfan sulfate	53	0-35	UJG
8081A	SH-21-WS-00	Endrin	55	0-35	UJG
8081A	SH-21-WS-00	Heptachlor	37	0-35	UJG
8081A	SH-21-WS-00	Heptachlor epoxide	48	0-35	UJG
8081A	SH-21-WS-00	Methyoxychlor	51	0-35	JG
8081A	SH-21-WS-00	Endrin ketone	58	0-35	UJG
8081A	SH-21-WS-00	alpha-Chlordane	37	0-35	UJG
8081A	SH-21-WS-00	gamma-Chlordane	46	0-35	UJG
8082	SH-04-SS-00	Aroclor 1016	37	0-35	UJG
7471A	SH-21-WS-00	Mercury	43	0-20	J

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Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Compound	MS % Rec	MSD %Rec	Limits	Qualifier
8081A	SH-21-WS-00	Aldrin	26	35	53-126	UJG
8081A	SH-21-WS-00	alpha-BHC	23	38	41-128	UJG
8081A	SH-21-WS-00	beta-BHC	37	53	48-121	UJG
8081A	SH-21-WS-00	delta-BHC	18	31	22-153	UJG
8081A	SH-21-WS-00	gamma-BHC	26	42	50-127	UJG
8081A	SH-21-WS-00	4,4'-DDD	18	27	44-141	UJG
8081A	SH-21-WS-00	4,4'-DDE	20	30	47-140	UJG
8081A	SH-21-WS-00	4,4'-DDT	15	27	34-159	UJG
8081A	SH-21-WS-00	Dieldrin	23	36	53-134	UJG
8081A	SH-21-WS-00	Endosulfan I	23	30	52-122	UJG
8081A	SH-21-WS-00	Endosulfan II	17	30	53-132	UJG
8081A	SH-21-WS-00	Endosulfan sulfate	17	30	42-128	UJG
8081A	SH-21-WS-00	Endrin	18	31	46-138	UJG
8081A	SH-21-WS-00	Endrin aldehyde	23	32	12-179	UJG
8081A	SH-21-WS-00	Heptachlor	20	32	50-130	UJG
8081A	SH-21-WS-00	Heptachlor epoxide	19	31	49-123	UJG
8081A	SH-21-WS-00	Methyoxychlor	11	24	46-154	JG
8081A	SH-21-WS-00	Endrin ketone	17	31	45-127	UJG
8081A	SH-21-WS-00	alpha-Chlordane	20	30	46-118	UJG
8081A	SH-21-WS-00	gamma-Chlordane	20	33	49-122	UJG
8082	SH-21-WS-00	Aroclor 1016	23	22	40-140	UJG
8082	SH-21-WS-00	Aroclor 1260	17	22	60-130	UJG
8082	SH-21-WS-00	Aroclor 1260	56	46	60-130	UJG

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Samples Qualified for Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
8081A	SH-21-WC-12	alpha-Chlordane	128	53-126	J
8081A	SH-21-WC-12	gamma-Chlordane	131	49-122	J
8081A	SH-16-SC-12	gamma-Chlordane	131	49-122	J
8081A	SH-30-WC-12	Aldrin	128	53-126	J
8081A	SH-30-WC-12	alpha-Chlordane	124	46-118	J
8081A	SH-30-WC-12	gamma-Chlordane	131	49-122	J
8081A	SH-12-SC-12	alpha-Chlordane	124	46-118	J
8081A	SH-12-SC-12	gamma-Chlordane	131	49-122	J
8081A	SH-18-WC-12	Aldrin	128	53-126	J
8081A	SH-18-WC-12	alpha-Chlordane	124	46-118	J
8081A	SH-18-WC-12	gamma-Chlordane	127	48-121	J

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

No compounds reported form reanalysis or dilution.

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

Method	Sample ID	Compound	Limits	Qualifier
8081A	SH-05-SS-00	Aldrin	< 40 percent	J
8081A	SH-05-SS-00	alpha-BHC	< 40 percent	J
8081A	SH-05-SS-00	beta-BHC	< 40 percent	J
8081A	SH-05-SS-00	delta-BHC	< 40 percent	J
8081A	SH-05-SS-00	Endosulfan sulfate	< 40 percent	J
8081A	SH-04-SS-00	Aldrin	< 40 percent	J
8081A	SH-04-SS-00	alpha-BHC	< 40 percent	J
8081A	SH-04-SS-00	beta-BHC	< 40 percent	J
8081A	SH-04-SS-00	gamma-BHC	< 40 percent	J
8081A	SH-04-SS-00	4,4’-DDD	< 40 percent	J
8081A	SH-04-SS-00	Dieldrin	< 40 percent	J
8081A	SH-04-SS-00	Heptachlor epoxide	< 40 percent	J
8081A	SH-09-SS-00	alpha-BHC	< 40 percent	J
8081A	SH-09-SS-00	gamma-BHC	< 40 percent	J
8081A	SH-09-SS-00	4,4’-DDD	< 40 percent	J
8081A	SH-09-SS-00	4,4’-DDE	< 40 percent	J
8081A	SH-09-SS-00	Dieldrin	< 40 percent	J
8081A	SH-19-WS-00	gamma-BHC	< 40 percent	JTG
8081A	SH-19-WS-00	Dieldrin	< 40 percent	JTG
8081A	SH-19-WS-00	Heptachlor epoxide	< 40 percent	JTG
8081A	SH-24-WS-00	Endrin	< 40 percent	J
8081A	SH-30-WS-00	gamma-BHC	< 40 percent	J
8081A	SH-30-WS-00	Endosulfan I	< 40 percent	J
8081A	SH-30-WS-00	Heptachlor epoxide	< 40 percent	J
8081A	SH-03-SS-00	4,4’-DDE	< 40 percent	J
8081A	SH-03-SS-00	Heptachlor epoxide	< 40 percent	U
8081A	SH-01-SC-12	delta-BHC	< 40 percent	J
8081A	SH-01-SC-12	gamma-BHC	< 40 percent	J
8081A	SH-01-SC-12	4,4’-DDE	< 40 percent	J
8081A	SH-09-SC-12	delta-BHC	< 40 percent	J
8081A	SH-09-SC-12	4,4’-DDD	< 40 percent	J
8081A	SH-09-SC-12	4,4’-DDE	< 40 percent	J
8081A	SH-09-SC-12	4,4’-DDT	< 40 percent	J
8081A	SH-09-SC-12	Endosulfan II	< 40 percent	J
8081A	SH-09-SC-12	Endosulfan sulfate	< 40 percent	J
8081A	HI-07-SS-00	gamma-BHC	< 40 percent	J
8081A	HI-07-SS-00	4,4’-DDD	< 40 percent	J

8081A	HI-07-SS-00	4,4'-DDE	< 40 percent	J
8081A	HI-07-SS-00	gamma-Chlordane	< 40 percent	J
8081A	SH-12-SS-00	4,4'-DDD	< 40 percent	J
8081A	SH-12-SS-00	4,4'-DDE	< 40 percent	J
8081A	SH-12-SS-00	4,4'-DDT	< 40 percent	J
8081A	SH-12-SS-00	Endosulfan I	< 40 percent	J
8081A	SH-12-SS-00	Endrin	< 40 percent	J
8081A	SH-12-SS-00	gamma-Chlordane	< 40 percent	J
8081A	SH-11-SS-00	4,4'-DDE	< 40 percent	J
8081A	SH-11-SS-00	4,4'-DDT	< 40 percent	J
8081A	SH-11-SS-00	Endrin	< 40 percent	U
8081A	SH-11-SS-00	Endrin aldehyde	< 40 percent	J
8081A	SH-18-WS-00	delta-BHC	< 40 percent	J
8081A	SH-18-WS-00	4,4'-DDT	< 40 percent	J
8081A	SH-25-WS-00	gamma-BHC	< 40 percent	JTG
8081A	SH-25-WS-00	4,4'-DDE	< 40 percent	JTG
8081A	HI-05-SS-00	alpha-BHC	< 40 percent	J
8081A	HI-05-SS-00	Heptachlor epoxide	< 40 percent	J
8081A	OB-02-SS-00	4,4'-DDD	< 40 percent	J
8081A	OB-02-SS-00	4,4'-DDE	< 40 percent	J
8081A	OB-02-SS-00	Endosulfan I	< 40 percent	J
8081A	OB-01-SS-00	4,4'-DDD	< 40 percent	J
8081A	OB-01-SS-00	4,4'-DDE	< 40 percent	J
8081A	SH-21-WC-12	alpha-BHC	< 40 percent	J
8081A	SH-21-WC-12	4,4'-DDD	< 40 percent	J
8081A	SH-21-WC-12	Endosulfan I	< 40 percent	J
8081A	SH-21-WC-12	Endosulfan II	< 40 percent	J
8081A	SH-21-WC-12	Endrin aldehyde	< 40 percent	J
8081A	SH-21-WC-12	alpha-Chlordane	< 40 percent	J
8081A	SH-16-SC-12	delta-BHC	< 40 percent	J
8081A	SH-16-SC-12	gamma-BHC	< 40 percent	J
8081A	SH-16-SC-12	4,4'-DDE	< 40 percent	J
8081A	SH-16-SC-12	Heptachlor epoxide	< 40 percent	J
8081A	SH-16-SC-12	gamma-Chlordane	< 40 percent	J
8081A	SH-30-WC-12	Aldrin	< 40 percent	J
8081A	SH-30-WC-12	delta-BHC	< 40 percent	J
8081A	SH-30-WC-12	gamma-BHC	< 40 percent	J
8081A	SH-30-WC-12	4,4'-DDE	< 40 percent	J
8081A	SH-30-WC-12	4,4'-DDT	< 40 percent	J
8081A	SH-30-WC-12	Endosulfan I	< 40 percent	J

8081A	SH-30-WC-12	Endosulfan II	< 40 percent	J
8081A	SH-30-WC-12	Endrin ketone	< 40 percent	J
8081A	SH-12-SC-12	4,4'-DDT	< 40 percent	J
8081A	SH-12-SC-12	Endosulfan I	< 40 percent	J
8081A	SH-12-SC-12	Endrin aldehyde	< 40 percent	J
8081A	SH-12-SC-12	alpha-Chlordane	< 40 percent	J
8081A	SH-12-SC-12	gamma-Chlordane	< 40 percent	J
8081A	SH-18-WC-12	4,4'-DDT	< 40 percent	J
8081A	SH-18-WC-12	Endosulfan I	< 40 percent	J
8081A	SH-18-WC-12	Endrin aldehyde	< 40 percent	J
8081A	SH-18-WC-12	gamma-Chlordane	< 40 percent	J

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
UJG	Analyte was not detected at or above the reported estimate with likely low bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 16, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11478

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. Te checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
OB-07-SS-00	10/05/08 ; 10:29	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-08-SS-00	10/05/08 ; 11:22	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-07-SS-00	10/05/08 ; 12:21	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-13-SS-00	10/05/08 ; 13:21	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
HI-02-SS-00	10/05/08 ; 14:35	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
HI-03-SS-00	10/05/08 ; 15:26	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
HI-04-SS-00	10/05/08 ; 16:11	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-18-WC-12	10/05/08 ; 17:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-11-SS-00	10/03/08 ; 09:40	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-09-SS-00	10/03/08 ; 11:15	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-05-SS-00	10/03/08 ; 11:55	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-17-WS-00	10/03/08 ; 13:04	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-18-WS-00	10/03/08 ; 13:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-04-SS-00	10/03/08 ; 14:52	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-06-SS-00	10/03/08 ; 15:35	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
HI-06-SS-00	10/03/08 ; 16:12	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-19-WS-00	10/04/08 ; 09:13	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-10-SS-00	10/04/08 ; 09:51	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-12-SS-00	10/04/08 ; 10:34	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
OB-13-SS-00	10/04/08 ; 11:24	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
OB-14-SS-00	10/04/08 ; 13:25	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons

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Analytical methods

Analysis	Analytical Method	Number of Samples
Metals	EPA method 6020	21
Mercury	EPA method 7471A	21
Pesticides	EPA method 8081A	21
Polychlorinated biphenyls (PCBs)	EPA method 8082	21
Petroleum hydrocarbons	Ecology's NWTPH-HCID	2

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	Yes. Twenty-one samples extracted outside of 14 day holding time for PCBs analysis. Samples qualified as estimated, as shown in the table below.

Pesticides and PCBs Checklist

Any compounds present in method blanks?	Yes
For samples, if results are <5 times the blank then "U" flag data.	See table below.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
MS/MSD percent recovery values within laboratory QC criteria?	No. Aroclor 1260 recovery outside of 60-130 percent control limit for MSD analysis of sample HI-03-SS-00 (59 percent).
MS/MSD relative percent difference values within QC criteria of <35%?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	No, aldrin (128 percent), alpha-chlordane (124 percent), and gamma-chlordane (131 percent) exceeded upper limit. All samples ND except those in table below.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes

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Pesticides and PCBs Checklist

Is continuing calibration for target compounds < 20%?	No. Compounds reported from in-control CCV.
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	See table below. Sample results that exceeded a relative percent difference of 40% between columns were qualified as estimated (J).

Petroleum Hydrocarbons Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
Laboratory QC frequency of one blank with each batch and one duplicate per 20 samples?	Yes
Duplicate relative percent difference values less than 35 percent?	Yes

Metals Checklist

Any compounds present in method blank?	Yes, see table below.
For samples, if results are <5 times the blank then "U" flag data.	See table below.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.

Metals Checklist

Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Twenty-one samples were extracted outside of holding time (2, 4, 23, or 24 days) for PCB analysis. PCB results for these samples were qualified as estimated (J) or estimated at the detection limit (UJ), as shown in the table below.

- Heptachlor epoxide and alpha-chlordane were detected in the method blank. Samples with detected concentrations of heptachlor epoxide and alpha-chlordane that were less than 5 times the method blank concentration were qualified as undetected (U), as shown in the table below.

- Several metals were detected in each of the three method blanks, as shown in the table below. With one exception, no samples were qualified because all sample results for all analytes were greater than 5 times the method blank results. The exception was the cadmium result for sample HI-02-SS-00. which was qualified as undetected (U), as shown in the table below.

- Surrogate recoveries for pesticides, PCBs, and HCID analyses of several samples were below the lower laboratory control limits as shown in the table below. Data were qualified because of surrogate recovery value criteria if the recovery value did not meet the EPA CLP limits of 30 to 150 percent, as shown in the table below.

- The percent recovery value for Aroclor 1260 for the MSD analysis of sample HI-03-SS-00 (59 percent) was below the lower laboratory control limit (60 to 130 percent). No data were qualified because the exceedance was marginal (1 percent) and the percent recovery for the MS analysis (63 percent) met the laboratory control limits of 60- to 130 percent.

- The percent recovery values for alpha-chlordane, gamma-chlordane, and aldrin for the LCS analyses exceeded the upper control limits. All associated samples with reported results of alpha-chlordane, gamma-chlordane, and aldrin above the detection limit were qualified as estimated (J), as shown in the table below.

- Several chlorinated pesticides compounds were identified with a RPD value between the primary and secondary columns greater than the 40 percent method limit. As shown in the table below, compounds with a RPD between columns of greater than 40 percent were qualified as estimated.

Samples Analyzed Outside of Holding Time

Method	Sample ID	Analyses	Holding Time	Day Outside of Holding Time	Qualifier
8082	OB-07-SS-00	PCBs	14 days	2	UJ
8082	OB-08-SS-00	PCBs	14 days	2	UJ
8082	SH-07-SS-00	PCBs	14 days	2	UJ
8082	SH-13-SS-00	PCBs	14 days	2	UJ
8082	HI-02-SS-00	PCBs	14 days	2	UJ
8082	HI-03-SS-00	PCBs	14 days	2	UJ
8082	HI-04-SS-00	PCBs	14 days	2	UJ
8082	OB-18-WC-12	PCBs	14 days	2	UJ
8082	OB-11-SS-00	PCBs	14 days	4	UJ
8082	OB-09-SS-00	PCBs	14 days	4	UJ
8082	OB-05-SS-00	PCBs	14 days	24	UJ
8082	OB-17-WS-00	PCBs	14 days	24	UJ
8082	OB-18-WS-00	PCBs	14 days	24	UJ
8082	OB-04-SS-00	PCBs	14 days	24	UJ
8082	OB-06-SS-00	PCBs	14 days	24	UJ
8082	HI-06-SS-00	PCBs	14 days	24	UJ or J
8082	OB-19-WS-00	PCBs	14 days	23	UJ
8082	OB-10-SS-00	PCBs	14 days	23	UJ
8082	OB-12-SS-00	PCBs	14 days	23	UJ
8082	OB-13-SS-00	PCBs	14 days	23	UJ
8082	OB-14-SS-00	PCBs	14 days	23	UJ

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Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
8081A	MB-580-36860	Method	Heptachlor epoxide	0.073	J	ug/L	1.0
8081A	MB-580-36860	Method	alpha-Chlordane	0.55	J	ug/L	1.0
6020	MB-580-36872	Method	Cadmium	0.0023	J	mg/kg	0.20
6020	MB-580-36872	Method	Chromium	0.0097	J	mg/kg	0.20
6020	MB-580-36872	Method	Lead	0.0023	J	mg/kg	0.20
6020	MB-580-36872	Method	Silver	0.0011	J	mg/kg	0.20
6020	MB-580-36872	Method	Zinc	0.033	J	mg/kg	0.70
6020	MB-580-36873	Method	Cadmium	0.0026	J	mg/kg	0.20
6020	MB-580-36873	Method	Chromium	0.017	J	mg/kg	0.20
6020	MB-580-36873	Method	Copper	0.0044	J	mg/kg	0.20
6020	MB-580-36873	Method	Lead	0.0057	J	mg/kg	0.20
6020	MB-580-36873	Method	Nickel	0.019	J	mg/kg	0.20
6020	MB-580-36873	Method	Silver	0.0038	J	mg/kg	0.20
6020	MB-580-36873	Method	Zinc	0.030	J	mg/kg	0.70
6020	MB-580-36875	Method	Chromium	0.0076	J	mg/kg	0.20
6020	MB-580-36875	Method	Lead	0.0011	J	mg/kg	0.20
6020	MB-580-36875	Method	Silver	0.0011	J	mg/kg	0.20

Samples Qualified for Positive Method Blank Results

Method	**Sample ID**	**Compound**	**Result**	**Units**	**Qualifier**
8081A	OB-05-SS-00	alpha-Chlordane	0.98	ug/kg	U
8081A	OB-13-SS-00	Heptachlor epoxide	0.13	ug/kg	U
8081A	OB-13-SS-00	alpha-Chlordane	0.28	ug/kg	U
8081A	OB-14-SS-00	Heptachlor epoxide	0.051	ug/kg	U
8081A	OB-14-SS-00	alpha-Chlordane	0.26	ug/kg	U
6020	HI-02-SS-00	Cadmium	0.11	mg/kg	U

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Samples with Surrogate Recoveries Outside Laboratory Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8081A	OB-07-SS-00	Decachlorobiphenyl	39	40-158	30-150	None
8081A	HI-04-SS-00	Decachlorobiphenyl	39	40-158	30-150	None
8082	OB-07-SS-00	Decachlorobiphenyl	38	60-125	30-150	None
8082	OB-08-SS-00	Decachlorobiphenyl	45	60-125	30-150	None
8082	SH-07-SS-00	Decachlorobiphenyl	54	60-125	30-150	None
8082	SH-13-SS-00	Decachlorobiphenyl	41	60-125	30-150	None
8082	HI-02-SS-00	Decachlorobiphenyl	51	60-125	30-150	None
8082	HI-03-SS-00	Decachlorobiphenyl	41	60-125	30-150	None
8082	HI-04-SS-00	Decachlorobiphenyl	46	60-125	30-150	None
8082	OB-18-WC-12	Tetrachloro-m-xylene	39	45-155	30-150	None
8082	OB-18-WC-12	Decachlorobiphenyl	25	60-125	30-150	UJ
8082	OB-11-SS-00	Decachlorobiphenyl	24	60-125	30-150	UJ
8082	OB-09-SS-00	Decachlorobiphenyl	48	60-125	30-150	None
8082	OB-17-WC-00	Decachlorobiphenyl	56	60-125	30-150	None
8082	OB-18-WS-00	Decachlorobiphenyl	51	60-125	30-150	None
8082	OB-04-SS-00	Decachlorobiphenyl	47	60-125	30-150	None
8082	OB-06-SS-00	Decachlorobiphenyl	57	60-125	30-150	None
8082	OB-19-WS-00	Decachlorobiphenyl	48	60-125	30-150	None
8082	OB-10-SS-00	Decachlorobiphenyl	59	60-125	30-150	None
8082	OB-12-SS-00	Decachlorobiphenyl	59	60-125	30-150	None
8082	OB-13-SS-00	Decachlorobiphenyl	56	60-125	30-150	None
HCID	OB-13-SS-00	4-Bromofluorbenzene	24	50-150	NA	UJ
HCID	OB-13-SS-00	o-Terphenyl	18	50-150	NA	UJ

Duplicate or Triplicate Results Outside Control Limits

No duplicate or triplicate results outside control limits

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Compound	MS % Rec	MSD %Rec	Limits	Qualifier
8082	HI-03-SS-00	Aroclor 1260	63	59	60-130	None

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Date Completed: January 16, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11478

Samples Qualified for Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
8081A	SH-07-SS-00	alpha-Chlordane	124	46-118	J
8081A	SH-13-SS-00	alpha-Chlordane	124	46-118	J
8081A	SH-13-SS-00	gamma-Chlordane	131	49-122	J

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

No compounds reported form reanalysis or dilution.

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

Method	Sample ID	Compound	Limits	Qualifier
8081A	OB-07-SS-00	alpha-BHC	< 40 percent	J
8081A	OB-07-SS-00	Dieldrin	< 40 percent	J
8081A	OB-07-SS-00	Endosulfan I	< 40 percent	J
8081A	SH-07-SS-00	alpha-BHC	< 40 percent	J
8081A	SH-07-SS-00	4,4’-DDE	< 40 percent	J
8081A	SH-07-SS-00	4,4’-DDT	< 40 percent	J
8081A	SH-07-SS-00	Endosulfan I	< 40 percent	J
8081A	SH-07-SS-00	alpha-Chlordane	< 40 percent	J
8081A	SH-13-SS-00	4,4’-DDE	< 40 percent	J
8081A	SH-13-SS-00	Endosulfan I	< 40 percent	J
8081A	SH-13-SS-00	gamma-Chlordane	< 40 percent	J
8081A	HI-02-SS-00	Endosulfan I	< 40 percent	J
8081A	HI-02-SS-00	Heptachlor epoxide	< 40 percent	J
8081A	HI-04-SS-00	Endosulfan I	< 40 percent	J
8081A	OB-09-SS-00	Heptachlor	< 40 percent	J
8081A	OB-05-SS-00	gamma-BHC	< 40 percent	J
8081A	OB-05-SS-00	4,4’-DDD	< 40 percent	J
8081A	OB-05-SS-00	4,4’-DDT	< 40 percent	J
8081A	OB-04-SS-00	alpha-BHC	< 40 percent	J
8081A	OB-12-SS-00	4,4’-DDT	< 40 percent	J
8081A	OB-12-SS-00	Endosulfan sulfate	< 40 percent	J
8081A	OB-13-SS-00	Endrin	< 40 percent	J
8081A	OB-14-SS-00	4,4’-DDT	< 40 percent	J
8081A	OB-14-SS-00	Endrin	< 40 percent	J

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
UJG	Analyte was not detected at or above the reported estimate with likely low bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 20, 2009	**Review Completed by: Gina Catarra**
Laboratory: Test America Tacoma	**Laboratory Work Order : 11513, 11566, and 11601**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
OB-17-WC-12	10/06/08 ; 10:35	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-29-WC-12	10/06/08 ; 13:15	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-27-WC-12	10/06/08 ; 14:15	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-26-WC-12	10/06/08 ; 15:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SSH-08-SC-12	10/06/08 ; 16:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-22-WC-12	10/07/08 ; 08:50	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-02-SC-12	10/07/08 ; 10:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-20-WC-12	10/07/08 ; 12:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
OB-19-WC-12	10/05/08 ; 15:40	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
RF-01-SS-00	10/09/08 ; 11:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
RF-02-SS-00	10/09/08 ; 14:15	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
RF-03-SS-00	10/09/08 ; 15:30	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls, petroleum hydrocarbons
SH-11-SC-12	10/14/08 ; 12:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-19-WC-12	10/14/08 ; 13:45	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls

Analytical methods

Analysis	Analytical Method	Number of Samples
Metals	EPA method 6020	14
Mercury	EPA method 7471A	14
Pesticides	EPA method 8081A	14
Polychlorinated biphenyls (PCBs)	EPA method 8082	14
Petroleum hydrocarbons	Ecology's NWTPH-HCID	4

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General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	Yes. Sample OB-19-WC-12 extracted 3 days outside of the 14 day holding time. Five samples prepared 1 day outside of holding time for mercury. See table below.

Pesticides and PCBs Checklist

Any compounds present in method blanks?	Yes. Heptachlor epoxide present in method blank associated with work orders 11566 and 11601. No samples qualified; all samples ND or greater than 5 times method blank value.
For samples, if results are <5 times the blank then "U" flag data.	None
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	No, see table below.
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria of <35%?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	See table below. Sample results that exceeded a relative percent difference of 40% between columns were qualified as estimated (J).

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Petroleum Hydrocarbons Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
Laboratory QC frequency of one blank with each batch and one duplicate per 20 samples?	Yes
Duplicate relative percent difference values less than 35 percent?	Yes

Metals Checklist

Any compounds present in method blank?	Yes, see table below.
For samples, if results are <5 times the blank then "U" flag data.	None less than 5 times blank result.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	No. Batch sample MS recovery result for chromium was 74%. No data flagged because failure was minimal and MSD met control limits.
Were elements recovered <u><</u>30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Sample OB-19-WC-12 was extracted one day outside of holding time for pesticide and PCB analyses. Sample results were qualified as estimated (UJ or J) as shown in the table below.

- Five samples were analyzed one day outside of holding time (28 days) for mercury. Because the exceedance was only one day, no samples were qualified.

- Heptachlor epoxide was detected in the method blank for sample batch 37339. No data were qualified because all associated samples were either not detected or were reported at a concentration 5 times the method blank concentration.

- Several metals were detected in the method blank for sample batch 37173, as shown in the table below. No samples were qualified because all sample results for all analytes were greater than 5 times the method blank results.

- Surrogate recoveries for pesticides, PCBs, and HCID analyses of several samples were outside the laboratory control limits as shown in the table below. Data were qualified because of surrogate recovery value criteria if the recovery value did not meet the EPA CLP limits of 30 to 150 percent, as shown in the table below.

- The percent recovery value for chromium (74 percent) in the MS analyses of batch sample SH-13-SC-12 exceeded the laboratory control limits (75 to 125 percent). No results were qualified because the exceedance was marginal (1 percent) and the MSD percent recovery was within control limits.

- Several chlorinated pesticides compounds were identified with a RPD value between the primary and secondary columns greater than the 40 percent method limit. As shown in the table below, compounds with a RPD between columns of greater than 40 percent were qualified as estimated.

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Samples Analyzed Outside of Holding Time

Method	Sample ID	Analyses	Holding Time	Day Outside of Holding Time	Qualifier
8081A	OB-19-WC-12	Pesticides	14 days	3	UJ or J
8082	OB-19-WC-12	PCBs	14 days	3	UJ
7471A	OB-17-WC-12	Total mercury	28 days	1	None
7471A	SH-29-WC-12	Total mercury	28 days	1	None
7471A	SH-27-WC-12	Total mercury	28 days	1	None
7471A	SH-26-WC-12	Total mercury	28 days	1	None
7471A	SH-08-SC-12	Total mercury	28 days	1	None

Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
8081A	MB-580-37339	Method	Heptachlor epoxide	0.0077	J	ug/L	1.0
6020	MB-580-37173	Method	Arsenic	0.0025	J	mg/kg	0.20
6020	MB-580-37173	Method	Cadmium	0.0013	J	mg/kg	0.20
6020	MB-580-37173	Method	Chromium	0.024	J	mg/kg	0.20
6020	MB-580-37173	Method	Copper	0.0086	J	mg/kg	0.20
6020	MB-580-37173	Method	Lead	0.0044	J	mg/kg	0.20
6020	MB-580-37173	Method	Nickel	0.028	J	mg/kg	0.20
6020	MB-580-37173	Method	Silver	0.0022	J	mg/kg	0.20
6020	MB-580-37173	Method	Zinc	0.19	J	mg/kg	0.70

Samples Qualified for Positive Method Blank Results

No samples qualified for positive method blank results.

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Samples with Surrogate Recoveries Outside Laboratory Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8081A	Method Blank	Tetrachloro-m-xylene	144	49-123	30-150	None
8081A	SH-27-WC-12	Tetrachloro-m-xylene	147	49-123	30-150	None
8081A	SH-26-WC-12	Tetrachloro-m-xylene	127	49-123	30-150	None
8081A	SH-02-SC-12	Decachlorobiphenyl	29	40-158	30-150	UJ or J
8081A	SH-20-WC-12	Tetrachloro-m-xylene	139	49-123	30-150	None
8082	Method Blank	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	Method Blank	Decachlorobiphenyl	49	60-125	30-150	None
8082	OB-17-WC-12	Decachlorobiphenyl	33	60-125	30-150	None
8082	SH-29-WC-12	Decachlorobiphenyl	35	60-125	30-150	None
8082	SH-27-WC-12	Tetrachloro-m-xylene	31	45-155	30-150	None
8082	SH-27-WC-12	Decachlorobiphenyl	27	60-125	30-150	UJ
8082	SH-26-WC-12	Tetrachloro-m-xylene	35	45-155	30-150	None
8082	SH-26-WC-12	Decachlorobiphenyl	36	60-125	30-150	None
8082	SH-08-SC-12	Tetrachloro-m-xylene	44	45-155	30-150	None
8082	SH-08-SC-12	Decachlorobiphenyl	36	60-125	30-150	None
8082	SH-22-WC-12	Tetrachloro-m-xylene	22	45-155	30-150	UJ
8082	SH-22-WC-12	Decachlorobiphenyl	18	60-125	30-150	UJ
8082	SH-02-SC-12	Tetrachloro-m-xylene	26	45-155	30-150	UJ
8082	SH-02-SC-12	Decachlorobiphenyl	18	60-125	30-150	UJ
8082	SH-20-WC-12	Tetrachloro-m-xylene	30	45-155	30-150	None
8082	SH-20-WC-12	Decachlorobiphenyl	28	60-125	30-150	UJ
HCID	SH-02-SC-12	4-Bromofluorobenzene	31	50-150	NA	UJ or J
HCID	SH-02-SC-12	o-Terphenyl	36	50-150	NA	UJ or J
8081A	OB-19-WC-12	Decachlorobiphenyl	31	40-158	30-150	None
8082	OB-19-WC-12	Decachlorobiphenyl	43	60-125	30-150	None
8082	RF-01-SS-00	Decachlorobiphenyl	52	60-125	30-150	None
8082	RF-02-SS-00	Decachlorobiphenyl	50	60-125	30-150	None
8082	RF-03-SS-00	Decachlorobiphenyl	54	60-125	30-150	None
HCID	RF-01-SS-00	4-Bromofluorobenzene	39	50-150	NA	UJ
HCID	RF-01-SS-00	o-Terphenyl	30	50-150	NA	UJ
HCID	RF-02-SS-00	4-Bromofluorobenzene	42	50-150	NA	UJ
HCID	RF-02-SS-00	o-Terphenyl	27	50-150	NA	UJ
8082	SH-11-SC-12	Decachlorobiphenyl	45	60-125	30-150	None
8082	SH-19-WC-12	Decachlorobiphenyl	51	60-125	30-150	None

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Duplicate or Triplicate Results Outside Control Limits

No duplicate or triplicate results outside of control limits.

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Compound	MS % Rec	MSD %Rec	Limits	Qualifier
6020	Batch	Chromium	74	83	75-125	None

Samples Qualified for Laboratory Control Sample Recoveries Outside Control Limits

No laboratory control sample recoveries outside control limits.

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

No compounds reported form reanalysis or dilution.

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

Method	Sample ID	Compound	Limits	Qualifier
8081A	SH-29-WC-12	delta-BHC	< 40 percent	J
8081A	SH-29-WC-12	4,4'-DDD	< 40 percent	J
8081A	SH-29-WC-12	Endosulfan II	< 40 percent	J
8081A	SH-27-WC-12	Aldrin	< 40 percent	J
8081A	SH-27-WC-12	gamma-BHC	< 40 percent	J
8081A	SH-27-WC-12	Endosulfan sulfate	< 40 percent	J
8081A	SH-26-WC-12	alpha-BHC	< 40 percent	J
8081A	SH-26-WC-12	delta-BHC	< 40 percent	J
8081A	SH-26-WC-12	Dieldrin	< 40 percent	J
8081A	SH-08-SC-12	Aldrin	< 40 percent	J
8081A	SH-08-SC-12	beta-BHC	< 40 percent	J
8081A	SH-08-SC-12	gamma-BHC	< 40 percent	J
8081A	SH-08-SC-12	Heptachlor	< 40 percent	J
8081A	SH-22-WC-12	Heptachlor epoxide	< 40 percent	J
8081A	SH-02-SC-12	4,4'-DDD	< 40 percent	J
8081A	SH-02-SC-12	4,4'-DDT	< 40 percent	J
8081A	SH-20-WC-12	alpha-BHC	< 40 percent	J
8081A	SH-20-WC-12	4,4'-DDD	< 40 percent	J
8081A	OB-19-WC-12	delta-BHC	< 40 percent	J
8081A	OB-19-WC-12	4,4'-DDE	< 40 percent	J
8081A	OB-19-WC-12	4,4'-DDT	< 40 percent	J
8081A	OB-19-WC-12	Endrin aldehyde	< 40 percent	J
8081A	OB-19-WC-12	alpha-Chlordane	< 40 percent	J
8081A	RF-01-SS-00	alpha-Chlordane	< 40 percent	J
8081A	RF-02-SS-00	4,4'-DDD	< 40 percent	J
8081A	RF-02-SS-00	Heptachlor epoxide	< 40 percent	J
8081A	RF-03-SS-00	alpha-Chlordane	< 40 percent	J
8081A	SH-11-SC-12	4,4'-DDT	< 40 percent	J
8081A	SH-19-WC-12	Methoxychlor	< 40 percent	J
8081A	SH-19-WC-12	alpha-Chlordane	< 40 percent	J

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Laboratory: Test America Tacoma	**Laboratory Work Order : 11513, 11566, and 11601**

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
UJ	Analyte was not detected at or above the reported estimate.

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Laboratory: Test America Tacoma	Laboratory Work Order : 11617

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-01-SS-00	10/15/08 ; 09:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-02-SS-00	9/30/08 ; 11:40	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-10-SS-00	9/30/08 ; 13:10	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-14-SS-00	9/30/08 ; 14:00	Sediment	Metals, mercury, pesticides, polychlorinated biphenyls
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210
SH-17-RI-0/3	10/15/08 ; 16:00	Sediment	Lead-210

Analytical methods

Analysis	Analytical Method	Number of Samples
Metals	EPA method 6020	4
Mercury	EPA method 7471A	4
Pesticides	EPA method 8081A	4
Polychlorinated biphenyls (PCBs)	EPA method 8082	4
Lead-210	RL-GAM-001	14

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Laboratory: Test America Tacoma	**Laboratory Work Order : 11617**

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	No

Pesticides and PCBs Checklist

Any compounds present in method blanks?	Yes, heptachlor epoxide detected in blank.
For samples, if results are <5 times the blank then "U" flag data.	See table below. One sample flagged as U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, refer to table below. Surrogate recoveries were within EPA limits, so no data were qualified.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria of <35%?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	No. However qualified compounds reported from column with CCV <20%
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	See table below. Sample results that exceeded a relative percent difference of 40% between columns were qualified as estimated bias low (JG,UJG, or JTG).

Metals Checklist

Any compounds present in method blank?	Yes, see table below.
For samples, if results are <5 times the blank then "U" flag data.	All results were greater than 5 times the blank result. No data were qualified.

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Metals Checklist

Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	No. MS recovery result for chromium was 74%. No data flagged because failure was minimal and MSD met control limits.
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.

Gamma Spectroscopy Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one duplicate per 20 samples?	Yes
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Arsenic, cadmium, copper, lead, nickel, silver, and zinc were detected in the method blank. No samples were qualified because all sample results for all analytes were greater than 5 times the method blank results.

- Surrogate recoveries for PCB analyses of sample SH-04-SC-12 were below the lower laboratory control limits as shown in the table below. Data were not qualified because the surrogate recovery values met the EPA CLP limits of 30 to 150 percent, as specified in the SAP.

- The percent recovery value for chromium (74 percent) in the MS analyses of sample SH-13-SC-12 exceeded the laboratory control limits (75 to 125 percent). No results were qualified because the exceedance was marginal (1 percent) and the MSD percent recovery was within control limits.

- Several chlorinated pesticides compounds were identified with a RPD value between the primary and secondary columns greater than the 40 percent method limit. The lower of the two values were reported by the laboratory for all samples. As shown in the table below, compounds with a RPD between columns of greater than 40 percent were qualified as estimated biased low.

Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
8081A	MB-580-37339	Method	Heptachlor epoxide	0.0077	JTG	Ug/L	1.0
6020	MB-580-36868	Method	Arsenic	0.0025	J	mg/kg	0.20
6020	MB-580-37173	Method	Cadmium	0.0013	J	mg/kg	0.20
6020	MB-580-37173	Method	Chromium	0.024	J	mg/kg	0.20
6020	MB-580-37173	Method	Copper	0.0086	J	mg/kg	0.20
6020	MB-580-37173	Method	Lead	0.0044	J	mg/kg	0.20
6020	MB-580-37173	Method	Nickel	0.028	J	mg/kg	0.20
6020	MB-580-37173	Method	Silver	0.0022	J	mg/kg	0.20
6020	MB-580-37173	Method	Zinc	0.19	J	mg/kg	0.70

Samples Qualified for Positive Method Blank Results

Method	Sample ID	Compound	Result	Units	Qualifier
8081A	SH-04-SC-12	Heptachlor epoxide	0.021	ug/kg	UJG

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Samples Qualified for Surrogate Recoveries Outside Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8082	SH-04-SC-12	Tetrachloro-m-xylene	43	45-155	30-150	None
8082	SH-04-SC-12	Decachlorobiphenyl	32	60-125	30-150	None

Duplicate or Triplicate Results Outside Control Limits

No duplicate results outside of control limits

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Type	Compound	% Rec	Limits	Qualifier
6020	SH-13-SC-12	MS	Chromium	74	75-125	None

Samples Qualified for Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
8081A	SH-14-SS-00	beta-BHC	127	48-121	J
8081A	SH-14-SC-12	beta-BHC	127	48-121	J
8081A	SH-23-WC-12	beta-BHC	127	48-121	J

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

No compounds reported form reanalysis or dilution.

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Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

Method	Sample ID	Compound	Limits	Qualifier
8081A	SH-13-SC-12	Endosulfan II	< 40 percent	JTG
8081A	SH-13-SC-12	Endrin aldehyde	< 40 percent	JTG
8081A	SH-04-SC-12	alpha-BHC	< 40 percent	JG
8081A	SH-04-SC-12	Endosulfan I	< 40 percent	JTG
8081A	SH-04-SC-12	Heptachlor epoxide	< 40 percent	UJG
8081A	SH-04-SC-12	Methoxychlor	< 40 percent	JTG
8081A	SH-04-SC-12	alpha-Chlordane	< 40 percent	JTG
8081A	SH-05-SC-12	alpha-Chlordane	< 40 percent	JTG
8081A	SH-07-SC-12	delta-BHC	< 40 percent	JTG
8081A	SH-07-SC-12	4,4'-DDD	< 40 percent	JTG
8081A	SH-07-SC-12	4,4'-DDT	< 40 percent	JTG
8081A	SH-07-SC-12	alpha-Chlordane	< 40 percent	JTG

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
UJG	Analyte was not detected at or above the reported estimate with likely low bias.

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Date Completed: January 13, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11629 and 11687

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
OB-15-RI-0/3	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-10/12	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-19/21	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-28/30	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-37/39	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-46/48	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-55/57	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-64/66	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-73/75	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-82/84	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-91/93	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-100/102	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-109/111	10/16/08 ; 11:45	Sediment	Lead-210
OB-15-RI-118/120	10/16/08 ; 11:45	Sediment	Lead-210
OB-16-RI-0/3	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-10/12	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-19/21	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-28/30	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-37/39	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-46/48	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-55/57	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-64/66	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-73/75	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-82/84	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-91/93	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-100/102	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-109/111	10/20/08 ; 11:30	Sediment	Lead-210
OB-16-RI-118/120	10/20/08 ; 11:30	Sediment	Lead-210

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 13, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11629 and 11687

Analytical methods

Analysis	Analytical Method	Number of Samples
Lead-210	RL-GAM-001	28

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	No

Gamma Spectroscopy Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one duplicate per 20 samples?	Yes
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- None

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 13, 2009	Review Completed by: Gina Catarra
Laboratory: Test America Tacoma	Laboratory Work Order : 11629 and 11687

Positive Blanks

No positive blanks

Samples Qualified for Positive Method Blank Results

No samples qualified for positive method blank results

Duplicate or Triplicate Results Outside Control Limits

No duplicate results outside of control limits.

Samples Qualified for Laboratory Control Sample Recoveries Outside Control Limits

No LCS recovery values outside of control limits.

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

No samples reanalyzed or diluted.

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	**Review Completed by: Gina Catarra**
Laboratory: Analytical Resources, Inc.	**Laboratory Work Order : NT34, NT35, NT36 and NT37**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NT34, NT35, NT36 and NT37

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
OB-19-WS-00	10/04/08 ; 09:13	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
OB-10-SS-00	10/04/08 ; 09:51	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-12-SS-00	10/04/08 ; 10:34	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-13-SS-00	10/04/08 ; 11:24	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-14-SS-00	10/04/08 ; 13:25	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-04-SC-12	10/04/08 ; 11:40	Sediment	Grain size, TOC, ammonia, sulfides
OB-12-SC-12	10/04/08 ; 16:00	Sediment	Grain size, TOC, ammonia, sulfides
OB-05-SC-12	10/04/08 ; 16:55	Sediment	Grain size, TOC, ammonia, sulfides
OB-11-SS-00	10/03/08 ; 09:40	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-09-SS-00	10/03/08 ; 11:15	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-05-SS-00	10/03/08 ; 11:55	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-17-WS-00	10/03/08 ; 13:04	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
OB-17-WS-00	10/03/08 ; 13:50	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
OB-04-SS-00	10/03/08 ; 14:52	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-06-SS-00	10/03/08 ; 15:35	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
HI-06-SS-00	10/03/08 ; 16:12	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-03-SC-12	10/03/08 ; 12:25	Sediment	Grain size, TOC, ammonia, sulfides
OB-02-SC-12	10/03/08 ; 13:25	Sediment	Grain size, TOC, ammonia, sulfides
HI-07-SC-12	10/03/08 ; 15:10	Sediment	Grain size, TOC, ammonia, sulfides
OB-01-SC-12	10/03/08 ; 16:00	Sediment	Grain size, TOC, ammonia, sulfides
OB-07-SS-00	10/05/08 ; 10:29	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-08-SS-00	10/05/08 ; 11:22	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-07-SS-00	10/05/08 ; 12:21	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-13-SS-00	10/05/08 ; 13:21	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
HI-02-SS-00	10/05/08 ; 14:35	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
HI-03-SS-00	10/05/08 ; 15:26	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
HI-04-SS-00	10/05/08 ; 16:11	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-10-SC-12	10/05/08 ; 11:50	Sediment	Grain size, TOC, ammonia, sulfides
OB-09-SC-12	10/05/08 ; 13:30	Sediment	Grain size, TOC, ammonia, sulfides
OB-06-SC-12	10/05/08 ; 16:45	Sediment	Grain size, TOC, ammonia, sulfides
OB-18-SC-12	10/05/08 ; 17:50	Sediment	Grain size, TOC, ammonia, sulfides
OB-19-WC-12	10/05/08 ; 15:40	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
OB-17-WC-12	10/06/08 ; 10:25	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NT34, NT35, NT36 and NT37

HI-06-SC-12	10/06/08 ; 11:45	Sediment	Grain size, TOC, ammonia, sulfides
SH-29-WC-12	10/06/08 ; 13:15	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-26-WC-12	10/06/08 ; 15:30	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-27-WC-12	10/06/08 ; 15:30	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-08-SC-12	10/06/08 ; 16:30	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs,
SH-22-WC-12	10/07/08 ; 08:50	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-02-SC-12	10/07/08 ; 10:30	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs,
SH-20-WC-12	10/07/08 ; 12:00	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
OB-14-SC-12	10/07/08 ; 17:10	Sediment	Grain size, TOC, ammonia, sulfides

Analytical methods

Analysis	Analytical Method	Number of Samples
Grain size	PSEP	42
TOC	Plumb, 1981	42
TVS	EPA 160.4	10
Ammonia	EPA 350.1	42
Total sulfides	EPA 376.2	42
SVOCs	EPA 8270D	29
Tributyltins	Krone 1988	1
Resin acids	EPA 8270D	11

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	No. Five of 12 coolers arrived at 7 to 8 degrees. No data flagged.
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No

Conventionals Checklist

Any positive method blank results?	No

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NT34, NT35, NT36 and NT37

Conventionals Checklist

Laboratory QC frequency of one blank and LCS with each batch and one set of MS and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	No. See table below.
Triplicate relative standard deviation (RSD) or duplicate relative percent difference (RPD) within QC limits of less than 20%?	No. See table below.
LCS percent recovery values within QC criteria of 80-120%?	Yes
Are calibration correlation coefficients > 0.995?	Yes
Are ICV percent recovery values 90-110%?	Yes
Are CCV percent recovery values 90-110% or 85-115% for total sulfides?	Yes

Semivolatile Organic Compound Checklist

Any compounds present in method blanks?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within laboratory QC criteria?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes. See table below.
Spot check retention time windows and second column confirmations as complete.	All acceptable

Resin Acids Checklist

Any compounds present in method blanks?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	**Review Completed by: Gina Catarra**
Laboratory: Analytical Resources, Inc.	**Laboratory Work Order : NT34, NT35, NT36 and NT37**

Resin Acids Checklist

Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within laboratory QC criteria?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	No. See table below.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes. See table below.
Spot check retention time windows and second column confirmations as complete.	Yes

Tributyltins Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NT34, NT35, NT36 and NT37

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Five of the 12 coolers were received at 7 to 8 deg C. Minor exceedance, no data qualified.

- The relative percent difference (RPD) value for the duplicate analysis of sample OB-05-SS-00 (27 percent) for sulfides exceeded the less than 20 percent criterion. Because all other QC data were within control for the sulfides analyses, only sample OB-05-SS-00 was qualified at estimated (J).

- The percent recovery value for the matrix spike analysis of sample OB-17-WC-12 (158 percent) for sulfides exceeded the method control limits (75 to 125 percent). Because all other QC data were within control for the sulfides analyses, only sample OB-17-WC-12 was qualified at estimated (J).

- The percent recovery for neoabietic acid in the laboratory control (27 percent) and laboratory control duplicate (20 percent) samples exceeded the 30 to 160 percent control limits. Results for neoabietic acid were qualified as estimated at the detection limit (UJ), as shown in the table below.

- Samples SH-22-WC-12, SH-20-WC-12, OB-18-WC-12, OB-19-WC-12, and SH-27-WC-12 were reanalyzed at a dilution because one or more compounds were reported at a concentration greater than the upper calibration range, as shown in the table below.

Positive Blanks

No positive blank results.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NT34, NT35, NT36 and NT37

Samples Qualified for Positive Method Blank Results

No samples qualified for positive method blank results.

Samples with Surrogate Recoveries Outside Laboratory Control Limits

No samples with surrogate recoveries outside laboratory control limits.

Duplicate or Triplicate Results Outside Control Limits

Method	Sample ID	Compound	% RPD	Limits	Qualifier
EPA 376.2	OB-17-WC-12	Sulfide	27	0-20	J

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Compound	MS % Rec	MSD %Rec	Limits	Qualifier
EPA 376.2	OB-17-WC-12	Sulfide	158	NA	75-125	J

Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
Resin	OB-19-WS-00	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	OB-17-WS-00	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	OB-18-WS-00	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	OB-18-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	OB-19-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	OB-17-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	SH-29-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	SH-26-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	SH-27-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	SH-22-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ
Resin	SH-20-WC-12	Neoabietic acid	27 / 20 (LCSD)	30-160	UJ

Samples Qualified for Internal Standard Recoveries Outside Control Limits

No samples qualified for internal standard recoveries outside control limits.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 23, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NT34, NT35, NT36 and NT37

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

Sample ID	Compound	Reason for reanalysis
SH-22-WC-12	Retene	Result exceeded linear range. Reanalyzed at a 15x dilution.
SH-20-WC-12	Retene	Result exceeded linear range. Reanalyzed at a 20x dilution.
OB-18-WC-12	Abietic acid	Result exceeded linear range. Reanalyzed at a 3x dilution.
OB-19-WC-12	Abietic acid	Result exceeded linear range. Reanalyzed at a 10x dilution.
SH-27-WC-12	Isopimaric acid	Result exceeded linear range. Reanalyzed at a 10x dilution.
SH-27-WC-12	Dehydroabietic acid	Result exceeded linear range. Reanalyzed at a 10x dilution.
SH-27-WC-12	Abietic acid	Result exceeded linear range. Reanalyzed at a 10x dilution.
SH-22-WC-12	Abietic acid	Result exceeded linear range. Reanalyzed at a 50x dilution.

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

No samples qualified for confirmation column percent difference values outside control limits.

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
UJ	Analyte was not detected at or above the reported estimate.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 20, 2009	**Review Completed by: Gina Catarra**
Laboratory: Analytical Resources, Inc.	**Laboratory Work Order : NS27, NT66 and NT67**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-01-SS-00	9/29/08 ; 18:05	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, TBT
SH-02-SS-00	9/30/08 ; 10:30	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, TBT
SH-10-SS-00	9/30/08 ; 13:40	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-14-SS-00	9/30/08 ; 15:05	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-22-WS-00	9/30/08 ; 16:48	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, resin acids
SH-23-WS-00	9/30/08 ; 15:43	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, resin acids
SH-26-WS-00	9/30/08 ; 12:50	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, resin acids
SH-27-WS-00	9/30/08 ; 11:55	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, resin acids
SH-28-WS-00	9/30/08 ; 14:29	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, resin acids
SH-10-SC-12	09/30/08 ; 14:50	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-14-SC-12	09/30/08 ; 17:30	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-23-WC-12	09/30/08 ; 18:20	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-28-WC-12	09/30/08 ; 19:00	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
OB-11-SC-12	10/08/08 ; 09:40	Sediment	Grain size, TOC, ammonia, sulfides
OB-13-SC-12	10/08/08 ; 10:40	Sediment	Grain size, TOC, ammonia, sulfides
RF-01-SS-00	10/09/08 ; 11:00	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, TBT, resin acids
RF-02-SS-00	10/09/08 ; 14:15	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, TBT, resin acids
RF-03-SS-00	10/09/08 ; 15:30	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, TBT, resin acids

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 20, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS27, NT66 and NT67

Analytical methods

Analysis	Analytical Method	Number of Samples
Grain size	PSEP	18
TOC	Plumb, 1981	18
TVS	EPA 160.4	5
Ammonia	EPA 350.1	18
Total sulfides	EPA 376.2	18
SVOCs	EPA 8270D	16
Tributyltins	Krone 1988	5
Resin acids	EPA 8270D	10

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No

Conventionals Checklist

Any positive method blank results?	No
Laboratory QC frequency of one blank and LCS with each batch and one set of MS and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes
Triplicate relative standard deviation (RSD) within QC limits of less than 20%?	Yes
LCS percent recovery values within QC criteria of 80-120%?	Yes
Are calibration correlation coefficients > 0.995?	Yes
Are ICV percent recovery values 90-110%?	Yes
Are CCV percent recovery values 90-110% or 85-115% for total sulfides?	Yes

Semivolatile Organic Compound Checklist

Any compounds present in method blanks?	No

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 20, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS27, NT66 and NT67

Semivolatile Organic Compound Checklist

For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, refer to table below. No data qualified because the method allows one surrogate to exceed control limits without qualification.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within laboratory QC criteria?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes. Sample SH-22-WS-00 analyzed at 3x dilutions for fluoranthene.
Spot check retention time windows and second column confirmations as complete.	All acceptable

Resin Acids Checklist

Any compounds present in method blanks?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within laboratory QC criteria?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	No. Abietic acid percent recovery was 282% in the LCS, neoabietic acid percent recoveries were 27 and 5 percent. See table below for qualified results.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes. SH-22-WS-00 analyzed at 3x dilution for two compounds, see table below.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 20, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS27, NT66 and NT67

Resin Acids Checklist

Spot check retention time windows and second column confirmations as complete.	All Acceptable

Tributyltins Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered <u><</u>30%? If so, “REJ” flag associated NDs on Form 1’s.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	Yes

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Recoveries of surrogate 2-fluorobiphenyl were greater than the upper laboratory control limit for several samples, as shown in the table below. No data were qualified because SVOC method 8270D allows one acid or base surrogate to exceed criteria, and all other surrogate recoveries were acceptable.

- Recoveries of surrogate tripropyl tin chloride were greater than the upper laboratory control limit for the MS and MSD analysis of sample SH-01-SS-00. No data were qualified because all other criteria were met.

- The percent recovery for abietic acid (282 percent) in the laboratory control sample, and neoabietic acid in the LCS (27 percent) and LCSD (5 percent) exceeded the control limits. The abietic acid result for sample RF-02-SS was qualified as estimated because this sample had a positive result. The results for neoabietic acid were qualified as estimated at the detection limit (UJ) for samples RF-01-SS-00, RF-02-SS-00, and RF-03-SS-00.

- Sample SH-22-WS-00 was reanalyzed at a 3x dilution because one or more compounds were reported at a concentration greater than the upper calibration range. Fluoranthene, dehydroabietic acid, and abietic acid were reported from a 3x dilution of sample SH-22-WS-00.

Positive Blanks

No blanks reported with positive results.

Samples Qualified for Positive Method Blank Results

No samples qualified for positive method blank results.

Samples with Surrogate Recoveries Outside Laboratory Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8270D	LCS	2-fluorobiphenyl	86	39-82	NA	None
8270D	LCSD	2-fluorobiphenyl	86	39-82	NA	None
8270D	SH-01-SS-00	2-fluorobiphenyl	94	32-88	NA	None
8270D	SH-02-SS-00	2-fluorobiphenyl	94	32-88	NA	None
8270D	SH-10-SS-00	2-fluorobiphenyl	92	32-88	NA	None
8270D	SH-26-WS-00 MS	2-fluorobiphenyl	94	32-88	NA	None
Krone	SH-01-SS-00 MS	Tripropyl tin chloride	105	32-104	NA	None
Krone	SH-01-SS-00 MSD	Tripropyl tin chloride	111	32-104	NA	None

Duplicate or Triplicate Results Outside Control Limits

No duplicate or triplicate results outside of control limits

Matrix Spike Recoveries Outside Control Limits

No matrix spike recoveries outside control limits

Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
Resin	RF-02-SS-00	Abietic acid	282	30-160	J
Resin	RF-01-SS-00	Neoabietic acid	27 / 5 (LCSD)	30-160	UJ
Resin	RF-02-SS-00	Neoabietic acid	27 / 5 (LCSD)	30-160	UJ
Resin	RF-02-SS-00	Neoabietic acid	27 / 5 (LCSD)	30-160	UJ

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

Sample ID	Compound	Reason for reanalysis
SH-22-WS-00	Fluoranthene	Result exceeded linear range. Reanalyzed at a 3x dilution.
SH-22-WS-00	Dehydroabietic acid	Result exceeded linear range. Reanalyzed at a 3x dilution.
SH-22-WS-00	Abietic acid	Result exceeded linear range. Reanalyzed at a 3x dilution.

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

No samples qualified for confirmation column percent difference values outside control limits.

Data Qualification Code Definitions

Code	**Description**
J	Analyte was positively identified. The reported result is an estimate.
UJ	Analyte was not detected at or above the reported estimate.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 4, 2008	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NV03

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project Sampling and Analysis Plan (SAP) (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the following tables and checklists. Any major or minor concern affecting data usability is summarized below. Checklists and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples Reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-13-SC-12	10/15/08 ; 09:00	Sediment	Total solids, grain size, TOC, ammonia, sulfides, SVOCs
HI-02-SC-12	10/15/08 ; 10:30	Sediment	Total solids, grain size, TOC, ammonia, sulfides
SH-04-SC-12	10/15/08 ; 11:40	Sediment	Total solids, grain size, TOC, ammonia, sulfides, SVOCs
SH-05-SC-12	10/15/08 ; 13:10	Sediment	Total solids, grain size, TOC, ammonia, sulfides, SVOCs
SH-07-SC-12	10/15/08 ; 14:00	Sediment	Total solids, grain size, TOC, ammonia, sulfides, SVOCs

Analytical Methods

Analysis	Analytical Method	Number of Samples
Total solids	EPA method 160.3	5
Grain size	PSEP	5
TOC	Plumb, 1981	5
Ammonia	EPA method 350.1	5
Total sulfides	EPA method 376.2	5
Semivolatile organic compounds	EPA method 8270D	4

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 degrees C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of QC samples correct? (MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.)	Yes.
Case narrative present and complete?	Yes
Any holding time violations?	No

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 4, 2008	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NV03

Conventionals Checklist

Any positive method blank results?	No
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes. MS for TOC and sulfide; triplicate analysis for total solids, grain size, and TOC; duplicate analysis for sulfide.
MS/MSD percent recovery values within QC criteria of 75-125% (65 to 130 percent for sulfides) (see Table 6)?	No. Sulfide MS percent recovery was 64%. Sulfide LCS okay, so no data qualified.
Triplicate relative standard deviation (RSD) within QC limits of less than 20%?	Yes – percent RSD ranged from 1 to 5 for all grain size fractions.
LCS percent recovery values within QC criteria of 80-120%?	Yes
Are calibration correlation coefficients > 0.995?	Yes
Are ICV percent recovery values 90-110%?	Yes
Are CCV percent recovery values 90-110% or 85-115% for total sulfides?	Yes

Semivolatile Organics Checklist

Any compounds present in method, trip, and field blanks?	Yes. Bis (2-ethylhexyl) phthalate detected in method blank above MDL but less than the RL.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	All samples below RL except SH-04-SC-12. See table below.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes. MS/MSD results not reported with these five samples.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Not Applicable.
MS/MSD relative percent difference values within laboratory QC criteria%?	Not Applicable.
LCS percent recovery values within Laboratory QC criteria?	Yes
Do internal standards areas and retention time meet criteria? If no, was sample re-analyzed to establish matrix?	No. Chrysene-d12 exceeded upper limit for sample SH-04-SC-12. Sample diluted 3X and re-analyzed with acceptable IS area. Associated compounds below RL reported from original analysis; associated detected compounds reported from dilution.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Do continuing calibration %D values meet criteria?	Yes
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes. Sample SH-04-SC-12 diluted due to internal standard failure. See table below for compounds reported from dilution.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 4, 2008	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NV03

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Matrix spike recovery (64 percent) of sulfide for sample SH-07-SC-12 was below criteria (65 to 130 percent). No data were qualified because the exceedance was minor (1 percent) and all other criteria were met.

- Bis (2-ethylhexyl) phthalate (BEHP) was detected in the method blank. With the exception of sample SH-04-SC-12, BEHP was not detected above the reporting limit in any samples. The reported result of BEHP for sample SH-04-SC-12 was qualified as estimated because the value was less than 10 times the method blank contamination.

- Percent recovery for internal standard compound chrysene-d_{12} exceeded 150 percent for sample SH-04-SC-12; the sample was re-analyzed at a 3 times dilution with acceptable results. For the original analysis, all associated compounds were not detected above the reporting limit with the exception of pyrene, benzo (a) anthracene, bis (2-ethylhexyl) phthalate, chrysene. These compounds were reported from dilution analysis of sample SH-04-SC-12 (see table below).

Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
8270D	MB-102203	Method	Bis(2-ethylhexyl) phthalate	0.14	J	ug/kg	20

Samples Qualified for Positive Method Blank Results

Method	Sample ID	Compound	Result	Units	Qualifier
8270D	SH-04-SC-12	Bis(2-ethylhexyl) phthalate	110	ug/kg	J

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 4, 2008	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NV03

Surrogate Recoveries Outside Control Limits

- No results outside control limits.

Duplicate or Triplicate Results Outside Control Limits

- No results outside control limits.

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Type	Compound	% Rec	Limits	Qualifier
EPA 376-2	SH-07-SC-12	MS	Sulfide	64	65 – 130	None

Laboratory Control Sample Recoveries Outside Control Limits

- No results outside control limits.

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

Sample ID	Compound	Reason for Reanalysis
SH-04-SC-12	Pyrene	Internal standard area outside criteria in undiluted sample
SH-04-SC-12	Benzo (a) anthracene	Internal standard area outside criteria in undiluted sample
SH-04-SC-12	Bis (2-ethylhexyl) phthalate	Internal standard area outside criteria in undiluted sample
SH-04-SC-12	Chrysene	Internal standard area outside criteria in undiluted sample

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
U	Analyte was not detected at or above the reported result.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	**Review Completed by: Gina Catarra**
Laboratory: Analytical Resources, Inc.	**Laboratory Work Order : NS78,79,80, NU81 and NV08**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS78,79,80, NU81 and NV08

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-05-SS-00	10/01/08 ; 09:11	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-04-SS-00	10/01/08 ; 09:50	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-03-SS-00	10/01/08 ; 10:20	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-09-SS-00	10/01/08 ; 11:21	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-21-WS-00	10/01/08 ; 11:45	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-20-WS-00	10/01/08 ; 12:28	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-19-WS-00	10/01/08 ; 12:52	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-24-WS-00	10/01/08 ; 13:32	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-15-SS-00	10/01/08 ; 15:44	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-29-WS-00	10/01/08 ; 16:19	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-16-SS-00	10/01/08 ; 16:54	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-30-WS-00	10/01/08 ; 17:15	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, TBT, resin acids
SH-15-SC-12	10/01/08 ; 16:20	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-01-SC-12	10/01/08 ; 12:35	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs, TBT
OB-01-SS-00	10/02/08 ; 15:23	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-03-SS-00	10/02/08 ; 16:10	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-21-WC-12	10/02/08 ; 09:50	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-16-SC-12	10/02/08 ; 12:00	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-30-WC-12	10/02/08 ; 13:30	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, TBT, resin acids
SH-09-SC-12	10/01/08 ; 18:00	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
HI-07-SS-00	10/02/08 ; 08:48	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-12-SS-00	10/02/08 ; 09:40	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-11-SS-00	10/02/08 ; 10:32	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-18-WS-00	10/02/08 ; 11:15	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
SH-25-WS-00	10/02/08 ; 12:05	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
HI-05-SS-00	10/02/08 ; 13:24	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
OB-02-SS-00	10/02/08 ; 14:30	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-12-SC-12	10/02/08 ; 15:30	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-18-WC-12	10/02/08 ; 16:30	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS78,79,80, NU81 and NV08

SH-11-SC-12	10/14/08 ; 12:00	Sediment	Grain size, TOC, ammonia, sulfides, SVOCs
SH-19-WC-12	10/14/08 ; 13:45	Sediment	Grain size, TOC, TVS, ammonia, sulfides, SVOCs, resin acids
HI-03-SC-12	10/14/08 ; 15:40	Sediment	Grain size, TOC, ammonia, sulfides
HI-04-SC-12	10/14/08 ; 16:50	Sediment	Grain size, TOC, ammonia, sulfides
OB-07-SC-12	10/16/08 ; 08:00	Sediment	Grain size, TOC, ammonia, sulfides
OB-08-SC-12	10/16/08 ; 10:15	Sediment	Grain size, TOC, ammonia, sulfides
HI-01-SC-12	10/16/08 ; 17:00	Sediment	Grain size, TOC, ammonia, sulfides

Analytical methods

Analysis	Analytical Method	Number of Samples
Grain size	PSEP	36
TOC	Plumb, 1981	36
TVS	EPA 160.4	12
Ammonia	EPA 350.1	36
Total sulfides	EPA 376.2	36
SVOCs	EPA 8270D	31
Tributyltins	Krone 1988	3
Resin acids	EPA 8270D	12

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	No. Three of eight coolers for NS78,79, 80 arrived at 7.0 to 7.6 degrees. No data flagged.
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No

Conventionals Checklist

Any positive method blank results?	No
Laboratory QC frequency of one blank and LCS with each batch and one set of MS and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes
Triplicate relative standard deviation (RSD) within QC limits of less than 20%?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS78,79,80, NU81 and NV08

Conventionals Checklist

LCS percent recovery values within QC criteria of 80-120%?	Yes
Are calibration correlation coefficients > 0.995?	Yes
Are ICV percent recovery values 90-110%?	Yes
Are CCV percent recovery values 90-110% or 85-115% for total sulfides?	Yes

Semivolatile Organic Compound Checklist

Any compounds present in method blanks?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, refer to table below.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within laboratory QC criteria?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes. See table below.
Spot check retention time windows and second column confirmations as complete.	All acceptable

Resin Acids Checklist

Any compounds present in method blanks?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS78,79,80, NU81 and NV08

Resin Acids Checklist

MS/MSD relative percent difference values within laboratory QC criteria?	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	No. See table below.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	Yes. See table below.
Spot check retention time windows and second column confirmations as complete.	Internal standard failed low in sample SH-21-WC-12. See table below.

Tributyltins Checklist

Any compounds present in method blank?	No
For samples, if results are <5 times the blank then "U" flag data.	
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within laboratory QC criteria? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Surrogate recovery values for samples within laboratory QC limits?	No, see table below.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted? For any sample re-analyzed of diluted is only one result reported?	No
Spot check retention time windows and second column confirmations as complete.	Yes

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Three of the 8 coolers for work orders NS78, 79, and 80 were received at 7.0 to 7.6 deg C. Minor exceedance, no data qualified

- Bis(2-ethylhexl)phthalate (BEHP) was detected in one of the method blanks at a concentration greater than the reporting limit. Only samples with positive results less than 10 times the blank contamination were qualified. Seven samples, as shown in the table below, had a positive result for (BEHP) that was less than 10 times the method blank result. These samples were qualified as not detected (U) at the reported result.

- Recoveries of one surrogate for several samples were outside of laboratory or EPA control limits, as shown in the table below. No data were qualified because SVOC method 8270D allows one acid or base surrogate to exceed criteria, and all other surrogate recoveries were acceptable.

- The percent recovery for surrogate o-methyl podocarpic arid (141 percent) was greater than the upper laboratory control limit (114 percent) for sample SH-21-WC-12. Not detected values were not qualified because the failure was high. Detected compound were qualified as estimated (J).

- The percent recovery values for three matrix spike analyses for sulfides were below the method control limits (75 to 125 percent). Because all other QC data were within control for the sulfides analyses, no data except the original sample were qualified. As shown in the table below, sample SH-21-WS-00 was qualified as estimated (J) and sample HI-01-SC-12 was qualified as estimated at the detection limit (UJ). Sample SH-11-SC-12 was not qualified because the matrix spike recovery failure was marginal (1 percent) and all other QC criteria were met.

- The percent recovery for neoabietic acid in two LCS (20 and 9 percent) and two LCSD (9 and 22 percent) samples exceeded the control limits. Results for neoabietic acid were qualified as estimated at the detection limit (UJ) or estimated (J) for 13 samples, as shown in the table below.

- The percent recovery for internal standard d12-perylene (42 percent) in the analysis of sample SH-21-WC-12 fell below method control limits (50 to 150 percent). The compounds associated with internal standard d12-perylene were qualified as estimated at the detection limit in sample

SH-21-WC-12, as shown in the table below.

- Samples SH-18-WC-12 and SH-21-WC-12 were reanalyzed at a 10x, 20x, or 50x dilution because one or more compounds were reported at a concentration greater than the upper calibration range, as shown in the table below.

Positive Blanks

Method	Sample ID	Blank Type	Compound	Result	Flag	Units	RL
8270D	MB-101408	Method	bis(2-Ethylhexyl)phthalate	80		ug/L	20

Samples Qualified for Positive Method Blank Results

Method	Sample ID	Compound	Result	Units	Qualifier
8270D	SH-05-SS-00	bis(2-Ethylhexyl)phthalate	49	ug/L	U
8270D	SH-04-SS-00	bis(2-Ethylhexyl)phthalate	55	ug/L	U
8270D	SH-03-SS-00	bis(2-Ethylhexyl)phthalate	60	ug/L	U
8270D	SH-20-WS-00	bis(2-Ethylhexyl)phthalate	23	ug/L	U
8270D	SH-19-WS-00	bis(2-Ethylhexyl)phthalate	35	ug/L	U
8270D	SH-30-WS-00	bis(2-Ethylhexyl)phthalate	21	ug/L	U
8270D	SH-12-SC-12	bis(2-Ethylhexyl)phthalate	73	ug/L	U

Samples with Surrogate Recoveries Outside Laboratory Control Limits

Method	Sample ID	Compound	% Rec	Lab Limits	EPA Limits	Qualifier
8270D	SH-05-SS-00	d4-2-Chlorophenol	89	30-84	13-101	None
8270D	SH-03-SS-00	d4-2-Chlorophenol	87	30-84	13-101	None
8270D	SH-20-WS-00	d5-Nitrobenzene	22	29-87	16-103	None
8270D	SH-20-WS-00	d4-1,2-Dichlorobenzene	17	25-82	NA	None
8270D	SH-12-SC-12	d14-p-Terphenyl	100	21-97	NA	None
8270D	SH-16-SC-12	d14-p-Terphenyl	99	21-97	NA	None
8270D	SH-30-WC-12	d14-p-Terphenyl	100	21-97	NA	None
8270D	HI-07-SS-00	d14-p-Terphenyl	103	21-97	NA	None
Resin	SH-21-WC-12	o-Methyl podocarpic acid	141	19-114	NA	J or none

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS78,79,80, NU81 and NV08

Duplicate or Triplicate Results Outside Control Limits

No duplicate or triplicate results outside of control limits

Matrix Spike Recoveries Outside Control Limits

Method	Sample ID	Compound	MS % Rec	MSD %Rec	Limits	Qualifier
EPA 376.2	SH-21-WS-00	Sulfide	43	NA	75-125	J
EPA 376.2	SH-11-SC-12	Sulfide	74	NA	75-125	None
EPA 376.2	HI-01-SC-12	Sulfide	59	NA	75-125	UJ

Laboratory Control Sample Recoveries Outside Control Limits

Method	Sample ID	Compound	LCS % REC	Lab Limits	Qualifier
Resin	SH-21-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-20-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-19-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-24-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-29-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-30-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-01-SC-12	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-21-WC-12	Neoabietic acid	20 / 9 (LCSD)	30-160	J
Resin	SH-30-WC-12	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-18-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-25-WS-00	Neoabietic acid	20 / 9 (LCSD)	30-160	UJ
Resin	SH-18-WC-12	Neoabietic acid	20 / 9 (LCSD)	30-160	J
Resin	SH-19-WC-12	Neoabietic acid	9 / 22 (LCSD)	30-160	UJ

Samples Qualified for Internal Standard Recoveries Outside Control Limits

Method	Sample ID	Compound	IS % REC	Lab Limits	Qualifier
Resin	SH-21-WC-12	14-Chlorodehydroabietic acid	42	50-150	UJ
Resin	SH-21-WC-12	12-Chlorodehydroabietic acid	42	50-150	UJ
Resin	SH-21-WC-12	Dichlorodehydroabietic acid	42	50-150	UJ
Resin	SH-21-WC-12	9,10-Dichlorostearic acid	42	50-150	UJ

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: January 22, 2009	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NS78,79,80, NU81 and NV08

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

Sample ID	Compound	Reason for reanalysis
SH-18-WC-12	Retene	Result exceeded linear range. Reanalyzed at a 10x dilution.
SH-21-WC-12	Dehydroabietic acid	Result exceeded linear range. Reanalyzed at a 20x dilution.
SH-21-WC-12	Abietic acid	Result exceeded linear range. Reanalyzed at a 20x dilution.
SH-18-WC-12	Dehydroabietic acid	Result exceeded linear range. Reanalyzed at a 50x dilution.
SH-18-WC-12	Abietic acid	Result exceeded linear range. Reanalyzed at a 50x dilution.

Samples Qualified for Confirmation Column Percent Difference Values Outside Control Limit.

No samples qualified for confirmation column percent difference values outside control limits.

Data Qualification Code Definitions

Code	Description
J	Analyte was positively identified. The reported result is an estimate.
UJ	Analyte was not detected at or above the reported estimate.

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 4, 2008	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NW66

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project SAP (Herrera 2008) and Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Compliance with the project QA program is indicated in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Samples reviewed

Sample ID	Date/Time Collected	Matrix	Analyses
SH-23-WS-00	9/30/08 ; 15:43	Sediment	Grain size
SH-04-SS-00	10/1/08 ; 09:50	Sediment	Grain size
SH-03-SS-00	10/1/08 ; 10:20	Sediment	Grain size
SH-19-WS-00	10/1/08 ; 12:52	Sediment	Grain size
OB-3-SS-00	10/2/08 ; 16:10	Sediment	Grain size
SH-12-SS-00	10/2/08 ; 09:40	Sediment	Grain size
SH-11-SS-00	10/2/08 ; 10:32	Sediment	Grain size
SH-25-WS-00	10/2/08 ; 12:05	Sediment	Grain size
OB-13-SS-00	10/4/08 ; 11:24	Sediment	Grain size
SH-13-SS-00	10/5/08 ; 13:21	Sediment	Grain size

Analytical methods

Analysis	Analytical Method	Number of Samples
Grain size	PSEP	10

General Sample Information Checklist

All samples/analyses on COC reported?	Yes
Did coolers arrive at lab between 2 and 6 deg C and in good condition as indicated on COC and Cooler Receipt Form?	No. Six or the 23 coolers received at 7 deg C and two of the 23 coolers received at 8 deg C. Minor exceedance, no data qualified.
Frequency of QC samples correct? MS/MSD, duplicate, or triplicate samples – 1/20 samples, if requested.	Yes. Batch sample analyzed in triplicate with project samples.
Case narrative present and complete?	Yes
Any holding time violations?	No

Quality Assurance Review Level 1 Report	Project: Ecology – Oakland Bay
Date Completed: December 4, 2008	Review Completed by: Gina Catarra
Laboratory: Analytical Resources, Inc.	Laboratory Work Order : NW66

Conventionals Checklist

Any positive method blank results?	Not Applicable
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes – triplicate analysis performed.
MS/MSD percent recovery values within QC criteria of 75-125%?	Not Applicable
Triplicate relative standard deviation (RSD) within QC limits of less than 20%?	Yes – percent RSD ranged from 1 to 5 for all grain size fractions.
LCS percent recovery values within QC criteria of 80-120%?	Not Applicable.
Are calibration correlation coefficients > 0.995?	Not Applicable.
Are ICV percent recovery values 90-110%?	Not Applicable.
Are CCV percent recovery values 90-110% or 85-115% for total sulfides?	Not Applicable.

Summary of Potential Impacts on Data Usability

Major Concerns

- None

Minor Concerns

- Six or the 23 coolers received at 7 deg C and two of the 23 coolers received at 8 deg C. Minor exceedance, no data qualified.

Duplicate or Triplicate Results Outside Control Limits

- No results outside control limits.

Compounds Reported from Reanalysis or Dilution Due to Quality Issues

- No reanalysis or dilutions required.

Data Qualification Code Definitions

Code	Description
U	Analyte was not detected at or above the reported result.

APPENDIX K

Fingerprinting Justification Memo

TECHNICAL MEMORANDUM

Oakland Bay Sediment Investigation
Potential for Fingerprinting Analysis using Sediment Data

April 2009

Prepared for

DEPARTMENT OF
ECOLOGY
State of Washington

Washington Department of Ecology
Toxics Cleanup Program
Southwest Regional Office

TECHNICAL MEMORANDUM

Oakland Bay Sediment Investigation
Potential for Fingerprinting Analysis using Sediment Data

April 23, 2009

Prepared for

DEPARTMENT OF ECOLOGY
State of Washington

Washington Department of Ecology
Toxics Cleanup Program
Southwest Regional Office
300 Desmond Drive SE
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Prepared by

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Telephone: 206/624-9537

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Acronyms

C	carbon number
CDD	chlorinated dibenzo-p-dioxin compounds
CDF	chlorinated dibenzofuran compounds.
cm	centimeters
ft	foot
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
MDL	method detection limit
mg/kg	milligrams per kilogram
NWTPH-HCID	Northwest Total Petroleum Hydrocarbon (TPH) method for Hydrocarbon Identification
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran
PAH	polycyclic aromatic hydrocarbons
PCDD/PCDF	dioxin/furan
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
PQL	practical quantitation limit
RL	reporting limit
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TPH	total petroleum hydrocarbons

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Potential for Fingerprinting Analysis using Oakland Bay Sediment Data

1. Introduction

A screening-level "fingerprinting" evaluation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), and dioxin/furan (PCDD/PCDF) sediment data has been conducted to provide a preliminary indication of the usefulness of the analytical data collected during the Oakland Bay Sediment Investigation to differentiate between sources of contaminants. The anticipated goal of fingerprinting is linking contaminants found in sediment to either general or specific sources by comparing the sediment data with known source data. Three lines of forensic evidence have been qualitatively investigated: TPH, PAHs, and PCDD/PCDF. Results of the evaluation of the potential utility of fingerprinting studies for each contaminant type are discussed in the following sections.

2. Fingerprinting Usability

Generally accepted guidelines for reporting data recommend that concentrations between the method detection limit and what would effectively be three times the practical quantitation limit should be reported as detected but not quantified due to the potential for misuse of low-level data of relatively high quantitative uncertainty (Taylor 1987). For this investigation, concentrations of all analytes reported between the method detection limits (MDL) and practical quantitation limits (PQL [also known as reporting limits]) have all been annotated with a "J" qualifier (estimated concentration) indicating the high level of uncertainty in the quantitative value. Statistical evaluations of data whose uncertainties are "high" can lead to erroneous conclusions; especially if the sample populations being compared are limited in size or highly censored (high percentages of non-detect data). In developing this preliminary indication of the usefulness of the analytical data to differentiate between sources of contaminants, only un-annotated data measured at concentrations three times or more above the practical quantitation limit are used to estimate the viability of the data for further analysis.

3. Oakland Bay Sampling

Previous studies in Oakland Bay provided evidence that sediment in some areas had been impacted by the presence of wood waste (Ecology 2000). Station names and sample designations in these areas are differentiated to facilitate data interpretation; the same sampling protocols were followed at all stations.

Sediment and wood waste sample locations were identified in the Oakland Bay Sediment Characterization Study Sampling and Analysis Plan (E & E 2008). Surface sediment samples were collected using grab samplers. Surface sediment samples were collected from the 0-10 centimeter (cm) interval. Subsurface sediment samples were collected using a corer. Core samples were collected over multiple depth ranges. (E & E 2008)

Core samples submitted for testing at the same time as the surface samples included sediment taken from the 1- 2 foot (ft) below surface interval at a subset of the stations.

4. Analytes Considered for Fingerprinting

The following subsections discuss the fingerprinting potential of Oakland Bay Sediment Investigation TPH, PAH, and dioxin/furan sediment data. Each analyte group is defined followed by a brief discussion of the analytical protocols used. Data summaries are presented and the utility of the data for fingerprinting is discussed.

4.1 Petroleum Hydrocarbons (TPH)

4.1.1 Nature of Petroleum Hydrocarbons

Petroleum products are often complex mixtures of hydrocarbons. Sources of petroleum products in the environment are numerous, including: diesel and motor oil from ships, motor vehicles, municipal/industrial outfalls, and runoff from combined sewer overflows and storm drains. The “genetic” composition of crude oil is altered during refining which may yield different petroleum products with distinct gas chromatographic patterns. These mixtures of petroleum hydrocarbons “weather” upon release into the environment. Weathering processes include: evaporation, dissolution into water, sorption onto sediments, photo-oxidation, and biological degradation; which alter the fingerprint of the refined petroleum source material. Mixtures of different petroleum products released into the environment at different times, together with naturally occurring hydrocarbons, may confound the identification of the type of petroleum in an environmental sample. Gas chromatogram patterns of peaks and their relative intensities may be evaluated to identify similarities and differences between environmental samples containing petroleum. (Murphy and Morrison 2002)

4.1.2 Petroleum Hydrocarbon Analysis

Petroleum hydrocarbons were analyzed using the Total Petroleum Hydrocarbon (TPH) method NWTPH-HCID for Hydrocarbon Identification. NWTPH-HCID is a qualitative and semi-quantitative screening tool used to confirm the presence and type of petroleum product in a sediment sample. Results are qualitatively reported as gasoline, diesel, or heavy oils. The method is most useful for elimination of the need for more detailed petroleum analyses where NWTPH-HCID results indicate TPH concentrations are below regulatory limits. The method, dry-weight reporting limits for sediment are 20 milligrams per kilogram (mg/kg) for gasoline, 50 mg/kg for #2 diesel, and 100 mg/kg for motor oil. Reporting limits are often elevated for sediment samples due to the water content (per cent moisture) in the samples. Pattern matching with known reference product chromatograms is used to identify the type of hydrocarbon. Laboratory analysts categorize the TPH based on chromatogram identification.

In addition to the uncertainties associated with low level gasoline, diesel and motor oil concentrations, TPH fingerprinting is further limited by an inherent limitation in the method: based on their operating parameters, different chromatographic instruments yield unequal spectra. Chromatograms from one gas chromatograph may not be directly comparable with spectra from other gas chromatographs or even the same gas chromatograph operating at earlier or later times. Significant effort would be required to convert spectral data using relative retention times and peak heights or areas normalized to known standards in order to reasonably compare sample results.

4.1.3 Summary of Oakland Bay Petroleum Hydrocarbon Analysis Results

Sediment sampling was described above. Figures 1 and 2 illustrate the locations of the samples analyzed for TPH.

As can be seen in Tables 1, 2, and 3 petroleum hydrocarbons were rarely detected; and when detected, had concentrations close to detection limits. These “low” concentrations are associated with high uncertainty in quantitative accuracy (Taylor 1987).

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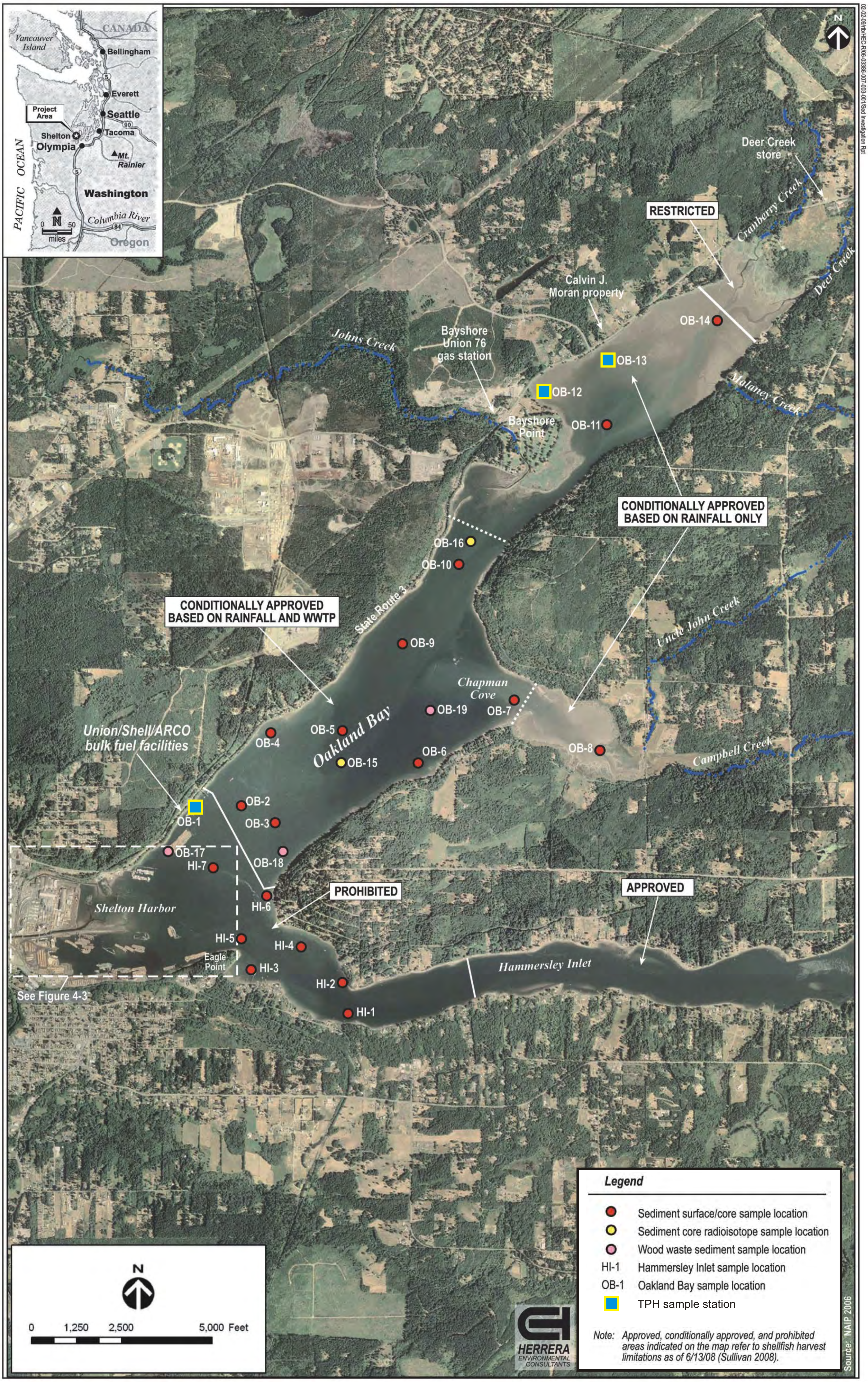


Figure 1 Oakland Bay and Hammersley Inlet Stations with Total Petroleum Hydrocarbon (TPH) Data

Figure 2 Shelton Harbor Stations with Total Petroleum Hydrocarbon (TPH) Data

Table 1. Summary of Gasoline Data from Oakland Bay Sediment Investigation

Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
0-10 cm	11	0	0	11	0	0%
1- 2 ft	2	0	0	2	0	0%
All	13	0	0	13	0	0%

Table 2. Summary of #2 Diesel Data from Oakland Bay Sediment Investigation

Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
0-10 cm	11	0	0	11	0	0%
1 – 2 ft	2	0	0	2	0	0%
All	13	0	0	13	0	0%

Table 3. Summary of Motor Oil Data from Oakland Bay Sediment Investigation

Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
0-10 cm	11	1	0	10	0	0%
1 – 2 ft	2	0	1	1	0	0%
All	13	1	1	11	0	0%

4.1.4 Utility of Petroleum Hydrocarbon Data for Fingerprinting

As shown in Tables 1, 2, and 3; there are no samples with petroleum concentrations above the recommended range of less certain quantitative data (greater than 3 times the PQL); with 0% of the gasoline, 0 % of the #2 diesel and 0% of the motor oil data meeting the minimum requirement for additional evaluation.

Based on the inherent limitations in TPH analyses and the highly censored nature of these data, conducting a detailed fingerprinting analysis of the petroleum hydrocarbon data would not be practicable.

Only general statements regarding petroleum hydrocarbon presence and absence can be made based on the data gathered during these studies.

4.2 Polycyclic Aromatic Hydrocarbons (PAH)

4.2.1 Nature of Polycyclic Aromatic Hydrocarbons

PAHs occur both naturally and from anthropogenic sources. PAHs are known to have characteristic distributions in differing materials. For example, petroleum and wood combustions sources are known to have different PAH patterns, Creosote and coal tar creosote are often used as preservatives on piling for docks, dolphins, and piers; these complex mixtures degrade in the environment and release PAH compounds in characteristic patterns. However, as with TPH, PAHs also weather in the environment. (Murphy and Morrison 2002)

4.2.2 Polycyclic Aromatic Hydrocarbons Analysis

Sediment samples were analyzed for 17 distinct PAHs using USEPA SW-846 method 8270 (EPA 1986). Analytes include: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, 2-methylnaphthalene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. (E & E 2008)

4.2.3 Summary of Oakland Bay Polycyclic Aromatic Hydrocarbons Analysis Results

Sediment sampling was described above. Figures 3 and 4 illustrate the locations of the samples analyzed for PAH.

As can be seen in Tables 4, 5, and 6; PAHs were only sporadically detected; and when detected often had concentrations close to detection limits. These "low" concentrations are associated with high uncertainty in quantitative accuracy (Taylor 1987). Almost all of the annotated data were "flagged" because the concentrations measured were above the MDL but below the PQL.

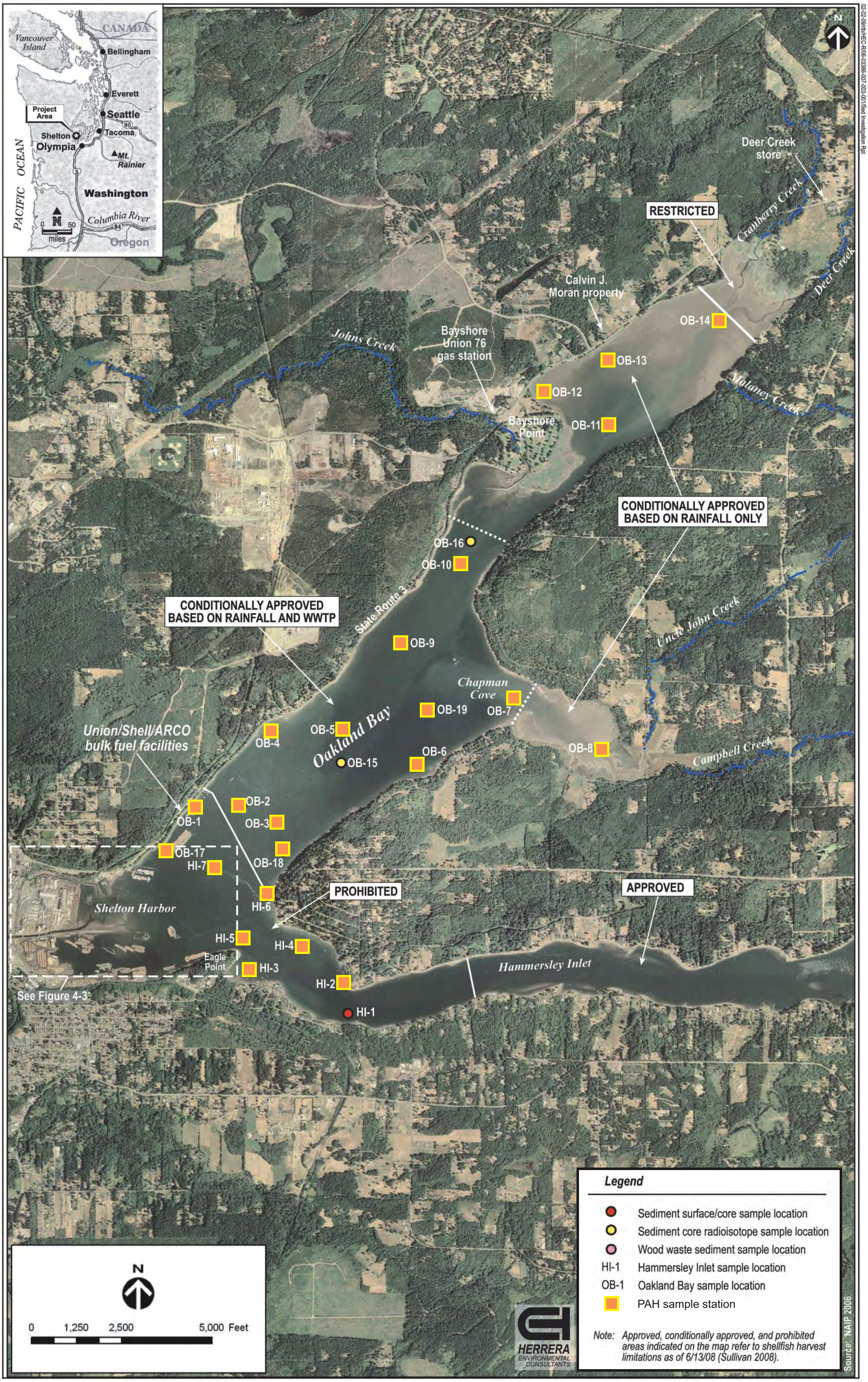


Figure 3 Oakland Bay and Hammersley Inlet Stations with Polycyclic Aromatic Hydrocarbons (PAH) Data

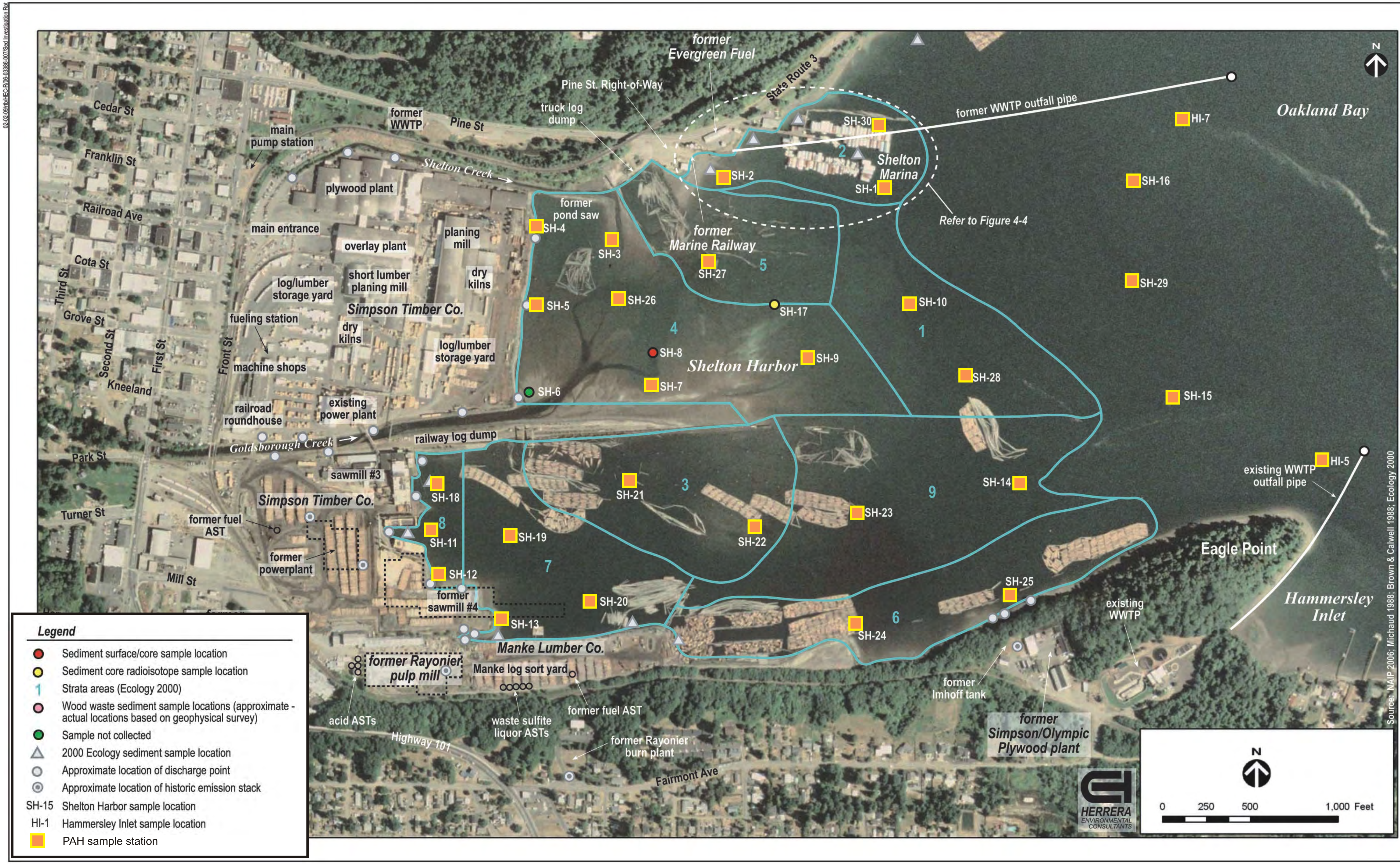


Figure 4 Shelton Harbor Stations with Polycyclic Aromatic Hydrocarbons (PAH) Data

Table 4. Summary of Individual PAH Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
naphthalene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	3	2	9	0	0%
	SH (WS)	0-10 cm	13	0	1	12	0	0%
	SH (SC)	1-2 ft	14	3	2	9	1	7%
	SH (WC)	1-2 ft	11	2	0	9	1	9%
	All	All	78	8	5	65	2	3%
2-methyl naphthalene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	0	0	14	0	0%
	SH (WS)	0-10 cm	13	0	0	13	0	0%
	SH (SC)	1-2 ft	14	0	0	14	0	0%
	SH (WC)	1-2 ft	11	0	0	11	0	0%
	All	All	78	0	0	78	0	0%
acenaphthylene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	2	2	10	0	0%
	SH (WS)	0-10 cm	13	1	0	12	0	0%
	SH (SC)	1-2 ft	14	1	1	12	1	7%
	SH (WC)	1-2 ft	11	0	0	11	0	0%
	All	All	78	4	3	71	1	1%

Table 4 continued. Summary of Individual PAH Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
acenaphthene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	0	2	12	0	0%
	SH (WS)	0-10 cm	13	0	1	12	0	0%
	SH (SC)	1-2 ft	14	1	1	12	1	7%
	SH (WC)	1-2 ft	11	1	0	10	1	9%
	All	All	78	2	4	72	2	3%
fluorene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	1	3	10	0	0%
	SH (WS)	0-10 cm	13	0	1	12	0	0%
	SH (SC)	1-2 ft	14	1	1	12	1	7%
	SH (WC)	1-2 ft	11	1	0	10	1	9%
	All	All	78	3	5	70	2	3%
phenanthrene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	2	0	12	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	9	0	5	4	29%
	SH (WS)	0-10 cm	13	7	2	4	1	8%
	SH (SC)	1-2 ft	14	8	3	3	3	21%
	SH (WC)	1-2 ft	11	5	2	4	4	36%
	All	All	78	31	7	40	12	15%

Table 4 continued. Summary of Individual PAH Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
anthracene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	3	2	9	2	14%
	SH (WS)	0-10 cm	13	3	0	10	1	8%
	SH (SC)	1-2 ft	14	2	0	12	1	7%
	SH (WC)	1-2 ft	11	3	0	8	2	18%
	All	All	78	11	2	65	6	8%
fluoranthene	HI (SS)	0-10 cm	6	0	1	5	0	0%
	OB (SS)	0-10 cm	14	2	2	10	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	1	2	0	0%
	SH (SS)	0-10 cm	14	11	1	2	8	57%
	SH (WS)	0-10 cm	13	10	2	1	6	46%
	SH (SC)	1-2 ft	14	12	0	2	6	43%
	SH (WC)	1-2 ft	11	7	0	4	4	36%
	All	All	78	42	7	29	24	31%
pyrene	HI (SS)	0-10 cm	6	0	1	5	0	0%
	OB (SS)	0-10 cm	14	2	2	10	1	7%
	OB (WS)	0-10 cm	3	1	0	2	0	0%
	OB (WC)	1-2 ft	3	0	1	2	0	0%
	SH (SS)	0-10 cm	14	11	1	2	8	57%
	SH (WS)	0-10 cm	13	11	1	1	6	46%
	SH (SC)	1-2 ft	14	13	0	1	7	50%
	SH (WC)	1-2 ft	11	7	0	4	4	36%
	All	All	78	45	6	27	26	33%

Table 4 continued. Summary of Individual PAH Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
benzo(a)anthracene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	1	1	12	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	9	1	4	5	36%
	SH (WS)	0-10 cm	13	6	2	5	1	8%
	SH (SC)	1-2 ft	14	7	2	5	2	14%
	SH (WC)	1-2 ft	11	5	2	4	3	27%
	All	All	78	28	8	42	11	14%
chrysene	HI (SS)	0-10 cm	6	0	1	5	0	0%
	OB (SS)	0-10 cm	14	2	3	9	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	11	1	2	7	50%
	SH (WS)	0-10 cm	13	9	2	2	4	31%
	SH (SC)	1-2 ft	14	9	1	4	5	36%
	SH (WC)	1-2 ft	11	6	1	4	3	27%
	All	All	78	37	9	32	19	24%
benzo(b)fluoranthene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	1	13	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	10	1	3	5	36%
	SH (WS)	0-10 cm	13	8	0	5	2	15%
	SH (SC)	1-2 ft	14	7	0	7	2	14%
	SH (WC)	1-2 ft	11	5	2	4	3	27%
	All	All	78	30	4	44	12	15%

Table 4 continued. Summary of Individual PAH Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
benzo(k)fluoranthene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	1	13	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	9	2	3	5	36%
	SH (WS)	0-10 cm	13	7	0	6	4	31%
	SH (SC)	1-2 ft	14	7	0	7	2	14%
	SH (WC)	1-2 ft	11	5	2	4	3	27%
	All	All	78	28	5	45	14	18%
benzo(a)pyrene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	1	13	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	1	0	2	0	0%
	SH (SS)	0-10 cm	14	9	1	4	6	43%
	SH (WS)	0-10 cm	13	7	1	5	2	15%
	SH (SC)	1-2 ft	14	7	2	5	2	14%
	SH (WC)	1-2 ft	11	6	1	4	2	18%
	All	All	78	30	6	42	12	15%
indeno(1,2,3-cd)pyrene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	1	13	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	5	2	7	1	7%
	SH (WS)	0-10 cm	13	3	0	10	1	8%
	SH (SC)	1-2 ft	14	2	2	10	1	7%
	SH (WC)	1-2 ft	11	0	1	10	0	0%
	All	All	78	10	6	62	3	4%

Table 4 continued. Summary of Individual PAH Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth range	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
dibenzo(a,h)anthracene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	0	0	3	0	0%
	SH (SS)	0-10 cm	14	0	2	12	0	0%
	SH (WS)	0-10 cm	13	0	1	12	0	0%
	SH (SC)	1-2 ft	14	0	0	14	0	0%
	SH (WC)	1-2 ft	11	0	0	11	0	0%
	All	All	78	0	3	75	0	0%
benzo(g,h,i)perylene	HI (SS)	0-10 cm	6	0	0	6	0	0%
	OB (SS)	0-10 cm	14	0	0	14	0	0%
	OB (WS)	0-10 cm	3	0	0	3	0	0%
	OB (WC)	1-2 ft	3	1	0	2	0	0%
	SH (SS)	0-10 cm	14	8	2	4	2	14%
	SH (WS)	0-10 cm	13	3	0	10	1	8%
	SH (SC)	1-2 ft	14	4	3	7	2	14%
	SH (WC)	1-2 ft	11	2	2	7	1	9%
	All	All	78	18	7	53	6	8%

HI (SS) – Hammersley Inlet surface sediment
OB (SS) – Oakland Bay surface sediment
OB (WS) – Oakland Bay wood waste area surface sediment
OB (WC) – Oakland Bay wood waste area subsurface sediment
SH (SS) – Shelton Harbor surface sediment
SH (WS) – Shelton Harbor wood waste area surface sediment
SH (SC) – Shelton Harbor subsurface sediment
SH (WC) – Shelton Harbor wood waste area subsurface sediment

Table 5. Summary of All PAH Analytes Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	Depth Range	# of analytes	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
All PAHs	HI	0-10 cm	102	0	3	99	0	0%
	OB	0-10 cm	289	10	12	267	1	0.3%
	OB	1-2 ft	51	2	2	47	0	0%
	SH	0-10 cm	459	176	39	244	82	18%
	SH	1-2 ft	425	139	31	255	69	16%
	All	All	1326	327	87	912	152	11%

HI – Hammersley Inlet
OB – Oakland Bay
SH – Shelton Harbor

Table 6. Summary of All PAH Data by Station from Oakland Bay Sediment Investigation

# of individual PAHs	# of stations with un-annotated positive results > 3 x PQL	% of stations with un-annotated positive results > 3 x PQL	Cumulative % of stations with un-annotated positive results > 3 x PQL
0	50	64%	64%
1	4	5%	69%
2	2	3%	72%
3	7	9%	81%
4	2	3%	83%
5	1	1%	85%
6	2	3%	87%
7	1	1%	88%
8	2	3%	91%
9	3	4%	95%
10	0	0%	95%
11	2	3%	97%
12	0	0%	97%
13	1	1%	99%
14	0	0%	99%
15	1	1%	100%
16	0	0%	100%
17	0	0%	100%
total	78	100%	100%

4.2.4 Utility of Polycyclic Aromatic Hydrocarbons Data for Fingerprinting

Based on the data presented in Tables 4, 5, and 6, PAH data from Oakland Bay and Hammersley Inlet are highly censored (large number of non-detect data) with only a single un-annotated positive result more than three times the PQL. In Shelton Harbor, 82% of the surface sediment and 84% of the subsurface sediment PAH data were determined to be of relatively high quantitative uncertainty (Taylor 1987).

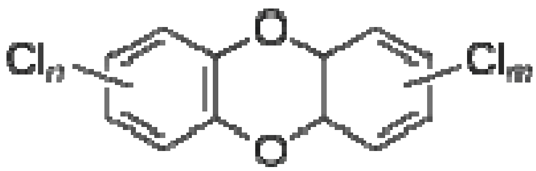
Assuming, for discussion purposes only, that a minimum of five individual PAHs must be present in a sample at concentrations above three times the PQL, then approximately one-sixth of the stations would have sufficient data at one or more depth intervals to fingerprint the PAHs using relative ratios of the individual PAH concentration. Even if the data set is restricted to only Shelton Harbor, more than three-quarters of the stations fail to meet the minimum requirement of 5 individual PAHs with un-annotated concentrations more than 3 times the PQL.

Fingerprinting PAHs in Oakland Bay, Hammersley Inlet, or Shelton Harbor would not provide reliable results.

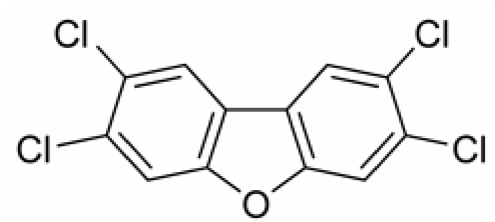
4.3 Dioxin/Furan (PCDD/PCDF)

4.3.1 Nature of Dioxin/Furan (PCDD/PCDF)

Briefly, dioxins and furans are families of related compounds with from 1 to 8 chlorine atoms located at various positions around a base carbon ring structure. Each unique compound is referred to as a congener. Congeners with the same number of chlorine atoms are referred to as homologues. There are 75 different dioxin congeners and 135 different furan congeners. Congeners vary significantly in their toxicity. The following figure illustrates the general structure of dioxin where *n* and *m* represent the number of chlorine atoms and may vary from 0 to 4.



The structure of the congener 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) is illustrated below.



It is generally accepted that dioxins and furans do not occur naturally and are not deliberately manufactured. Small quantities of these compounds are inadvertent by-products resulting from a number of chemical processes. For example, pentachlorophenol used in wood preserving often contains dioxin/furan as impurities. Chlorination of wastewater effluent from treatment plants may produce dioxin/furan. Two important sources of dioxin/furan are waste incineration, especially when plastics are burned, and effluent from pulp and paper mills that use chlorine bleaching.

Different processes produce dioxin/furan in differing congener relative ratios. These patterns may be used to indicate the type(s) of sources that may have generated the dioxin/furan. As with the TPH and PAH compounds noted above, dioxin/furan also "weather" in the environment. The use of homologue data for fingerprinting is limited since the concentration of each homologue is based on the sum of several congeners having the same number of chlorine atoms.

4.3.2 Dioxin/Furan Analysis

Sediment samples were analyzed for 17 dioxin/furan congeners and 8 dioxin/furan homologues using USEPA method 1613 (EPA 1994). Target analytes are listed below:

2,3,7,8-TCDD
Total TCDD
1,2,3,7,8-PeCDD
Total PeCDD
1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD
Total HxCDD
1,2,3,4,6,7,8-HpCDD
Total HpCDD
OCDD
2,3,7,8-TCDF
Total TCDF
1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF
Total PeCDF
1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF
2,3,4,6,7,8-HxCDF
Total HxCDF
1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF
Total HpCDF
OCDF

Key:

CDD = chlorinated dibenzo-p-dioxin compounds
CDF = chlorinated dibenzofuran compounds.
HxCDD = hexachlorodibenzo-p-dioxin
HxCDF = hexachlorodibenzofuran
HpCDD = heptachlorodibenzo-p-dioxin

HpCDF	= heptachlorodibenzofuran
OCDD	= octachlorodibenzo-p-dioxin
OCDF	= octachlorodibenzofuran
PeCDD	= pentachlorodibenzo-p-dioxin
PeCDF	= pentachlorodibenzofuran
TCDD	= tetrachlorodibenzo-p-dioxin
TCDF	= tetrachlorodibenzofuran

4.3.3 Summary of Oakland Bay Dioxin/Furan Analysis Results

Sediment sampling was described above. Some analyte concentration data were annotated “B” during data validation, indicating that the analyte was detected in the blank associated with the sample. Generally, these blank concentrations were significantly below the measured concentration. Data annotated “B” were considered un-annotated if the measured concentration was 10 times the PQL. Dioxins/furans were only analyzed in surface sediment samples. Figures 5 and 6 illustrate the locations of the samples analyzed for dioxin/furan.

As can be seen in Tables 7, 8, and 9; one or more dioxin/furan congeners were detected in 100% of the samples.

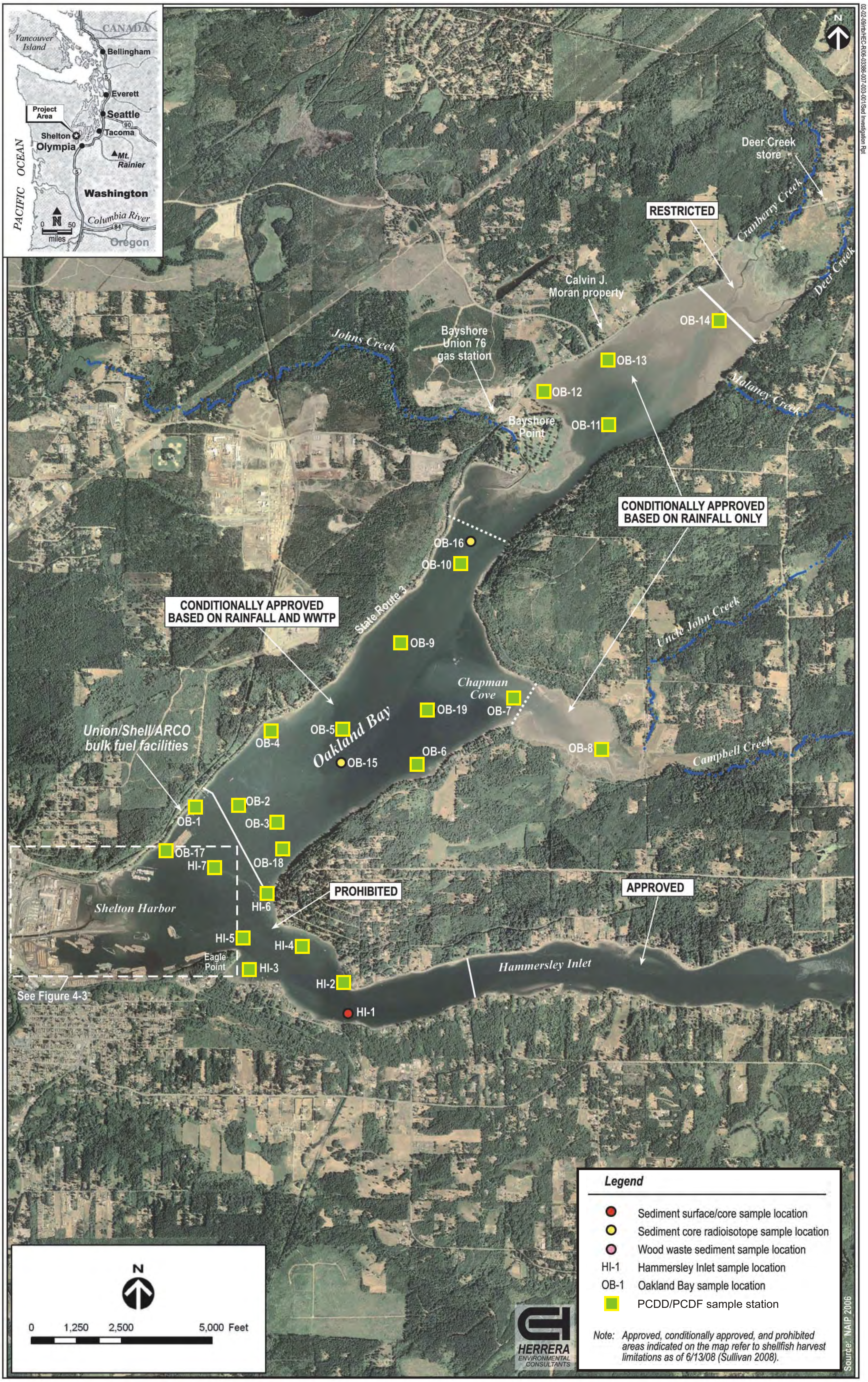


Figure 5 Oakland Bay and Hammersley Inlet Stations with Dioxin/Furan (PCDD/PCDF) Data

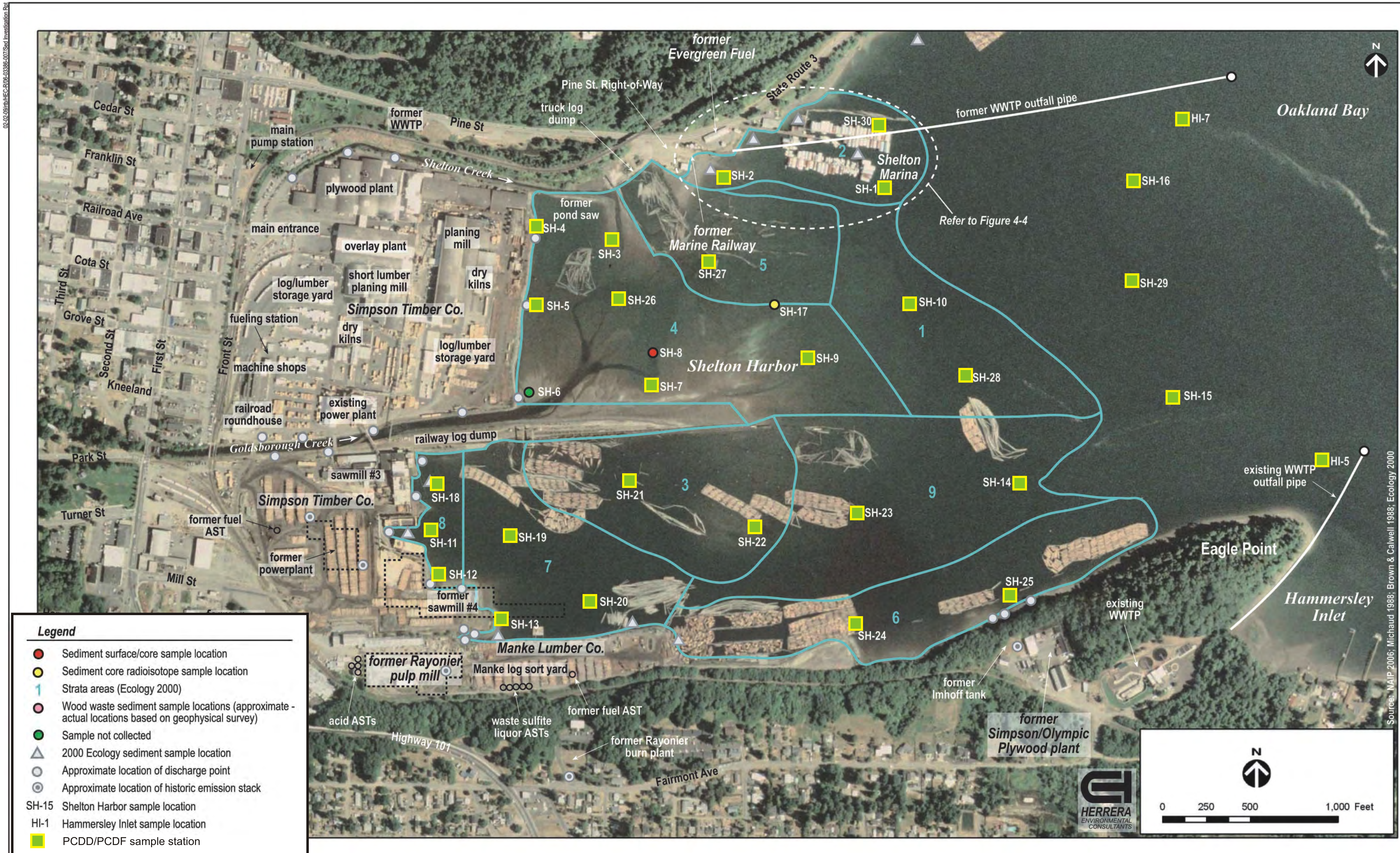


Figure 6 Shelton Harbor Stations with Dioxin/Furan (PCDD/PCDF) Data

Table 7. Summary of Individual Dioxin/Furan Congener Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
1,2,3,4,6,7,8-HpCDD	HI (SS)	6	6	0	0	6	100%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	14	100%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	50	100%
1,2,3,4,6,7,8-HpCDF	HI (SS)	6	6	0	0	6	100%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	14	100%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	50	100%
1,2,3,4,7,8,9-HpCDF	HI (SS)	6	6	0	0	4	67%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	12	86%
	SH (WS)	13	13	0	0	11	85%
	All	50	49	0	0	44	83%
1,2,3,4,7,8,-HxCDD	HI (SS)	6	6	0	0	2	33%
	OB (SS)	14	14	0	0	13	93%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	12	2	0	12	86%
	SH (WS)	13	13	0	0	10	77%
	All	50	48	2	0	40	75%

Table 7 continued. Summary of Individual Dioxin/Furan Congener Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
1,2,3,4,7,8-HxCDF	HI (SS)	6	6	0	0	5	83%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	12	86%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	47	89%
1,2,3,6,7,8-HxCDD	HI (SS)	6	6	0	0	6	100%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	13	93%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	49	92%
1,2,3,6,7,8,-HxCDF	HI (SS)	6	6	0	0	2	33%
	OB (SS)	14	14	0	0	13	93%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	13	1	0	11	79%
	SH (WS)	13	13	0	0	9	69%
	All	50	49	1	0	38	72%
1,2,3,7,8,9-HxCDD	HI (SS)	6	6	0	0	6	100%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	13	93%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	49	92%

Table 7 continued. Summary of Individual Dioxin/Furan Congener Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
1,2,3,7,8,9-HxCDF	HI (SS)	6	0	6	0	0	0%
	OB (SS)	14	11	3	0	0	0%
	OB (WS)	3	2	1	0	0	0%
	SH (SS)	14	9	5	0	3	21%
	SH (WS)	13	9	4	0	0	0%
	All	50	31	19	0	3	6%
1,2,3,7,8-PeCDD	HI (SS)	6	3	3	0	2	33%
	OB (SS)	14	14	0	0	13	93%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	12	2	0	11	79%
	SH (WS)	13	11	2	0	9	69%
	All	50	43	7	0	38	72%
1,2,3,7,8-PeCDF	HI (SS)	6	2	4	0	1	17%
	OB (SS)	14	13	1	0	12	86%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	12	2	0	10	71%
	SH (WS)	13	9	4	0	9	69%
	All	50	39	11	0	35	66%
2,3,4,6,7,8-HxCDF	HI (SS)	6	5	1	0	2	33%
	OB (SS)	14	14	0	0	13	93%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	12	2	0	11	79%
	SH (WS)	13	12	1	0	9	69%
	All	50	46	4	0	38	72%

Table 7 continued. Summary of Individual Dioxin/Furan Congener Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
2,3,4,7,8-PeCDF	HI (SS)	6	1	5	0	1	17%
	OB (SS)	14	11	3	0	10	71%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	11	3	0	11	79%
	SH (WS)	13	11	2	0	9	69%
	All	50	37	13	0	34	64%
2,3,7,8-TCDD	HI (SS)	6	2	4	0	1	17%
	OB (SS)	14	14	0	0	12	86%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	12	2	0	11	79%
	SH (WS)	13	11	1	1	8	62%
	All	50	42	7	1	35	66%
2,3,7,8-TCDF	HI (SS)	6	5	1	0	2	33%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	11	3	0	10	71%
	SH (WS)	13	8	5	0	7	54%
	All	50	41	9	0	36	72%
OCDD	HI (SS)	6	6	0	0	6	100%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	14	100%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	50	100%

Table 7 continued. Summary of Individual Dioxin/Furan Congener Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	# of samples	# of un-annotated positive results	# of annotated positive results	# of non-detect samples	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
OCDF	HI (SS)	6	6	0	0	6	100%
	OB (SS)	14	14	0	0	14	100%
	OB (WS)	3	3	0	0	3	100%
	SH (SS)	14	14	0	0	14	100%
	SH (WS)	13	13	0	0	13	100%
	All	50	50	0	0	50	100%

HI (SS) – Hammersley Inlet surface sediment
OB (SS) – Oakland Bay surface sediment
OB (WS) – Oakland Bay wood waste area surface sediment
SH (SS) – Shelton Harbor surface sediment
SH (WS) – Shelton Harbor wood waste area surface sediment

Table 8. Summary of All Dioxin/Furan Congener Data from Oakland Bay Sediment Investigation

Analyte	Area (sample matrix)	# of analytes	# of un-annotated positive results	# of annotated positive results	# of non-detect analytes	# of un-annotated positive results > 3 x PQL	% of un-annotated data > 3 x PQL
All dioxin/furan congeners	HI	102	78	24	0	58	57%
	OB	289	281	8	0	260	90%
	SH	459	417	41	1	368	80%
	All	850	776	73	1	686	81%

HI (SS) – Hammersley Inlet surface sample
OB (SS) – Oakland Bay surface sample
SH (SS) – Shelton Harbor surface sample

Table 9. Summary of All Dioxin/Furan Congener Data by Station from Oakland Bay Sediment Investigation

# of congeners	# of stations with un-annotated positive results > 3 x PQL	% of stations with un-annotated positive results > 3 x PQL	Cumulative % of stations with un-annotated positive results > 3 x PQL
0	0	0%	0%
1	0	0%	0%
2	0	0%	0%
3	0	0%	0%
4	1	2%	2%
5	0	0%	2%
6	2	4%	6%
7	3	6%	12%
8	3	6%	18%
9	2	4%	22%
10	1	2%	24%
11	0	0%	24%
12	0	0%	24%
13	1	2%	26%
14	2	4%	30%
15	7	14%	44%
16	25	50%	94%
17	3	6%	100%
total	50	100%	100%

4.3.4 Utility of Dioxin/Furan Congener Data for Fingerprinting

Based on the data presented in Tables 7, 8, and 9, it is clear that dioxin/furan data are not highly censored (less than 1% of the data were non-detect). In addition, a significant percentage of the un-annotated positive results are greater than three times the PQL.

Assuming, for discussion purposes only, that a minimum of five congeners must be present in a sample at concentrations above three times the PQL, then approximately 98 per cent of the stations would have sufficient data to fingerprint dioxin/furan congeners using relative ratios of the congener concentrations.

Dioxin/furan fingerprinting would be appropriate for Hammersley Inlet, Oakland Bay, and Shelton Harbor.

Visual comparisons of relative ratios of dioxin/furan congener concentrations to published ratios from sources such as wood burning may provide some indication of the nature of potential source material.

5. Summary

Based on the available data, fingerprinting is not possible for TPH in Oakland Bay, Hammersley Inlet, or Shelton Harbor.

Again, based on the available data, fingerprinting is not possible for PAHs in Oakland Bay, Hammersley Inlet, or Shelton Harbor.

Oakland Bay, Hammersley Inlet, and Shelton Harbor sediment dioxin/furan data are amenable to fingerprinting. The Oakland Bay Sediment Investigation Report will include comparisons of relative dioxin/furan congener sediment concentrations with relative dioxin/furan congener concentrations from sources such as wood burning, automotive exhaust, and pulp and paper mill effluent. Sediment dioxin/furan data will also be compared with the recently released Puget Sound Dioxin/PCB Survey, OSV Bold, 2008 (DMMP 2009)data, data provided by Ecology for sediment samples collected from Goose Lake (where Rayonier pumped sulfite waste liquor during a portion of its operating period), and if available, data from salt-laden hog fuel boiler emissions.

References

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APPENDIX L

Correlation Matrices Comparing Toxicity Test Metrics with Select Parameter Concentrations

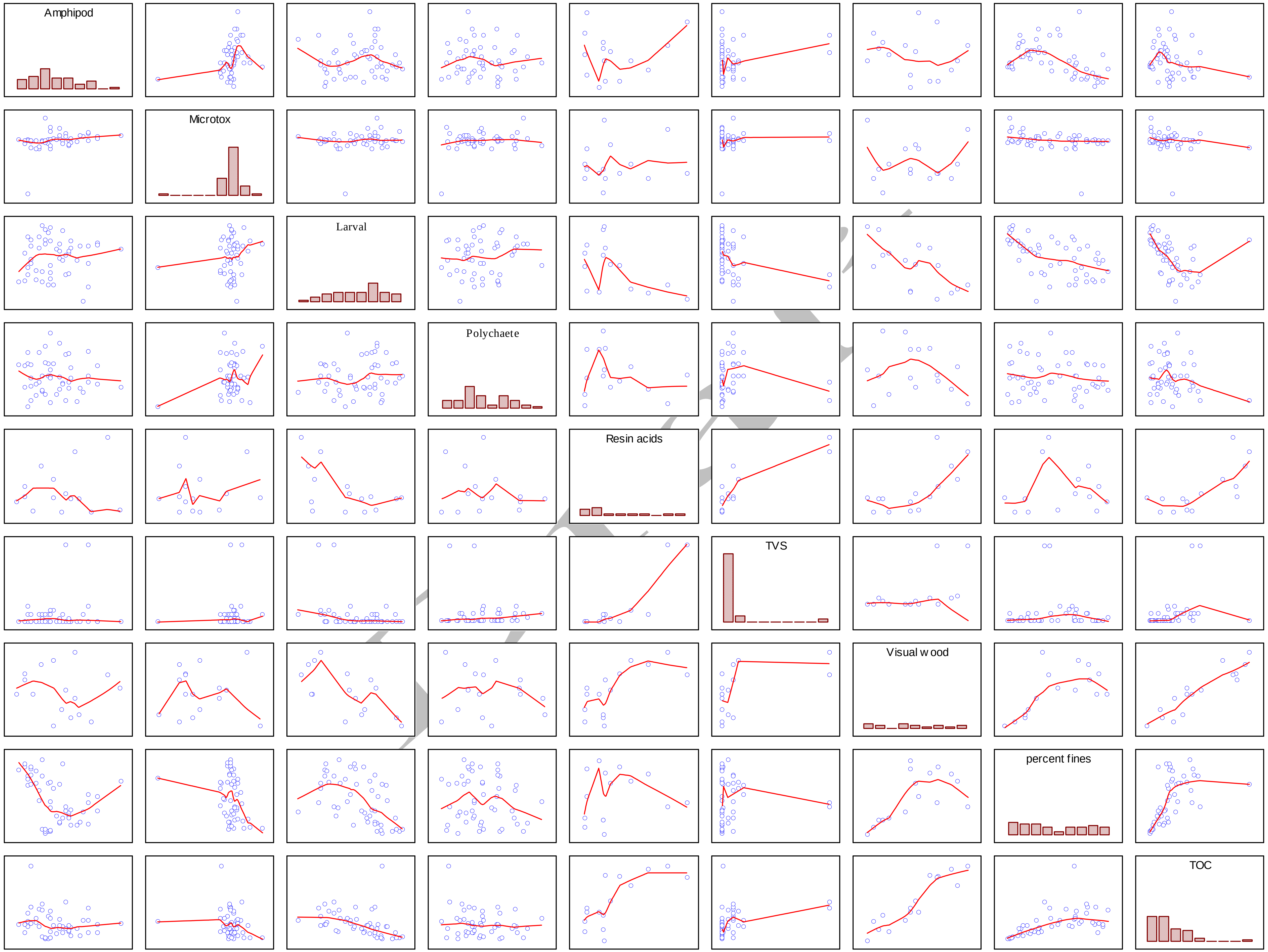

Figure L-1. Correlation matrix comparing four toxicity metrics with resin acids, total volatile solids, wood content (visual), percent fines, and total organic carbon for all the project sites except the reference sites.

jr /06-03386-007 apx l correlation matrices.doc

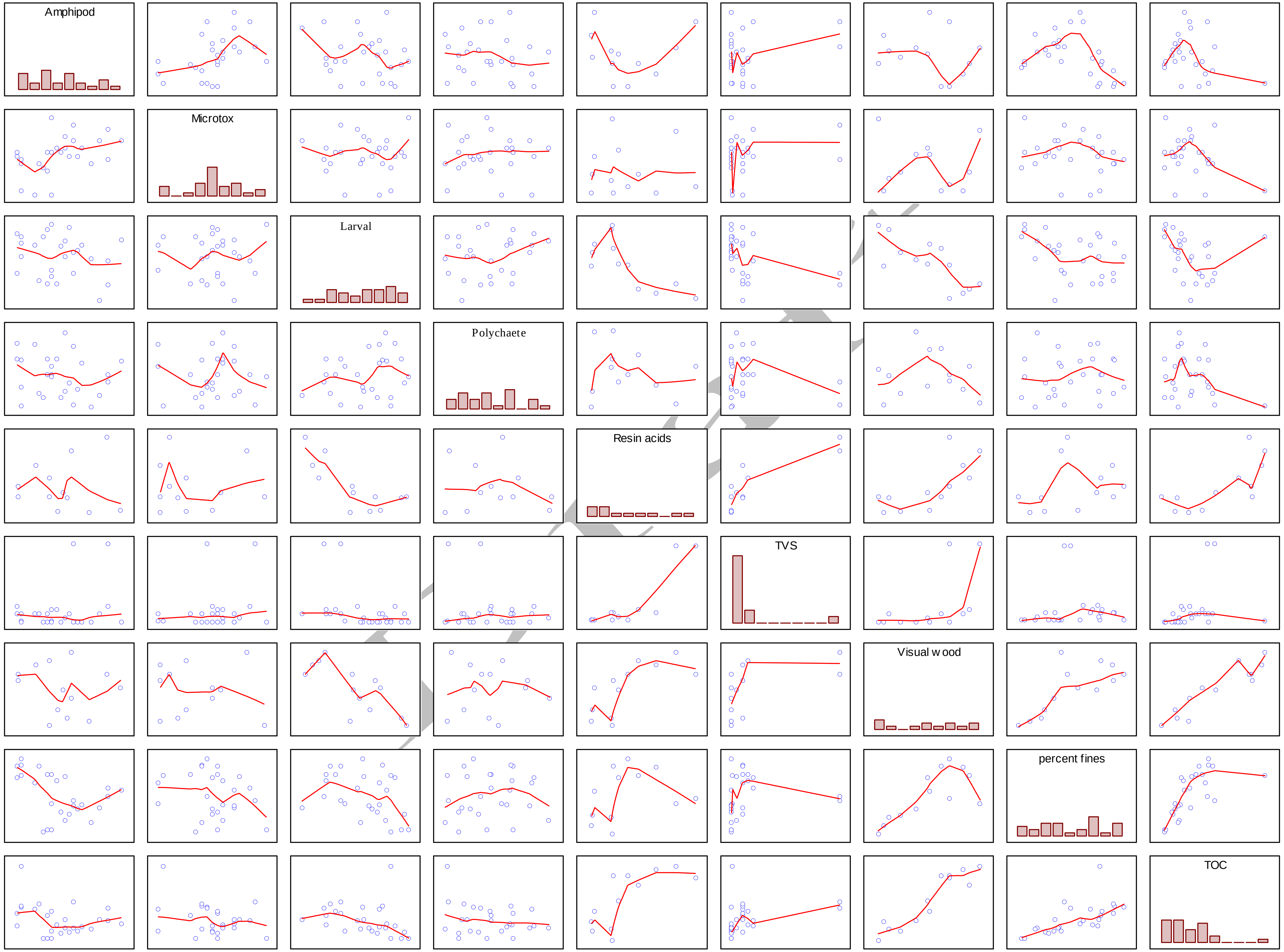

Figure L-2. Correlation matrix comparing four toxicity metrics with resin acids, total volatile solids, wood content (visual), percent fines, and total organic carbon for the Shelton Harbor sites.

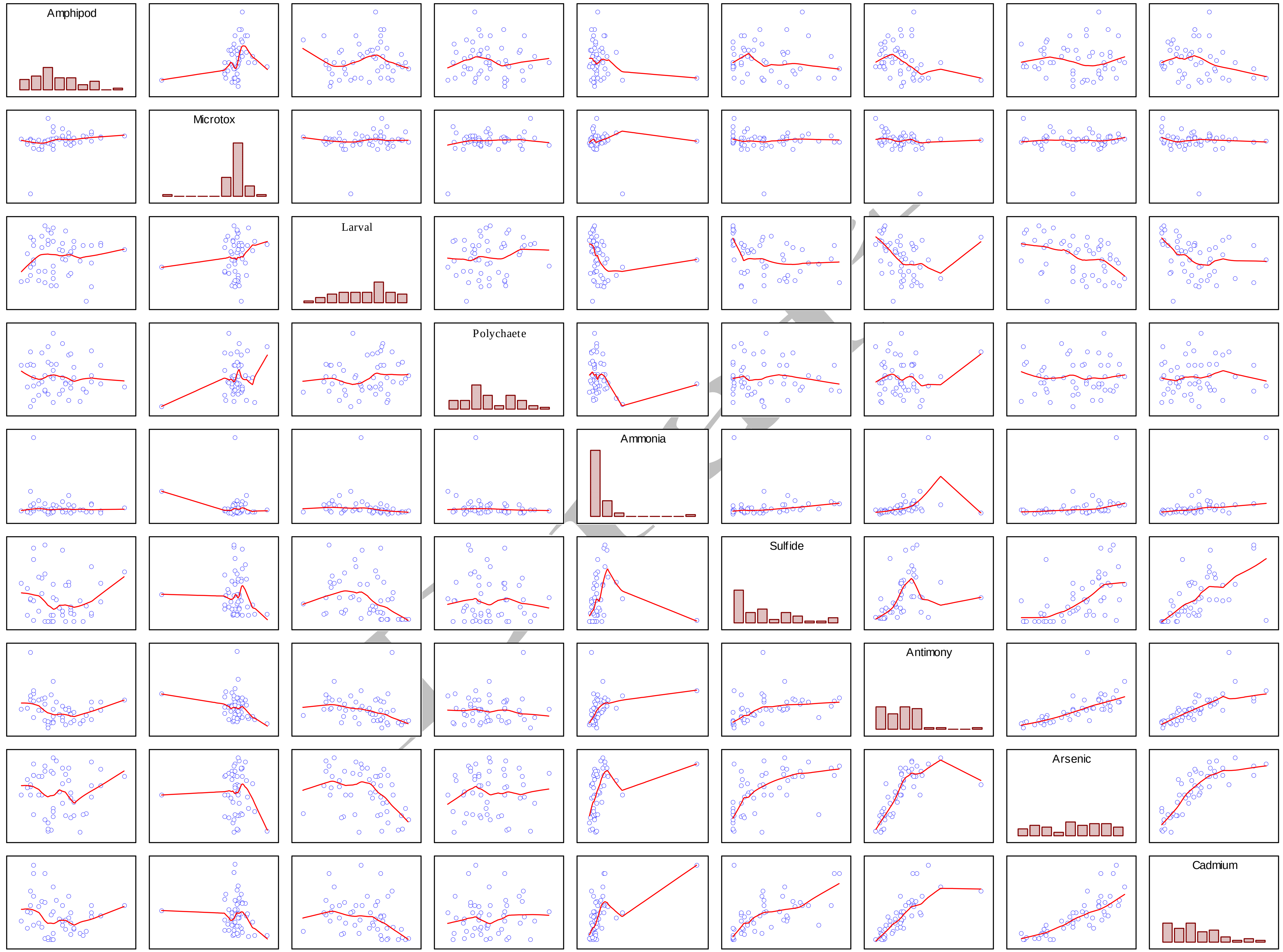

Figure L-3. Correlation matrix comparing four toxicity metrics with ammonia, sulfide, antimony, arsenic, and cadmium for all the project sites except the reference sites.

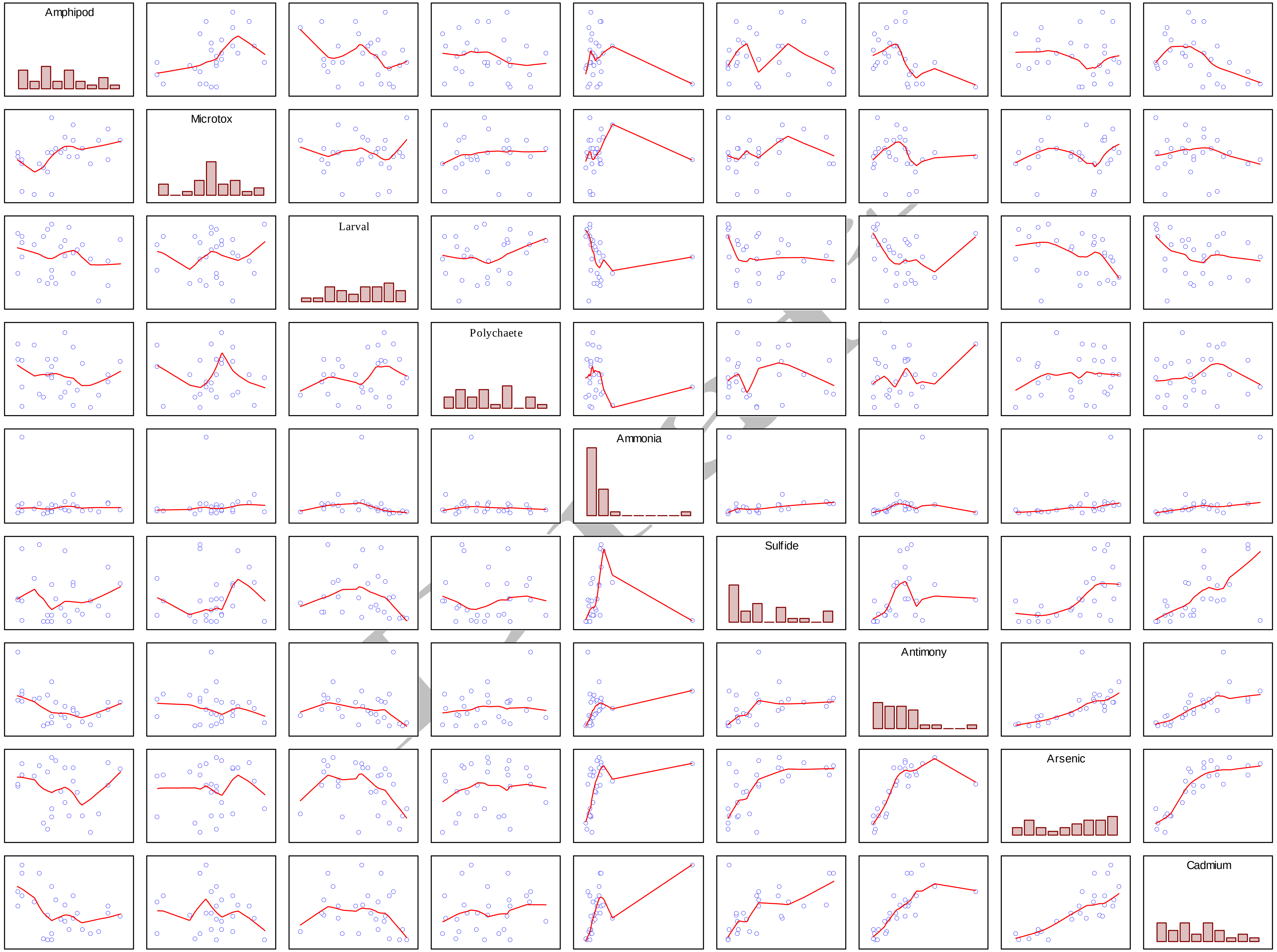

Figure L-4. Correlation matrix comparing four toxicity metrics with ammonia, sulfide, antimony, arsenic, and cadmium for the Shelton Harbor sites.

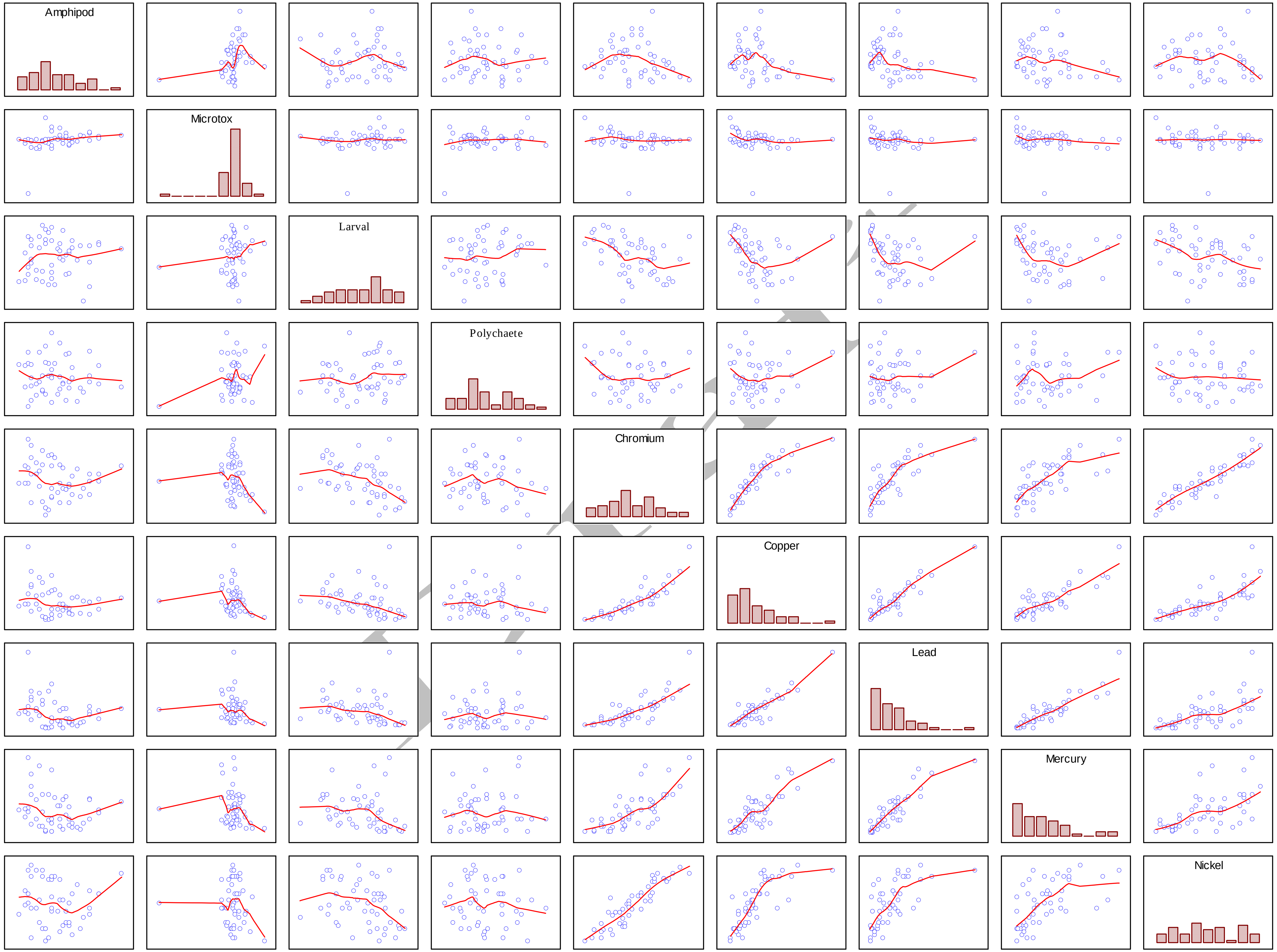

Figure L-5. Correlation matrix comparing four toxicity metrics with chromium, copper, lead, mercury, and nickel for all the project sites except the reference sites.

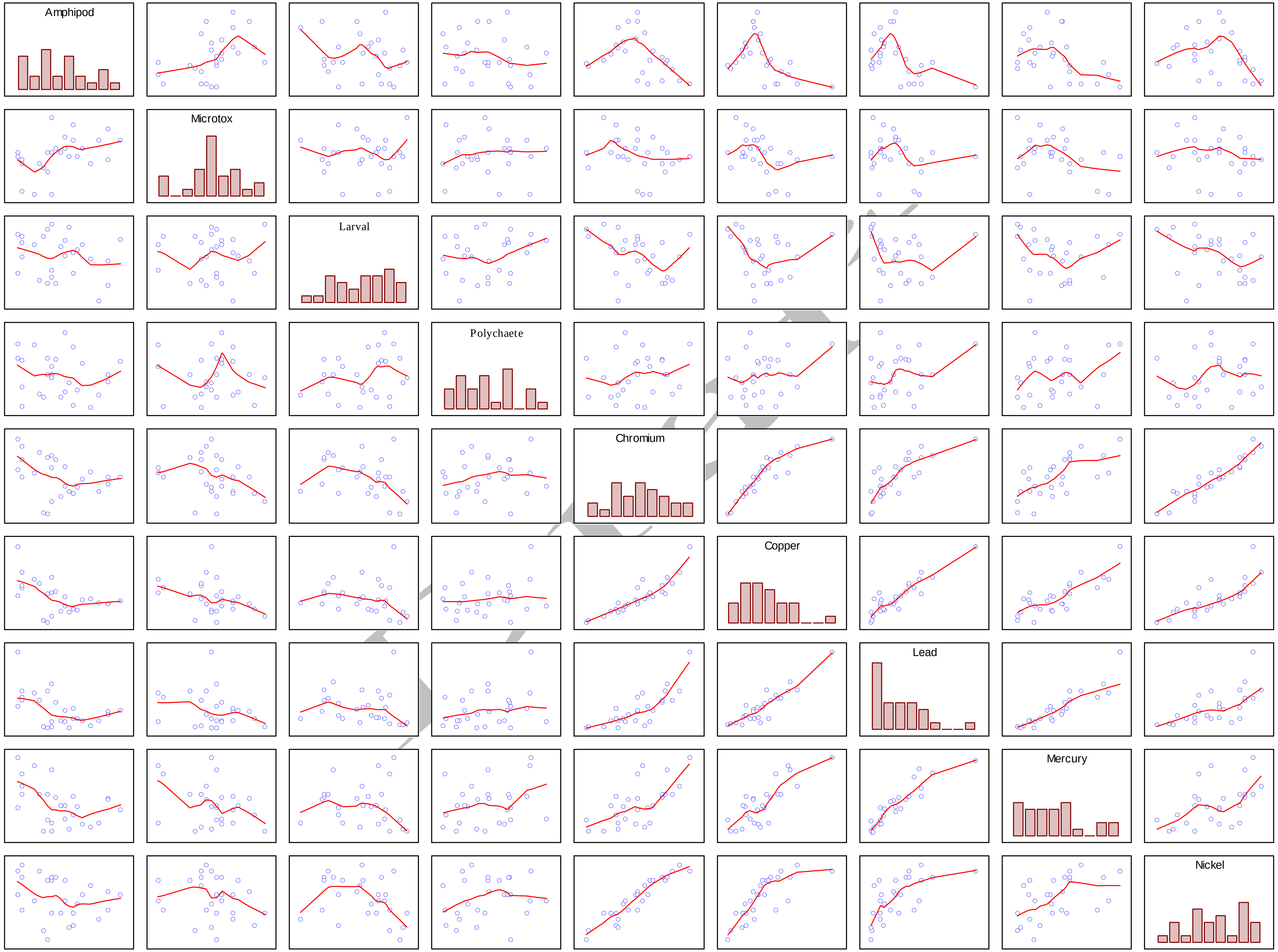

Figure L-6. Correlation matrix comparing four toxicity metrics with chromium, copper, lead, mercury, and nickel for the Shelton Harbor sites.

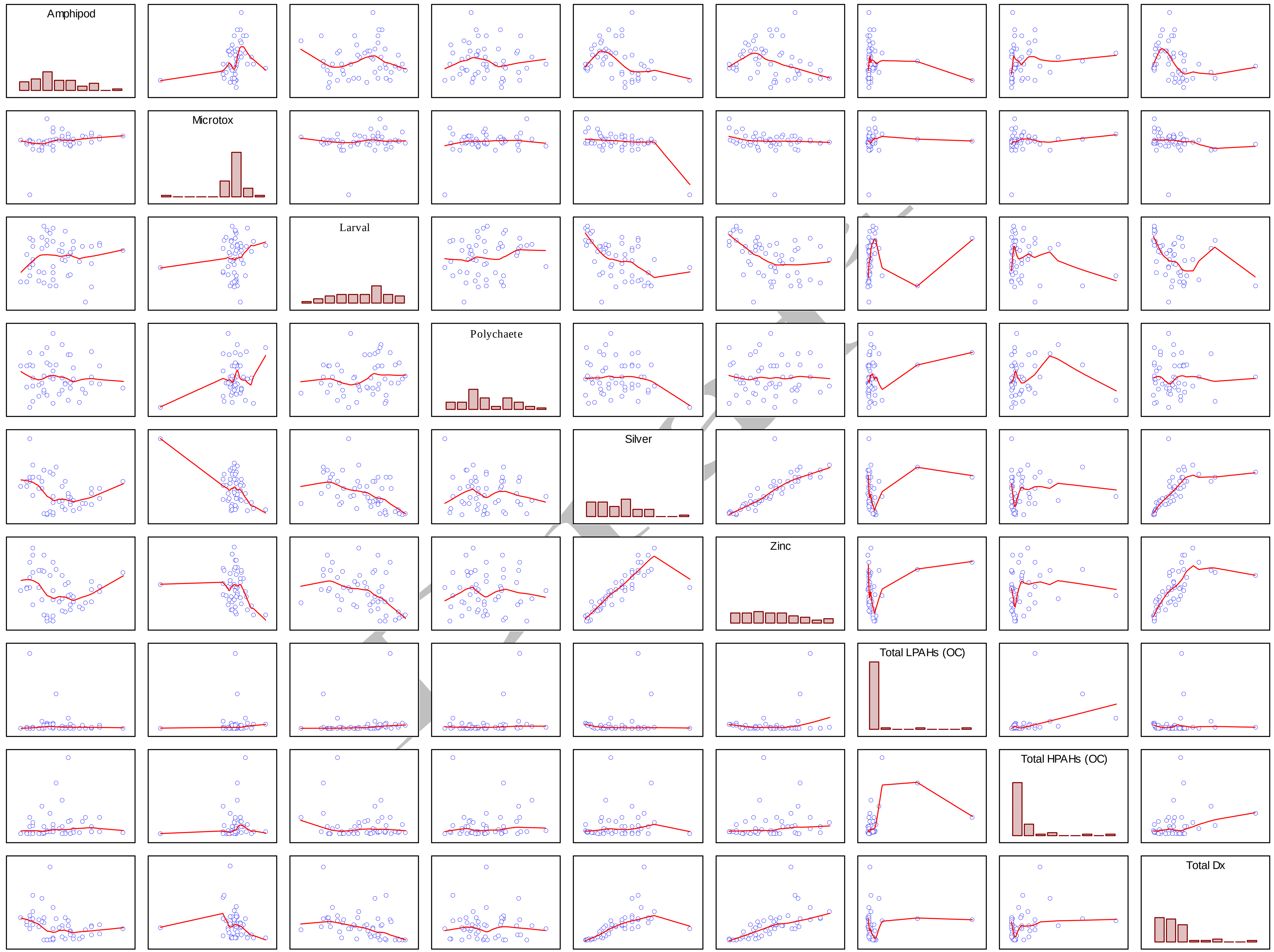

Figure L-7. Correlation matrix comparing four toxicity metrics with silver, zinc, total LPAHs, total HPAHs, and total DX for all the project sites except the reference sites.

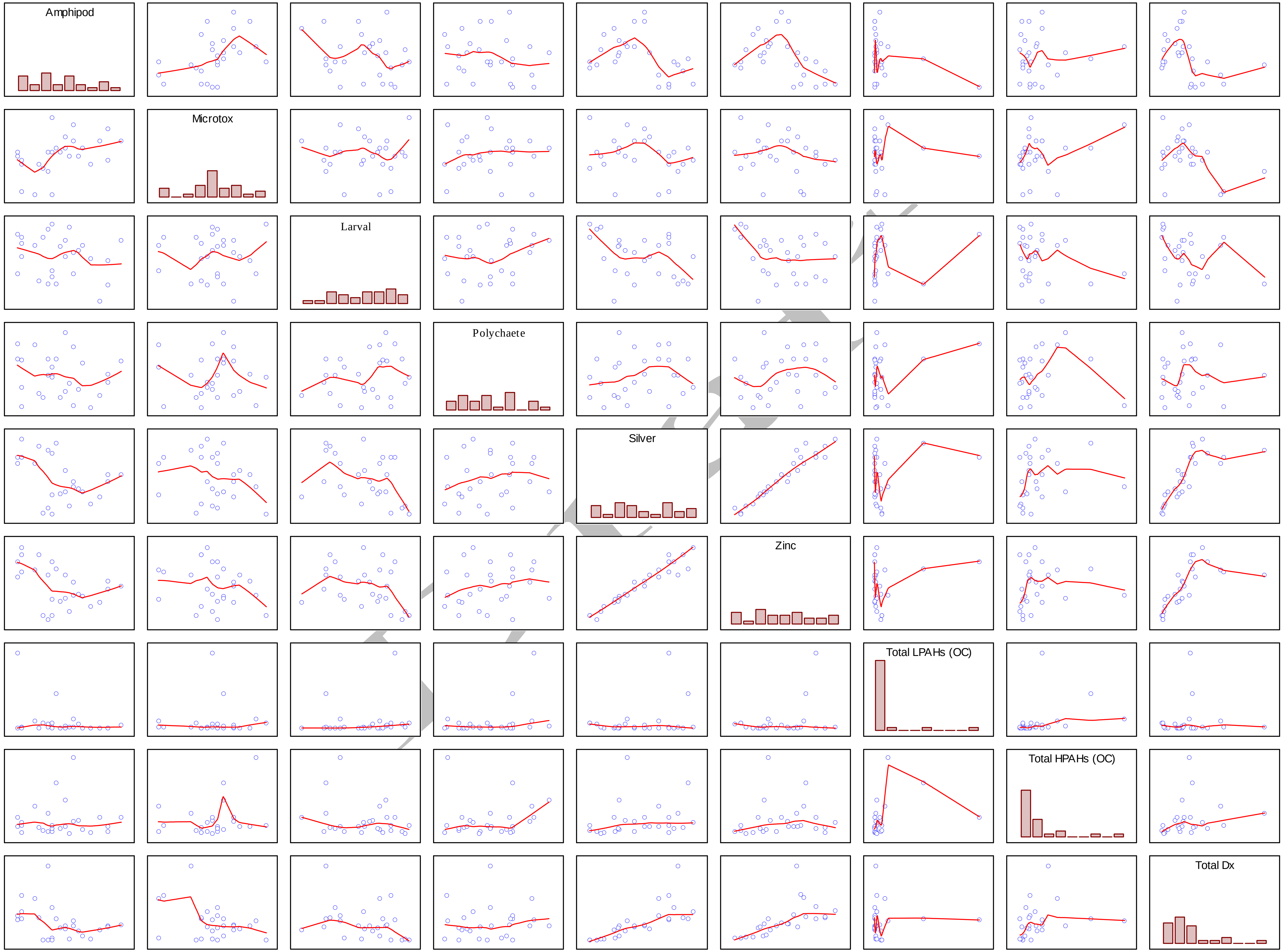

Figure L-8. Correlation matrix comparing four toxicity metrics with silver, zinc, total LPAHs, total HPAHs, and total DX for the Shelton Harbor sites.