

**MIDDLE WATERWAY SHORE RESTORATION PROJECT
MONITORING AND ADAPTIVE MANAGEMENT PLAN
DATA REPORT**

POST-CONSTRUCTION (YEAR 3)

Prepared for

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INTRODUCTION

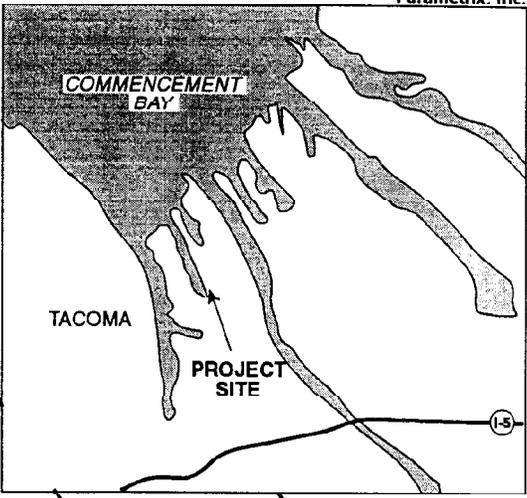
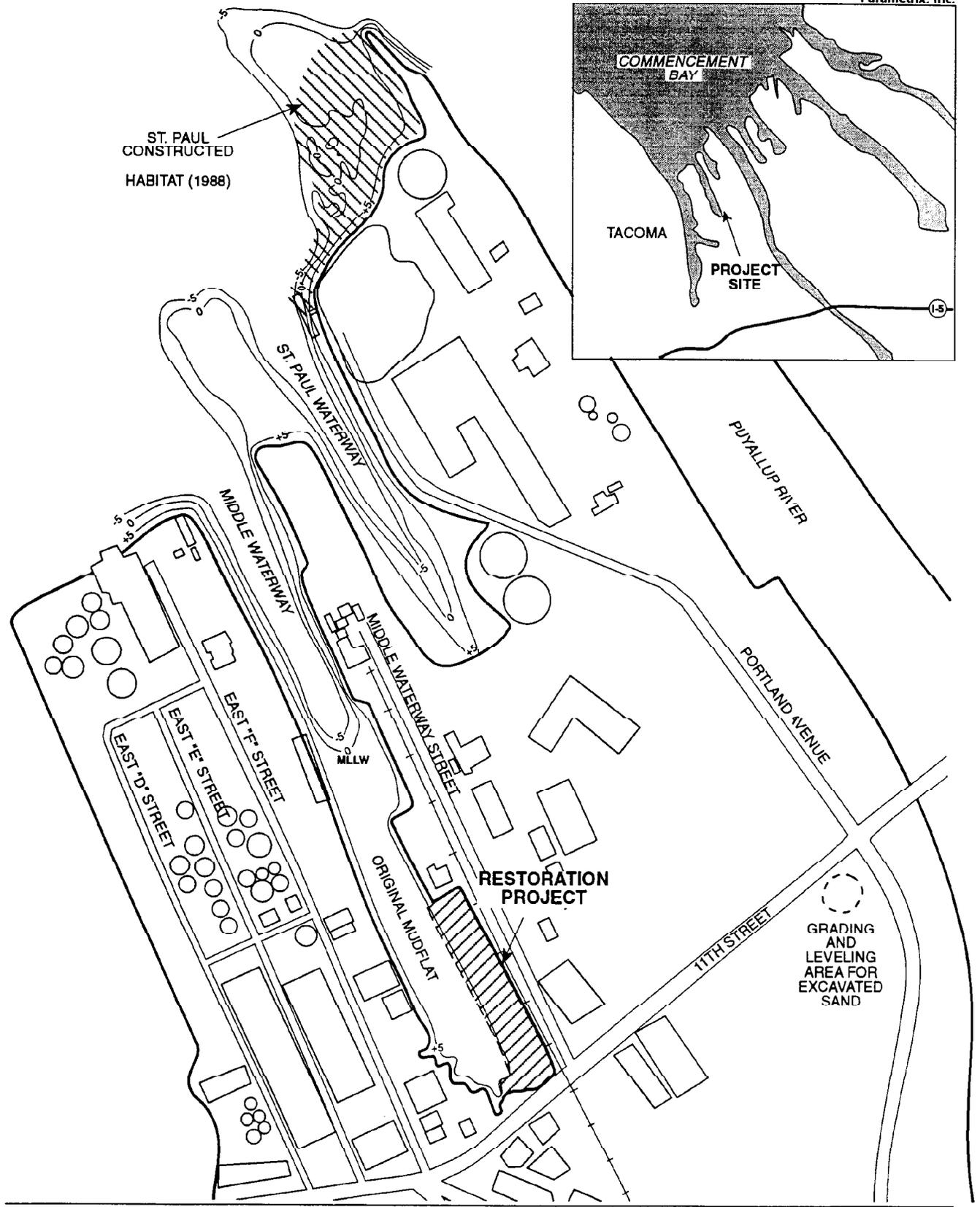
PROJECT DESCRIPTION

Under the St. Paul Waterway Natural Resource Damage (NRD) settlement agreement, Simpson Tacoma Kraft Company (Simpson) and Champion International Corporation (Champion) funded the completion of an additional restoration project to provide habitat value in Commencement Bay. The Middle Waterway Shore Restoration Project (the Project) is located on property owned by Simpson along the southeastern shore of the Middle Waterway in Commencement Bay. The project is located in close proximity, and functionally related to, the intertidal habitat constructed in 1988 as part of the St. Paul Waterway Area Remedial Action and Habitat Restoration Project conducted by Simpson and Champion at the north end of the Tacoma Kraft mill, as well as other intertidal and subtidal areas near the Puyallup River delta (Parametrix 1993) (Figure 1).

The Project was developed in cooperation with Champion and the Natural Resource Trustees for Commencement Bay (the Trustees), and other cooperating agencies. The Trustees include the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish & Wildlife Service (USFWS), the Washington Department of Ecology (Ecology), the Muckleshoot Indian Tribe, and the Puyallup Tribe of Indians. Cooperating agencies include the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (the Corps), the Washington Department of Natural Resources (DNR), and the Washington Department of Fish and Wildlife (WDFW). Together, these organizations and agencies comprise the Restoration Project Planning Group.

The Project has dual goals of providing long-term environmental restoration and study value. The primary objective of the Project is to provide valuable estuarine habitat, in perpetuity, that is adjacent to one of the largest remaining areas of original Commencement Bay intertidal mud flat (nearly 20 acres) and functionally related to the intertidal habitat constructed at the north shore of the Tacoma Kraft Mill in 1988, the Puyallup delta, and other nearby intertidal and shallow subtidal habitats. Other environmental restoration objectives of the Project include the following:

- Conversion of approximately 1.5 upland acres from existing industrial use to estuarine intertidal wetland;
- Increase the length of natural shoreline along the +9 to +13 foot contour from 840 to 960 feet;
- Establish approximately 1.2 acres of habitat at known high and low salt marsh elevations;
- Provide a riparian buffer and transition zone between the tide flat and the upland area to screen, protect, and support the integrity of the remaining original Middle Waterway mud flat and the diverse species that use this biologically productive area of the estuary; and
- Restore a minimum of 0.23 acres of estuarine intertidal mud/sand habitat as mitigation for placing fill on a like acreage of intertidal mud/sand habitat at similar elevations.



Middle Waterway/55-1016-02(U2) 11/98

SCALE IN FEET
0 300 600



Figure 1. Vicinity Map, Middle Waterway Shore Restoration, Commencement Bay

Restoration at the Project site enhances and supports the continued existence of the remnant tide flats at the head of the Middle Waterway. The Natural Resource Trustees for Commencement Bay, together with Simpson and Champion, could not identify another location that would meet the Project's environmental restoration objective while also providing the additional benefit of protecting original Commencement Bay tide flats.

A detailed description of the Project and its objectives can be found in *Project Analysis: Middle Waterway Shore Restoration Project* (Parametrix 1993) and *Project Supplemental Information Summary: Middle Waterway Shore Restoration Project* (Parametrix 1994a). The following provides an overview of the objectives and methodology used to monitor the Project and a summary of the 1998 monitoring data.

PROJECT MONITORING

The Middle Waterway Shore Restoration Project consists of an approximately 3.3-acre nearshore site in Commencement Bay that is in the process of being restored to functional estuarine habitat. In early 1995, approximately 1.5 acres of an industrial fill area was converted into estuarine wetland. In addition, the adjacent lower intertidal area was re-graded into a more structurally diverse intertidal area. The site presently comprises a low-elevation mud flat, low salt marsh, high salt marsh, and upland riparian buffer. On October 21, 1995, the riparian buffer was planted with upland vegetation and a small area of low salt marsh was planted with "sods"¹ of saltgrass (*Distichlis spicata*). On October 16 and 23, 1995, groundcover and trees were planted. On May 22, 1996, additional areas were planted with a variety of high and low salt marsh vegetation. Post-construction site monitoring began in April 1996.

Several descriptive and experimental studies were proposed as elements of the monitoring plan to collect data that would help determine the success and health of the restoration site over time and assist in developing future restoration projects in Commencement Bay. The Project monitoring program includes the following descriptive studies:

- Document the general development of estuarine habitat on the project site [through aerial photographs (through Year 5) and photogrammetric elevation mapping (when necessary)];
- Document the general development of new intertidal and salt marsh substrates [through grain size analyses (through Year 5)];
- Document trends in sediment chemistry, including potential contaminant transport from adjacent mud flats [through sediment chemistry analyses (Years 0, 1, 3, and 5)];
- Document trends in benthic infauna that correspond to changes in sediment grain size and chemistry [through sediment analyses (Years 1, 3, and 5) and benthic analysis in Year 5];

¹ Sods refer to clumps of vegetation with the root mass surrounded by attached soil.

- Evaluate predictions about elevations and salt marsh establishment, using vegetation established on-site [through vegetation analyses (Years 0, 1, 2, and 3) and periodic measurement of elevations (when necessary)]; and
- Document the general use of intertidal, salt marsh, and riparian habitats by wildlife [through general qualitative observations (periodically, through volunteer effort)].

A schedule of annual monitoring activities is provided in Table 1. As originally envisioned in the *Middle Waterway Shore Restoration Project Monitoring and Adaptive Management Plan* (the Monitoring Plan) (Parametrix 1994b), site construction and vegetation planting were to have been completed in early 1995, followed immediately by Year 0 monitoring for physical and soil characteristics. Vegetation and sediment chemistry monitoring was to begin the second year after construction. Because nearly a year elapsed between the site construction in 1995 and the final vegetation planting efforts in 1996, the first year of post-construction monitoring combined some Year 0 and Year 1 activities. That report was referred to as Year 0-1, in the *Middle Waterway Shore Restoration Project Monitoring and Adaptive Management Plan Data Report—Post-Construction (Year 0-1)* (the 1996 Data Report) (Parametrix 1996). In 1997 (Year 2), the site was monitored and results were presented in *Middle Waterway Shore Restoration Project Monitoring and Adaptive Management Plan Data Report—Post-Construction – Year 2* (Parametrix 1997a). This report summarizes findings from the third full year of monitoring in 1998. This report is referred to as Year 3.

Table 1. Middle Waterway Shore Restoration post-construction monitoring schedule.

Activity	Frequency	Activities Conducted		
		1996 (Year 0-1)	1997 (Year 2)	1998 (Year 3)
<u>Physical Surveys</u>				
Transects	Annually (years 0-1 and 2)		X	
Topographic Mapping	Years 0-1 and 2 (only if necessary thereafter)	X	X	
<u>Sediment Surveys</u>				
Grain Size	Annually (years 0-1, 3, and 5)	X		X
Biological	Annually (year 5)			
Chemical	Annually (years 0-1, 3, and 5)	X		X
<u>Vegetation Surveys</u>				
Transplant/Colonization	Semi-annually (year 0-1), annually (years 2 and 3)	X	X	X
Plant Protection	Semi-annually (year 0-1); (as needed thereafter)	X	X	X
Soil Salinity	Annually (years 0-1, 3, and 5)	X		X
<u>Wildlife Surveys</u>				
Aerial Photo	Periodically per volunteer effort	X	X	X
	Annually (years 0-1, 2, 3, 4, 5)	X	X	X

Year 0-1 = period of construction, planting, and first annual surveys

This data report contains the sampling methods, data, analytical results, and other related information collected during the third year of post-construction monitoring. In keeping with the Project understanding between Simpson, Champion, and the Trustees, limited data interpretation

was provided, other than discussions of how sampling methods may have affected or influenced the data. Copies of field survey data forms and analytical data can be found in the Data Appendix. Monitoring Plan revisions previously discussed and approved by representatives from Champion, Simpson, and the Trustees in 1997 are specified in a memorandum that can also be found in the Data Appendix.

The two primary survey elements comprising the third year of monitoring included physical and chemical characterization of sediments, and vegetation surveys of species and substrates present in planted and unplanted areas. Wildlife observations were reported separately by an independent observer.

METHODS AND RESULTS

SEDIMENT MONITORING

Surface sediments were last monitored in 1996. In 1998 sediments were collected from the Site for chemical analysis, grain size distribution, and total organic carbon. Sediment sampling was conducted in August 1998. All samples were analyzed by AmTest, in Redmond Washington.

Sediment Physical Characteristics

Surface sediments on the restored habitat were monitored to assess physical characteristics (i.e., grain size). Sampling methods and analyses adhered to the methods specified in the original monitoring plan (Parametrix 1994b). In 1997 Champion, Simpson and the trustees agreed to minor changes to the sampling locations for collection of sediments to be analyzed for grain size distribution (Parametrix 1997b). In 1998, sediment samples to be analyzed for grain size distribution were collected from 15 locations. Five stations (i.e., GS-3², GS-4, GS-9, GS-11 and GS-15) previously sampled were eliminated from the 1998 sampling event. Samples for grain size distribution were also collected at the sediment chemistry sampling locations. Figure 2 presents the grain size sample locations monitored in 1998.

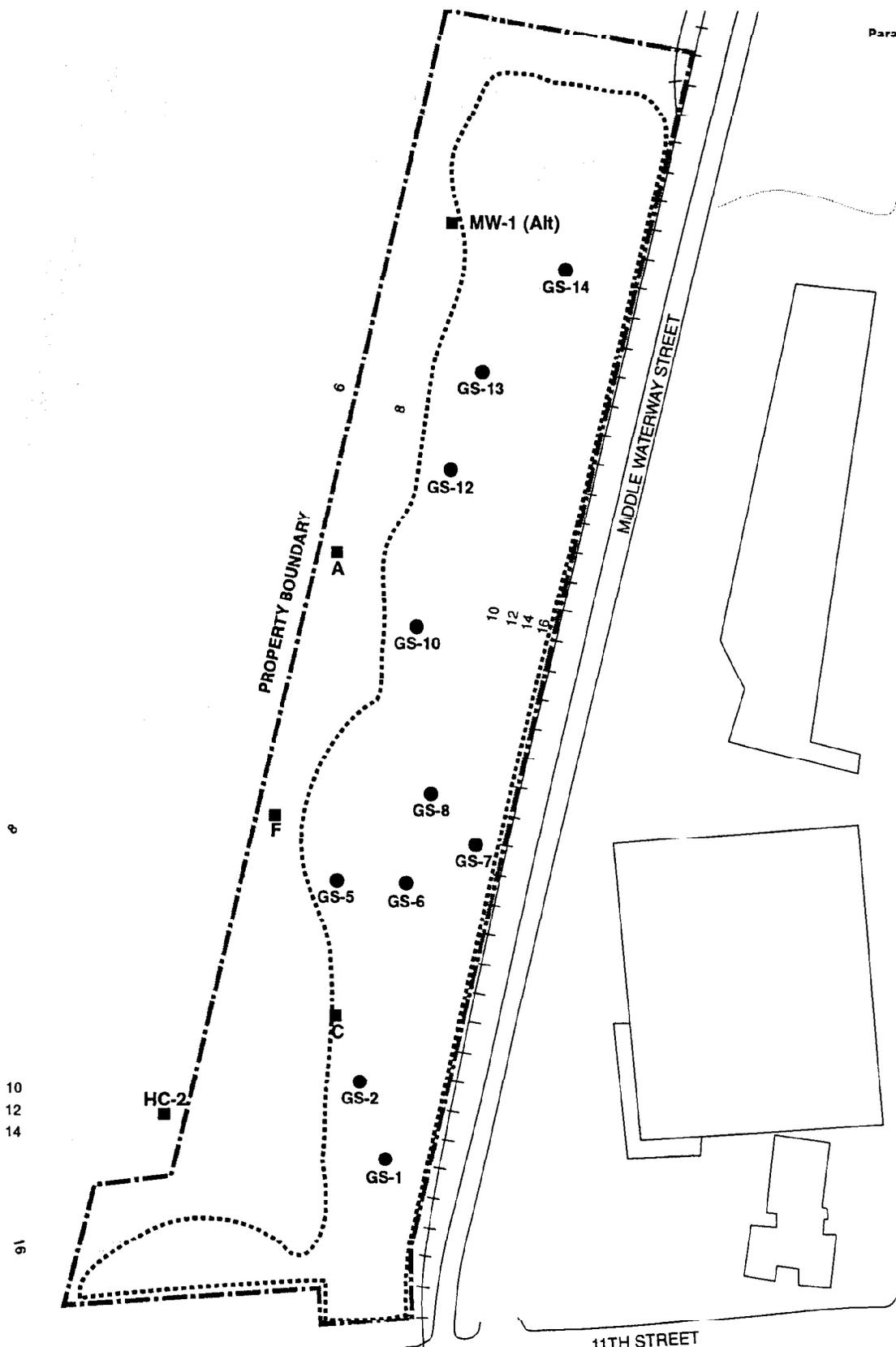
Grain size samples were collected on August 25, 1998 at fifteen stations (Figure 2). Station coordinates are provided in Table 2. A field duplicate sample was collected at station MW-1. Station locations were based on locations indicated in the monitoring plan (Parametrix 1994b). Surveyors located these areas and placed stakes at the 15 sample locations.

Table 2. State plane coordinates and evaluations (ft MLLW) for 1998 Middle Waterway Shore Restoration sediment sampling stations.

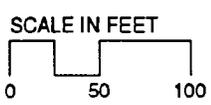
Station	North	East	Elevation ^a	Descriptor
GS-1	707091.2	1521953.9	14.9	Sediment-Grain Size #1
GS-2	707125.5	1521909.3	11.6	Sediment-Grain Size #2
GS-5	707240.7	1521810.2	11.1	Sediment-Grain Size #5
GS-6	707279.4	1521838.6	12.4	Sediment-Grain Size #6
GS-7	707330.2	1521851.0	14.2	Sediment-Grain Size #7
GS-8	707345.9	1521806.6	12.3	Sediment-Grain Size #8
GS-10	707418.1	1521742.1	11.1	Sediment-Grain Size #10
GS-12	707561.1	1521676.1	9.8	Sediment-Grain Size #12
GS-13	707668.2	1521655.3	12.2	Sediment-Grain Size #13
GS-14	707767.9	1521642.7	10.3	Sediment-Grain Size #14
GS-15	707792.5	1521600.4	12.8	Sediment-Grain Size #15
HC-2	707120.0	1521797.0	7.1	Sediment-Chemistry
C	707198.8	1521891.3	10.0	Sediment-Chemistry
A	707432.5	1521715.0	8.6	Sediment-Chemistry
F	707315.0	1521733.0	10.1	Sediment-Chemistry
MW-1	707652.0	1521609.0	9.4	Sediment-Chemistry

^a City of Tacoma datum

² Location GS-3 is the same as sediment chemistry sample location C.



Datum: City of Tacoma MLLW
 Middle Waterway/55-1616-08(02) 10/98



- Sediment Chemistry and Grain Size Distribution
- Only Grain Size Distribution
- Property Boundary
- Project Activity Boundary

Figure 2.
Sediment Sampling Locations

All sediment samples were collected by hand, using pre-cleaned stainless steel spoons, from the upper 2 cm of the sediment. In years when benthic infauna are collected (i.e., years 0 and 5), a sediment core of the upper 5 cm is collected for grain size to characterize the biologically active zone. This year, only shallow (0-2 cm) surface sediments were examined to evaluate if post-construction sedimentation had taken place.

Sediments collected for grain size distribution analysis (approximately 200 ml) were placed in clean ziplock plastic bags, labeled, and stored on ice in a cooler. Sediment samples were transported to the analytical laboratory (i.e., AmTest, Inc., Redmond, WA) for analysis.

Laboratory analysis followed the Puget Sound Estuarine Program (PSEP) protocols and were analyzed within the PSEP-specified holding time. A copy of the complete laboratory data package, including quality assurance/quality control (QA/QC) procedures can be found in the Data Appendix. As an additional data validation measure, Relative Percent Difference (RPD) was calculated for all particle sizes (i.e., Wentworth scale in phi units) for the sample, the laboratory duplicate, and the laboratory replicate analyses at stations MW-A and GS-10. All RPD results were within an acceptable range of $\pm 20\%$ (see Data Appendix). Results of the sediment grain size analysis are summarized in Table 3.

In general, sediment grain size distribution at all stations was relatively similar, and dominated by sand (i.e., coarser than phi size +4). Sediments from stations C, MW-1, GS-1, GS-2, GS-5, GS-6, GS-7, GS-8, GS-12, and GS-13 contained greater than 80% sand. These stations were located primarily in the high to mid-intertidal areas (i.e., between 8 - 16 feet). Sediments containing the greatest silt fraction (69.4%) were collected from station HC-2, located in the mud flat area and at one of the lowest elevations (i.e., between 8 - 10 feet) at the site. Sediments from stations F and A also had relatively high (> 40%) silt fractions, these sites were also located in the mud flat areas in low elevation areas (i.e., between 8 - 12 feet). The dominance of coarse sand or fine silt/clay substrates in the grain size data corresponded to site observations and vegetation substrate data.

Sediment Chemical Characteristics

Sediment samples were collected to monitor chemical concentrations in project site sediments. Sediment samples were analyzed for mercury, semi-volatile organic compounds (low- and high-density polynuclear aromatic hydrocarbons [PAHs]), and conventional parameters (i.e., total solids, total volatile solids, acid volatile sulfide, and total organic carbon). Sampling methods and analyses adhered to the methods specified in the monitoring plan (Parametrix 1994b).

Table 3. Sediment grain size distribution for Middle Waterway Shore Restoration Project, 1998.

Upper (mm)	Mesh Size	4.75	4.00	2.00	1.00	0.50	0.25	0.125	0.063	0.032	0.016	0.008	0.004	0.002	0.001	0.001	<0.001	>+10	%Sand/ Gravel	%Silt/ Clay	%Total Solids
Lower (mm)	Mesh Size	4.00	2.00	1.00	0.50	0.25	0.125	0.063	0.032	0.016	0.008	0.004	0.002	0.001	<0.001	<0.001	<0.001	>+10			
Finer than Phi		-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+10						
Location¹	Relative Percent Sediment Present in Each Mesh Size																				
A ²		2.40	0.30	0.70	2.40	15.8	19.1	13.9	3.50	7.70	13.6	6.50	4.80	1.80	0.90	6.60	6.60	54.6	45.4	57.7	
C ²		1.20	0.30	0.30	1.60	26.4	37.1	17.2	6.30	0.90	1.30	1.60	1.60	0.20	<0.1	4.00	4.00	84.1	16.0	75.7	
F ²		1.30	0.30	1.60	2.90	15.7	24.6	11.7	19.9	9.70	1.50	2.90	2.10	0.20	<0.1	5.70	5.70	58.1	42.1	70.0	
MW-1 ²		2.20	0.90	1.90	4.20	21.1	24.9	20.6	11.6	0.90	2.80	0.90	3.10	0.50	<0.1	4.50	4.50	87.4	12.8	67.4	
MW-1(D) ²		2.20	0.60	1.70	3.60	15.8	29.0	18.9	10.10	7.60	0.50	2.40	2.30	0.30	<0.1	4.90	4.90	81.9	18.1	72.0	
HC-2 ²		2.80	0.50	1.40	2.10	3.90	6.70	6.70	6.90	29.9	12.0	7.9	6.8	1.2	<0.1	11.5	11.5	31.0	69.4	43.5	
GS-1		1.70	<0.1	2.20	4.30	26.2	42.8	12.8	4.40	1.70	1.80	0.10	0.40	0.10	<0.1	1.50	1.50	94.5	5.7	100.0	
GS-2		<0.1	0.10	0.20	1.30	13.3	40.4	24.9	9.10	3.90	1.70	0.20	1.00	0.20	<0.1	3.60	3.60	89.4	10.7	82.7	
GS-5		1.80	0.20	1.20	3.20	25.1	30.3	16.6	8.40	5.30	2.30	0.50	1.10	0.20	<0.1	3.70	3.70	86.8	13.2	81.2	
GS-6		1.00	0.10	1.50	4.40	26.5	34.2	14.2	5.00	5.30	<0.1	<0.1	0.90	0.20	<0.1	6.80	6.80	86.9	13.5	88.8	
GS-7		1.00	<0.1	2.20	7.80	34.3	38.4	10.1	2.70	1.40	<0.1	<0.1	0.40	0.10	<0.1	1.50	1.50	96.7	3.7	99.6	
GS-8		1.20	0.40	1.70	3.80	23.9	29.3	17.2	8.30	4.70	1.10	1.90	1.00	0.50	0.30	4.70	4.70	85.8	14.2	83.2	
GS-10		3.60	<0.1	1.40	2.80	12.6	23.3	12.7	9.10	19.8	2.90	2.80	3.40	1.00	0.30	4.20	4.20	65.6	34.4	69	
GS-12		0.90	0.10	0.60	1.60	8.60	23.3	31.1	15.6	2.90	4.80	2.60	2.40	0.80	0.40	4.2	4.2	81.1	18.1	68.6	
GS-13		<0.1	0.10	0.40	1.70	13.9	34.9	27.4	10.3	4.30	1.50	0.80	1.00	0.20	<0.1	3.40	3.40	88.8	11.3	89.0	
GS-14		0.60	0.10	0.60	2.70	25.3	28.0	14.9	5.50	10.6	3.70	1.60	1.80	0.20	<0.1	4.50	4.50	77.7	22.5	67.2	

D - Duplicate Sample

¹ Sample locations GS-3, GS-4, GS-9, GS-11, and GS-15 were discontinued in 1997 (Parametrix 1997)

² These samples correlate with sediment chemistry sample locations.

Sediment samples for chemical analysis were collected on August 25, 1998, at five stations (Figure 2). These stations correspond to the benthic infauna stations that will be monitored in year 5 (year 2000). A field duplicate sample was collected from station MW-1. Samples were collected from the upper 2 cm of sediment using a decontaminated stainless steel spoon, and placed either directly into a laboratory container (for acid-volatile sulfide (AVS) analysis) or into a decontaminated stainless steel mixing bowl (for all other analyses). Sediment samples placed in mixing bowls were completely homogenized prior to transfer into laboratory containers. All containers were stored on ice in a cooler.

Sediment chemistry samples were transported, along with a chain-of-custody form, and delivered to the analytical laboratory (AmTest, Inc., Redmond, WA). Sediment samples were analyzed for the compounds listed in Table 4, using analytical methods specified in the monitoring plan (Parametrix 1994b). For comparison, sediment chemistry results from the 1993 pre-construction and 1996 post construction monitoring are included (Parametrix 1994b). The pre-construction chemistry results were taken from two reports (Parametrix 1994c, d). Pre-construction chemistry data for Station F that was incorrectly entered in Parametrix 1994d has been corrected for Table 4. The post construction data were taken from Parametrix (1997a). Following monitoring plan protocols, sediment chemistry results are presented with Washington Sediment Quality Standards (SQS) for comparison. Following Washington Department of Ecology guidelines, all sediments with greater than 0.5% organic carbon content were organic carbon normalized (organic carbon content of all sediments was greater than 0.5%).

Sediment mercury concentrations ranged from 0.076 mg/kg (dry wt.) at station C to 0.417 mg/kg (dry wt) at station MW-1. In general, 1998 sediment mercury concentrations were similar to those found in 1996. Duplicate sediment samples were collected at MW-1, where mercury in one sample was 0.207 mg/kg (dry wt.), below the mercury SQS of 0.41 mg/kg, and 0.41 mg/kg in the second sample. Sample location MW-1 is located in the Middle Waterway mudflats outside of the Project boundary where physical restoration activities were implemented and near the Site property boundary. Sediment mercury levels in all of the other sediment samples were below the mercury SQS, and of similar magnitude to concentrations found in 1996.

Concentrations of organic chemicals in all sediment samples were well below their corresponding SQS values. Concentrations of total low molecular weight polycyclic aromatic hydrocarbons (LPAH) were low at all stations and ranged from 5.0 mg/kg organic carbon (OC) at station MW-1 (duplicate) to 29.17 mg/kg OC at station C, 12 to 75 times below the LPAH SQS. A number of individual LPAHs were not detected above their respective detection limits at some or all sampling locations. In 1998 sediment LPAHs concentrations at stations MW-1, A, and HC-2 were lower than levels identified in 1996, and at stations C and F sediment LPAH levels in 1998 were similar to those found in 1996.

Table 4. Sediment chemistry results for Middle Waterway Shore Restoration Project, 1998.

Chemical	Pre-Construction - 1993				Post-Construction - 1996				Post-Construction - 1998										
	SQS*	MW-1 (g)**	A***	HC-2**	C***	F**	MW-1 (a)	A	HC-2	C	F	MW-1 (a) (dup)	A	HC-2	C	F			
Metals (mg/kg dry wt)																			
Mercury	0.41	0.31	0.49	1.18	0.04	0.59	0.198	0.175	0.352	U	0.031	0.129	0.417	0.207	0.260	0.359	0.076	0.160	
Organics (mg/kg OC)																			
HPAH																			
Acenaphthylene	66	0.6	3.4	2.3	7.5 ^d	U	3.0	2.5	U	0.8	4.9	U	0.5	U	0.57	U	0.3	U	0.67
Acenaphthene	16	0.5	2.6	8.3	7.5 ^d	U	2.9	2.5	U	0.8	4.9	U	0.6	U	0.57	U	0.3	U	0.64
Anthracene	220	1.0	5.4	11.4	7.5 ^d	U	5.8	2.5	U	1.6	4.9	U	1.3	U	0.57	U	4.4	U	1.8
Fluorene	23	0.6	4.0	6.1	7.5 ^d	U	3.9	2.5	U	0.8	4.9	U	0.7	U	0.57	U	1.9	U	0.64
Naphthalene	99	1.2	7.7	3.6	7.5 ^d	U	10.0	2.5	U	0.8	4.9	U	0.7	U	0.57	U	0.7	U	0.64
Phenanthrene	100	5.3	23.0	97.1	D	7.5 ^d	U	4.5	17.3	U	4.9	U	6.7	U	1.57	U	100	U	7.6
2-Methylnaphthalene	38	0.5	2.8	2.0	8.8 ^d	U	3.6	2.5	U	0.8	4.9	U	0.5	U	0.57	U	0.5	U	0.63
Total HPAHs	370	9.8	48.9	130.8	53.8 ^d	U	49.2	19.4	33.7	12.1	34.1	10.9	7.6	5.0	7.7	183	29.2	12.6	
HPAH																			
Benzo(a)anthracene	110	5.3	26.0	43.7	D	7.5 ^d	U	6.5	17.8	7.7	4.9	U	2.3	2.1	3.4	115	11.2	9.7	
Benzo(a)pyrene	99	5.3	34.0	43.7	D	17 ^d	29.0	8.2	18.2	8.7	4.9	U	2.9	2.7	3.4	117	10.3	11.2	
Benzo(b)fluoranthene	-	4.4	43.0	29.1	D	23 ^d	39.0	10.6	15.6	10.3	4.9	U	3.0	2.8	10.7	119	9.0	11.5	
Benzo(k)fluoranthene	-	8.9	14.0	19.4	7.5 ^d	U	11.0	8.6	15.8	8.1	4.9	U	2.1	2.0	3.5	83	8.2	7.3	
Total Benzofluorantenes	230	13.3	57.0	48.5	30.5 ^d	U	50.0	19.2	31.5	18.4	9.7	U	5.1	4.8	19.3	202	34.3	18.8	
Benzo(g,h,i)perylene	31	2.8	22.0	9.7	27 ^d	U	14.0	6.4	9.5	5.5	4.9	U	1.5	1.7	4.7	72	11.0	6.7	
Chrysene	110	8.0	26.0	58.3	D	11 ^d	23.0	12.7	25.5	11.6	4.9	U	3.1	3.4	13.3	178	29.0	13.0	
Dibenz(a,h)anthracene	12	1.1	4.9	4.6	7.5 ^d	U	3.0	2.5	U	0.8	4.9	U	0.5	U	0.57	U	2.4	2.3	
Fluoranthene	160	11.6	26.0	77.7	D	13 ^d	22.0	11.7	32.7	14.2	4.9	U	4.5	3.7	11.8	185	18.3	14.5	
Indene(1,2,3-c,6)pyrene	34	3.0	23.0	10.4	21 ^d	U	15.0	6.2	1.2	5.8	4.9	U	2.2	2.0	6.2	82	6.8	8.5	
Pyrene	3,000	7.6	34.0	116.5	D	17 ^d	48.0	10.3	32.7	13.5	7.2	10.0	4.5	4.0	12.2	185	20.0	16.4	
Total HPAHs	960	57.9	252.9	413.1	151.5 ^d	U	224.0	83.6	170.2	86.3	52.3	73.3	27.1	25.0	85.5	111.9	107.0	101.1	
Conventionals																			
Total solids (%)	-	66.59	55.7	39.17	82.6	57.4	77.8	59	45.5	76.9	81.5	67.4	72.0	72.0	57.7	43.5	75.7	70.0	
Total volatile solids (%)	-	-	11.5	-	1.40	13.4	1.9	5.4	12.1	1.3	3.6	3.3	2.7	6.7	1.4	2.8	6.2		
Total organic carbon (%)	-	2.25	3.5	4.12	0.24	d	3.3	0.77	5.5	0.39	D	3.6	2.2	3.5	5.0	5.4	0.6	3.3	
Acid volatile sulfides (mg/kg)	-	348	-	2.33	U	-	90	b ₁ , 5,500	b ₁ , 1,300	b ₁ , 780	b ₁ , 100	b ₁ , 81	290	290	210	290	210	12	

Notes:

- = No Data
 - D = Dilution required.
 - U = Value below stated detection limit.
 - b = The associated value was detected in the method blank analysis, possible blank contamination.
 - d = Per Ecology guidelines, samples with <0.5%OC should not be compared to organic carbon-based criteria.
 - j = The associated value is an estimate.
- Mg/kg of Organic Carbon
Washington Sediment Quality Standard
Data from Parametrix 1994c
Data corrected from Parametrix 1994d

Sediment concentrations of total high molecular weight polycyclic aromatic hydrocarbons (HPAH) were also low and ranged from 25.0 mg/kg OC at MW-1 (duplicate) to 115.9 mg/kg at HC-2, or 8 to 38 times below the HPAH SQS. With the exception of dibenzo(a,h)anthracene, all of the individual HPAHs evaluated were detected in all sediment samples. In 1998 sediment HPAH concentrations at stations MW-1 and HC-2 were lower than levels identified in 1996, and HPAH concentrations at stations C and F were higher than 1996 levels. At station A, 1998 HPAH concentrations were similar to those found in 1996.

Total sediment organic carbon content (TOC) levels in 1998 were similar to those identified in both 1993 and 1996. The highest TOC levels continue to be found at station A, while the lowest levels are found at station C. These data suggest that the restoration efforts have not resulted in a significant increase in the production of organic matter (e.g., through plant productivity, or sedimentation of fine grained materials).

Concentrations of acid volatile sulfides (AVS) were lower in 1998 than in 1996. It should be noted, however, that problems were encountered with the AVS analyses in 1996, and these data may have been biased high due to possible blank contamination.

Validation of laboratory data was conducted according to EPA functional guidelines for evaluating organics and inorganics (U.S. EPA 1994a, b). Because the data were reported in the laboratory standard reporting format, the following items were included in the data review performed:

- holding times
- blanks
- surrogate recovery
- internal standards recoveries
- matrix spike and matrix spike duplicate
- system performance and overall data assessment
- standard reference sample
- laboratory duplicate analysis

Some of these categories are only applicable to select analyses.

All summary tables generated from the laboratory data were checked for transcription errors. Copies of raw data, data validation checklists, and a data validation summary memorandum are provided in the Data Appendix.

Briefly, all laboratory and field quality assurance (QA) and quality control (QC) results associated with these sediment samples were within acceptable ranges.

VEGETATION SAMPLING

The Middle Waterway Shore Restoration site was planted with high and low salt marsh vegetation on May 22, 1996. Vegetation monitoring was designed and conducted to assess the post-construction presence, species composition, and distribution of planted and colonizing vegetation. As part of the Project Monitoring Program, both vascular (e.g., salt marsh plants) and non-vascular (e.g., seaweeds) macrophytes were surveyed. An aerial photograph was used to delineate plants on a site-wide basis for mapping.

Aerial Photo Mapping

An aerial photo of the Middle Waterway has been taken in July of 1996, 1997, and 1998. In 1998, the photograph was taken on August 9. As in previous years, photographic conditions were good, so the aerial photo provides clear images of the waterway, including upland buildings, the reconstructed shore, salt marsh and mudflat areas, vegetation, transplant enclosures, logs and debris. The aerial photo can be used in conjunction with the vegetation monitoring report to evaluate the extent of intertidal vegetation at the Project site and to identify any processes within the waterway that may be affecting the Project site.

Vegetation Sampling

In 1996, the low salt marsh, high salt marsh, and mud flat areas of the site were divided into nine beds (Parametrix 1996). Selected beds in the high and low salt marsh areas were planted. Planted beds were associated with unplanted beds with similar elevation and substrate (planted, high marsh Beds 1,2 paired with unplanted Bed 3; planted, low marsh Beds 4,5 paired with Bed 6). Most planted beds were enclosed with string and flagging to exclude geese; one low salt marsh bed in the north was planted without an enclosure (Bed 4). Low and high mudflat areas (Beds 7-9) were not planted, and Beds 8 and 9 were top-dressed with salvaged soils that, it was hoped, would promote recruitment of vegetation.

Fourteen transects were established through the site. The ends of each transect were semi-permanently marked with rebar (Figure 3) and eighty random locations were selected along the transects. On September 9, 1988, transect endpoints were relocated and percent cover by individual species in 1-m² quadrats was visually estimated at the original eighty locations. Copies of vegetation monitoring data field sheets can be found in the Data Appendix.

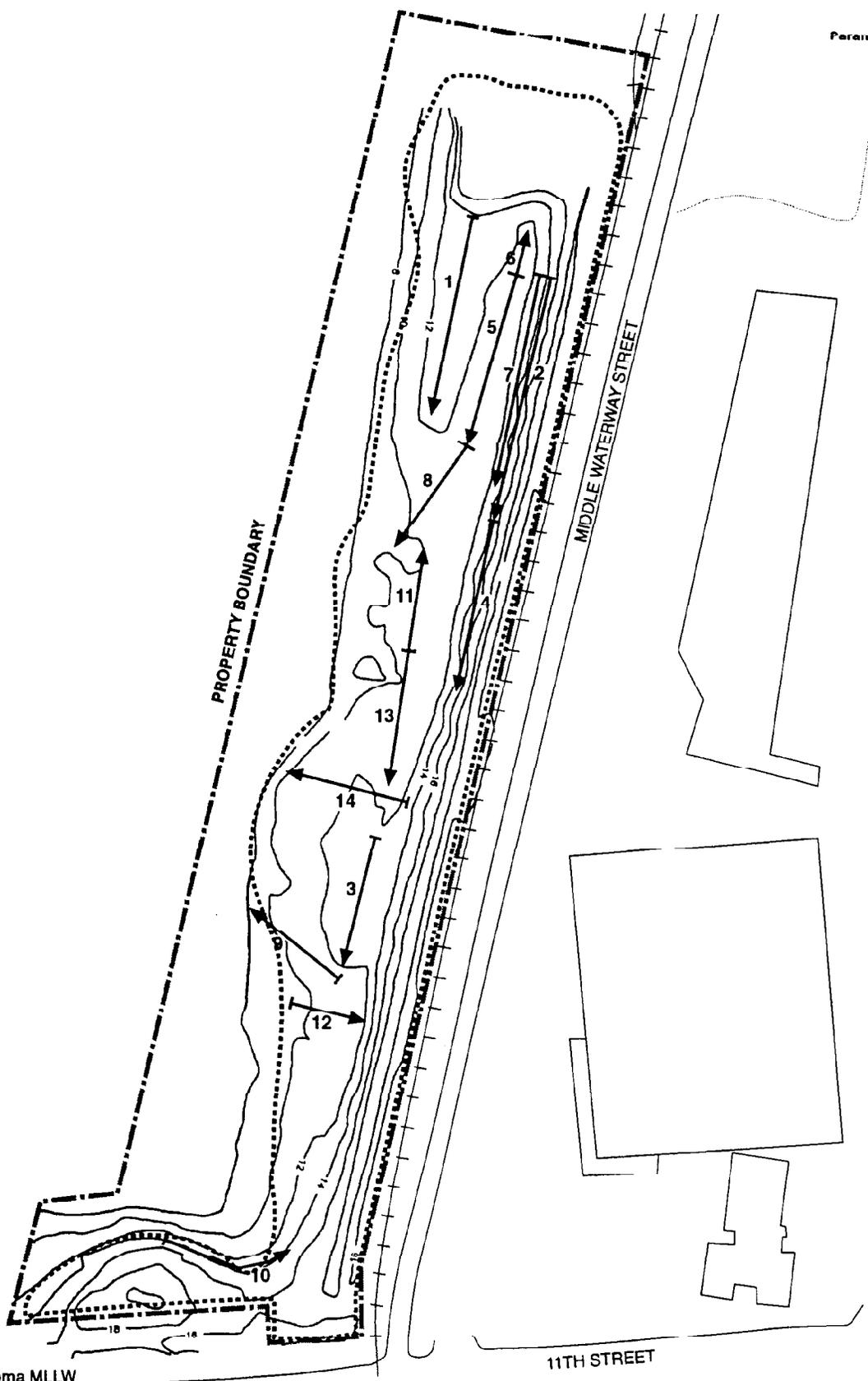
As in 1996 and 1997, most of the low and high salt marsh communities lacked vegetation or had extremely low cover by vascular plants (Figure 4, Table 5). High salt marsh bed number 1, along Transect 1, was devoid of vegetation except for a few scattered recruits of *Atriplex patula* (salt weed) and exposed root masses of *Distichlis spicata* (saltgrass; remains from sods planted in 1996). This bed, a sandy berm in the northwest section of the site, had been planted with *Carex lyngbyei* and protected from predation by geese. In high-marsh Bed 2, along Transect 2, *Deschampsia caespitosa* is surviving and growing but has not completely filled in the area.

Table 5. Vegetation species, percent cover, and dominant substrate characteristics by transect, 1998.

Transect # (Bed #)	Endpoints	Species	% Cover (Range) ¹	Dominant Substrate (>50%) ²
1 (1)	A, A1	<i>Atriplex patula</i>	0-7	<u>sand</u> , mud
		<i>Distichlis spicata</i>	0-2	
2 (2)	B, B1	<i>Atriplex patula</i>	0-25	<u>Sand</u>
		<i>Deschampsia caespitosa</i>	0-15	
		<i>Distichlis spicata</i>	0-5	
3 (3)	C, C1	No vegetation	--	<u>Sand</u>
4 (2,3)	D, D1	No vegetation	--	<u>Sand</u>
5 (4,5)	E, E1	Diatoms	0-100	<u>Mud</u>
		<i>Vaucheria</i> sp.	0-100	
		<i>Fleischeria parvula</i>	0-15	
6 (4)	F, F1	<i>Vaucheria</i> sp.	0-40	<u>Mud</u>
7 (5)	G, G1	<i>Distichlis spicata</i>	0-12	<u>sand</u>
		<i>Atriplex patula</i>	0-25	
8 (6)	H, H1	<i>Vaucheria</i> sp.	0-50	<u>Mud</u>
		<i>Eleocharis parvula</i>	trace	
		<i>Vaucheria</i> sp.	0-20	
9 (6)	I, I1	<i>Deschampsia caespitosa</i>	0-65	<u>sand</u> , mud
		<i>Fragaria chiloensis</i>	0-4	
		<i>Distichlis spicata</i>	0-15	
		<i>Agrostis</i> sp.	0-10	
		<i>Agropyron repens</i>	0-10	
		<i>Bromus</i> sp.	0-10	
		<i>Atriplex patula</i>	0-1	
		Scotch broom	0-45	
11 (7, 6)	K, K1	<i>Vaucheria</i> sp.	1-100	<u>Mud</u>
		<i>Rhizoclonium</i> sp.	0-100	
		<i>Vaucheria</i> sp.	0-40	
12 (7)	L, L1	<i>Rhizoclonium</i> sp.	0-65	<u>mud</u> , small pools
13 (8,9)	M, M1	Diatoms	0-100	<u>Mud</u>
		<i>Rhizoclonium</i>	0-100	
		<i>Vaucheria</i> sp.	0-1	
		<i>Eleocharis parvula</i>	0-75	
14 (9)	N, N1	<i>Vaucheria</i> sp.	0-95	<u>sand</u> , silt, cobble
		<i>Rhizoclonium</i>	0-10	
		<i>Enteromorpha flexuosa</i>	trace	

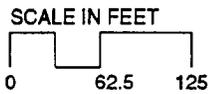
¹ Cover estimates comprise live plants; dead plants were included as litter under the substrate heading.

² Underlined substrate is dominant; other substrates were present.



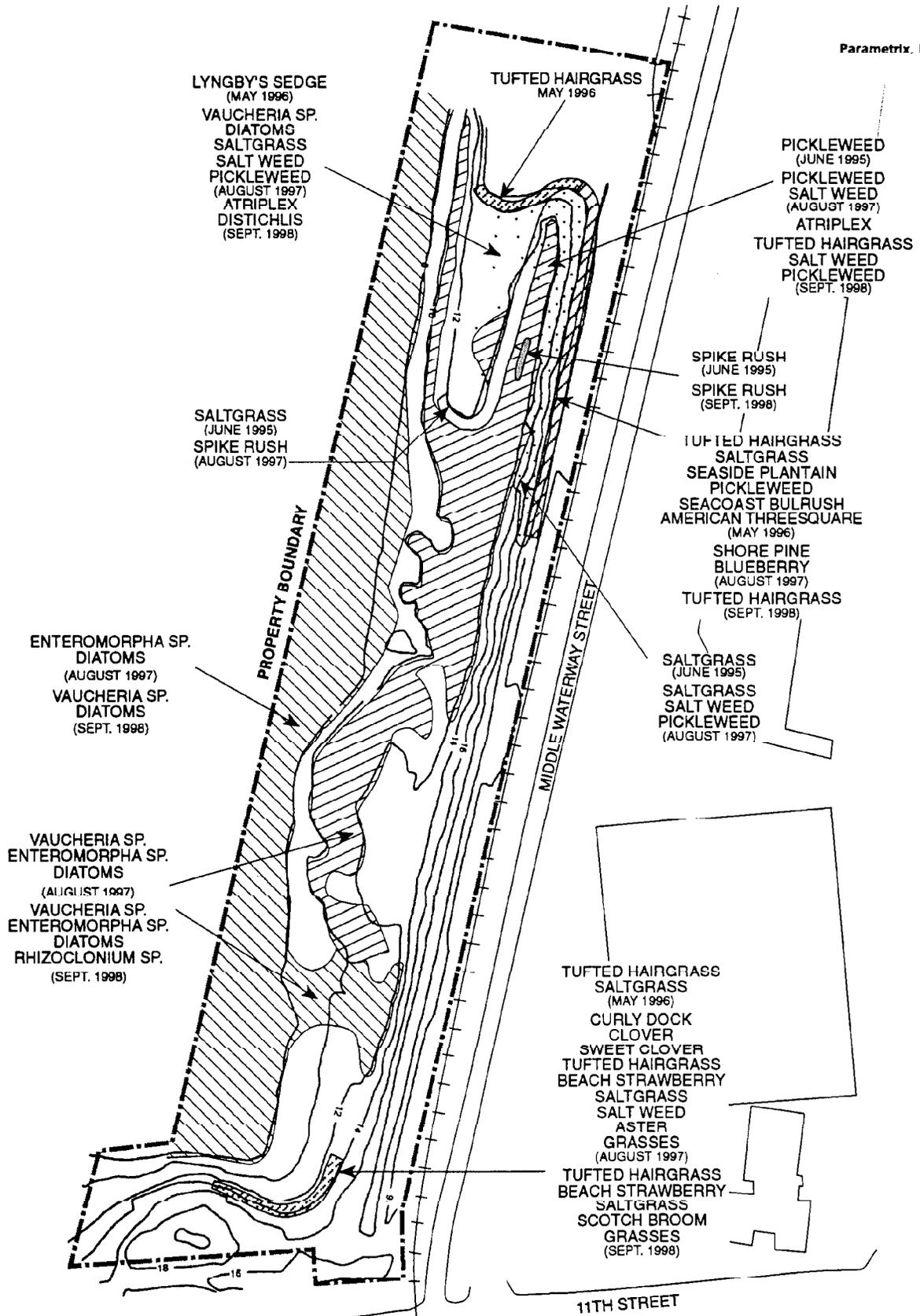
Datum: City of Tacoma MLLW

Middle Waterway/55-1616-09(02) 11/98



- Property Boundary
- Project Activity Boundary

Figure 3.
Vegetation Monitoring
Transects and Directions



Datum: City of Tacoma MLLW

Middle Waterway/55-1616-00(02) 11/08



Figure 4. Extent of Salt Marsh Vegetation 1998

In a portion of low-marsh Bed 4, at the head of the small channel west of the berm and north of Transect 7, some clumps of *Salicornia virginica* (pickleweed), *D. caespitosa* (tufted hair grass), *D. spicata*, and *A. patula* were growing outside of the exclosures. This 20-30 m² area contained the majority of the low marsh vegetation at the site. The shallow slope and protection from exposure to waves in this area may promote the retention of seeds and organic matter and reduce the exposure of established plants. It was not clear if the existing plants in the area were new recruits or growth from plantings in 1996.

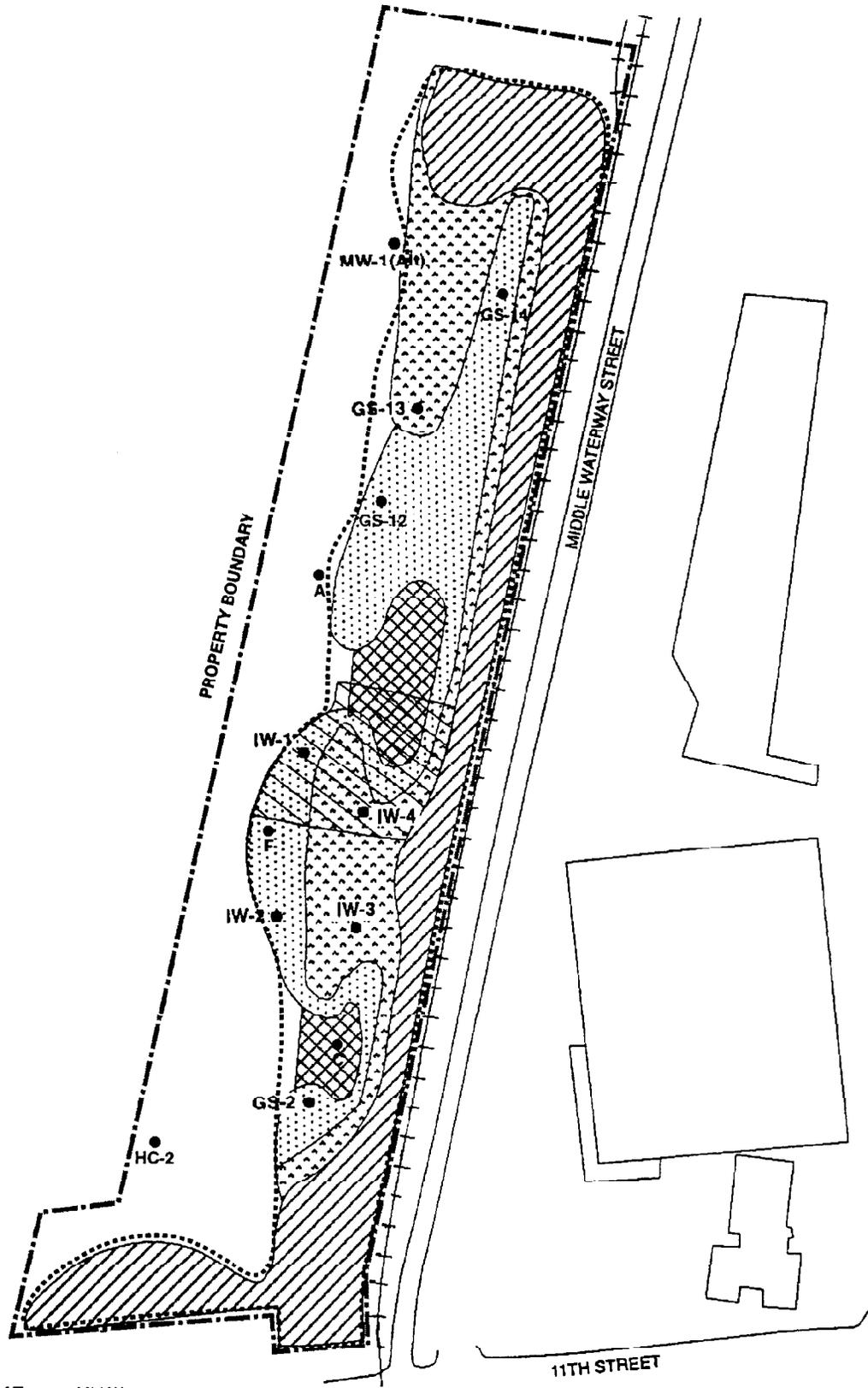
Other beds originally designated as low marsh, i.e., Beds 4, 5, and 6 (Transects 5, 6, 8), were functioning as mudflat. Most mudflat areas had very shallow slopes and were dominated by a mix of *Vaucheria* sp. (a yellow-green alga), *Rhizoclonium* sp. (a green alga), and diatoms. A few small patches of (vascular) *Eleocharis parvula* (spike rush) were found along Transects 5 and 8. These plants are common in protected mudflat areas around Puget Sound. Algal and vascular plant biomass may be consumed directly by some animals but, perhaps more importantly, it generates detritus which is consumed by bacteria. Bacteria and microalgae such as diatoms are important food sources for secondary consumers (e.g., harpacticoid copepods) that, in turn, are consumed by tertiary consumers (e.g., juvenile salmon).

Plants in the sandy upland buffer generally appeared healthy although bare areas between the plants still dominated the space. In the southern portion of the site, upland buffer coverage was slightly higher than in the northern areas and several grasses have recruited to the area. The *Melilotus alba* (sweet clover) that was very abundant last year was not seen this year.

Currently, the low mudflat areas, covered by nonvascular plants, are the most productive portions of the site. High and low marsh vegetation has been largely unsuccessful at the site, except for the small protected area at the northern end of the site. Upland buffer vegetation is surviving, but might benefit from the addition of some organic matter, nutrients, and, perhaps, fresh water. It appears that "treatments" used to promote growth and recruitment of vegetation, goose exclosures in salt marsh areas and top-dressing in mudflat areas, played a less important role in determining the distribution of plants at the site than other physical factors such as slope, exposure, and substrate.

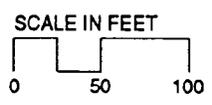
Interstitial Water Salinity Sampling

Interstitial water was sampled for salinity and temperature on August 25, 1998 at 14 stations (Figure 5). Sampling was conducted on an ebb tide, on a day without rainfall (no rainfall for more than a month). Stations were selected to characterize salinity near the north, central, and south areas of the site. Temperature and salinity were measured *in situ* with a refractometer and mercury thermometer (Table 6). To collect interstitial water, a small hole was dug to a depth of about 30 cm and interstitial water was allowed to seep in. A clean pipette was used to transfer water to the refractometer; the thermometer was placed directly into the water. All equipment was rinsed with deionized water between stations.



Datum: City of Tacoma MLLW

Middle Waterway/55-1616-00(02) 11/08



- | | | | |
|--|-------------------|--|---------------------------|
| | High Salt Marsh | | Upland Buffer |
| | Low Salt Marsh | | Sampling Station |
| | Mud Flat | | Property Boundary |
| | Sediment Topdress | | Project Activity Boundary |

Figure 5.
Marsh Zones, Buffer,
and Interstitial Water
Stations

Interstitial water stations were co-located with either the sediment chemistry or grain size sample collection locations.

Table 6. Interstitial water salinity results.

Station	Time (PST)			Temp. (°C)			Salinity (ppt)		
	1997	1996	1998	1997	1996	1998	1997	1996	1998
IW-1	1650	1810	--	11.5	14.4	--	19	28	--
IW-2 (GS-5)	1655	1830	1430	11.5	14.9	20	29	30	25
IW-3 (GS-6)	1427	1710	1445	12.5	15.3	21	13	20	15
IW-4 (GS-8)	1420	1720	1100	12.5	15.7	21	9	19	14
MW-1(Alt)	1354	--	1245	12.5	--	18	8	--	25
GS-13	1410	--	1330	14.0	--	20	24	--	30
GS-2	1702	--	--	11.3	--	--	21	--	--
F	--	--	1130	--	--	18	--	--	25
A	--	--	1200	--	--	17	--	--	25
GS-10	--	--	1215	--	--	18	--	--	20
GS-12	--	--	1230	--	--	18	--	--	25
GS-14	--	--	1345	--	--	19	--	--	25
C	--	--	1450	--	--	20	--	--	22
HC-2	--	--	1500	--	--	18	--	--	25

-- not sampled

WILDLIFE OBSERVATIONS

Wildlife observations on the Project site were recorded by a local volunteer. Observations focused primarily on birds and small mammals.

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- Parametrix, Inc. 1993. Project analysis: Middle Waterway shore restoration project. Prepared for Simpson Tacoma Kraft Company, Tacoma, Washington.
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- Parametrix, Inc. 1994b. Middle Waterway shore restoration monitoring and adaptive management plan. Prepared by the Restoration Project Planning Group for Simpson Tacoma Kraft Company, Tacoma, Washington. 23 pp.+ Appendices.
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- Parametrix, Inc. 1994d. Preliminary draft sampling report Puget Sound dredged disposal analysis for sediment characterization at Middle Waterway shore restoration project. Prepared for Simpson Tacoma Kraft Company, Tacoma, Washington. 47 pp.+ Appendices.
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- Parametrix, Inc. 1997a. Middle Waterway Shore Restoration Project monitoring and adaptive management plan data report, post-construction (year 2). Prepared for Simpson Tacoma Kraft company, Tacoma, Washington and Champion International, Stamford, Connecticut. 19pp.+ Appendices.
- Parametrix, Inc. 1997b. Changes to the Middle Waterway Shore Restoration Project monitoring and adaptive management plan. Memorandum from Allison Reak, Parametrix to Dave McEntee, Simpson Tacoma Kraft Company. November 2, 1997. 3p.
- U.S. Environmental Protection Agency. 1994a. Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Solid Waste and Emergency Response. 540/R-94-012.
- U.S. Environmental Protection Agency. 1994b. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Office of Solid Waste and Emergency Response. 540/R-94-013.

DATA APPENDIX

AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011964
 CLIENT ID MW-C
 DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	< 19		560	1,300
Acenaphthene	< 19		500	2,000
Anthracene	< 19		960	13,000
Fluorene	< 19		540	3,600
Naphthalene	< 19		2,100	2,400
Phenanthrene	61		1,500	21,000
2-Methylnaphthalene	< 19		670	1,900
HPAH				
Benzo(a)anthracene	67		1,300	5,100
Benzo(a)pyrene	62		1,600	3,600
Benzo(b)fluoranthene	54		3,200	9,900
Benzo(k)fluoranthene	49			
Benzo(ghi)perylene	33		670	3,200
Chrysene	87		1,400	21,000
Dibenzo(a,h)anthracene	< 19		230	1,900
Fluoranthene	110		1,700	30,000
Indeno(1,2,3-cd)pyrene	41		600	4,400
Pyrene	120		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	39.			
D-6-Phenol	56.			
D-5-Nitrobenzene	52.			
2-Fluorobiphenyl	65.			
2,4,6-Tribromophenol	98.			
D14-Terphenyl	95.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011969
CLIENT ID GS#8
DATE SAMPLED 8/25/98

	RESULT	Q	S.I.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	83.2			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.20		
-2,	4.00	0.40		
-1,	2.00	1.70		
0,	1.00	3.80		
+1,	0.50	23.9		
+2,	0.25	29.3		
+3,	0.125	17.2		
+4,	0.063	8.30		
+5,	0.032	4.70		
+6,	0.016	1.10		
+7,	0.008	1.90		
+8,	0.004	1.00		
+9,	0.002	0.50		
+10,	0.001	0.30		
>+10,	<0.001	4.70		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011970
CLIENT ID GS#10
DATE SAMPLED 8/25/98

	RESULT	O	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	69.0			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	3.60		
-2,	4.00	< 0.1		
-1,	2.00	1.40		
0,	1.00	2.80		
+1,	0.50	12.6		
+2,	0.25	23.3		
+3,	0.125	12.7		
+4,	0.063	9.10		
+5,	0.032	19.8		
+6,	0.016	2.90		
+7,	0.008	2.80		
+8,	0.004	3.40		
+9,	0.002	1.00		
+10,	0.001	0.30		
>+10,	<0.001	4.20		

VEGETATION PLOT FIELD SURVEY DATA

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 5 **Observers:** L. Tear, D. Lester

Macrophyte Bed: Low salt marsh, planted, not enclosed

Starting Point: North

Plot #	Distance (m)		Species	% Cover	Remarks
1	0.87	W 1.62	<i>Vaucheria</i> sp.	90	
2	3.00	W 1.81	<i>Vaucheria</i> sp.	75	
3	6.24	W 0.05	<i>Vaucheria</i> sp.	100	
4	9.53	W 0.43 3	<i>Vaucheria</i> sp.	100	
5	14.0 9	W 2.56	<i>Vaucheria</i> sp.	50	
6	16.4 2	E 2.02	<i>Vaucheria</i> sp. <i>Eleocharis parvula</i> Diatoms	5 15 100	
7	19.0 9	W 1.09	<i>Vaucheria</i> sp.	100	
8	24.0 2	E 1.5	<i>Vaucheria</i> sp. Diatoms	20 85	
9	25.1	E 3.68	Bare	0	
10	30.9 0	E 2.85	<i>Vaucheria</i> sp.	75	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 12 Observer: L. Tear, D. Lester

Macrophyte Bed: Mud, unplanted, undressed, south end Starting Point: West @ GS-4

Plot #	Distance (m)			Species	% Cover	Remarks
1	1.1	S	0.61	<i>Vaucheria</i> sp. <i>Rhizochlonium</i> sp.	40 65	
2	5.07	N	2.61	Diatoms	50	Thin coverage Mud
3	8.93	N	1.10	<i>Vaucheria</i> sp.	3	Mud
4	13.2 2	S	2.48	<i>Rhizochlonium</i> sp.	4	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/98 Transect: 13 Observer: L. Tear, D. Lester

Macrophyte Bed: Mud, unplanted, dressed

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	5.69	E	2.94	<i>Rhizochlonium</i> sp. <i>Vaucheria</i> sp.	100 1	
2	16.1 5	E	2.95	<i>Eleocharis parvula</i> Diatoms	75 100	
3	24.2 9	E	1.63	<i>Eleocharis parvula</i> Diatoms	45 100	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 11 **Observer:** L. Tear, D. Lester

Macrophyte Bed: Mud, unplanted, undressed

Starting Point: South

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.16	E	3.78	<i>Vaucheria</i> sp.	100	Thick
2	1.94	W	1.55	<i>Vaucheria</i> sp.	100	
3	7.09	E	4.78	<i>Vaucheria</i> sp.	75	
4	10.7 5	W	0.89	<i>Rhizochlonium</i> sp.	100	
5	16.4 6	E	3.78	<i>Vaucheria</i> sp. <i>Rhizochlonium</i> sp.	20 80	
6	22.2 7	W	0.21	<i>Vaucheria</i> sp.	100	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 9 **Observer:** L. Tear, D. Lester

Macrophyte Bed: Low salt marsh control, unplanted, unenclosed

Starting Point: South

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.4	E	4.3	Bare	0	
2	3.9	E	2.7	Bare	0	
3	10.6	W	0.19	<i>Vaucheria</i> sp.	20	Thin coverage
4	16.7	E	3.2	<i>Vaucheria</i> sp.	10	Thin coverage
5	23.2	W	4.2	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 4 **Observer:** L. Tear, D. Lester

Macrophyte Bed: High salt marsh, unplanted, with enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	3.1	W	1.7	Bare	0	Sandy
2	10.4	W	2.4	Bare	0	Sandy
3	20.2	W	0.0	Bare	0	Sandy
4	30.6	W	2.2	Bare	0	Sandy
5	34.6	W	0.3	Bare	0	Sandy

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 8 Observer: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh control, unplanted, mud base Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.2	E	3.5	<i>Vaucheria</i> sp. <i>Eleocharis parvula</i>	25 Trace	
2	7.3	W	8.6	Bare	0	
3	14.2	E	3.7	<i>Vaucheria</i> sp.	50	
4	17.3	E	0.7	<i>Vaucheria</i> sp.	50	
5	23.5	E	1.4	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 6 Observer: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh, planted, enclosure

Starting Point: South

Plot #	Distance (m)			Species	% Cover	Remarks
1	1.8	E	2.2	<i>Vaucheria</i> sp.	Trace	
2	4.4	E	0.1	Bare	0	
3	11.1	W	2.0	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 1 **Observer:** L. Tear, D. Lester

Macrophyte Bed: High salt marsh, planted, enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.8	E	1.0	Bare	0	
2	2.9	W	3.9	<i>Atriplex patula</i>	7	Spindly plant, not robust
3	8.1	E	0.0	Bare	0	Silty/sand-substrate throughout transect
4	11.3	E	4.7	Bare	0	
5	16.3	E	2.2	Bare	0	
6	22.4	W	4.8	Bare	0	@ 27.4 m, 29.6 m 2 small patches of <i>Atriplex patula</i>
7	29.1	W	3.0	Bare	0	
8	33.6	E	4.5	Bare	0	
9	41.6	W	3.0	<i>Distichlis spicata</i>	2	Strips of sod remaining perpendicular to transect
10	46.7	E	1.4	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 7 Observer: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh, planted, enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.7	W	0.2	Bare	0	Sand
2	4.7	W	0.9	Bare	0	Sand
3	17.4	W	0.6	Bare	0	Sand
4	21.7	W	0.25	<i>Distichlis spicata</i>	Trace	Sand
5	25.8	W	0.7	<i>Atriplex patula</i> <i>Distichlis spicata</i>	25 Trace	Sand
6	31.9	W	0.15	<i>Distichlis spicata</i> (dead)	Trace	Sand
7	42.8	W	0.55	<i>Distichlis spicata</i>	12	Sand

Notes: Random patches of *Atriplex patula* along transect from 20 m to end of transect, sods of dying *Distichlis spicata* here and there.

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 2 Observer: L. Tear, D. Lester

Macrophyte Bed: High salt marsh, planted, enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	10.5	W	1.2	<i>Atriplex patula</i> <i>Deschampsia caespitosa</i>	25 Trace	
2	19.7	W	0.5	<i>Deschampsia caespitosa</i>	Trace	
3	23.5	W	0.4	<i>Deschampsia caespitosa</i>	3	
4	33.8	W	0.3	Bare	0	
5	49.0	W	1.3	<i>Distichlis spicata</i> <i>Atriplex patula</i>	5 Trace	
6	64.9	W	1.5	<i>Distichlis spicata</i>	Trace	
7	79.7	W	1.9	<i>Deschampsia caespitosa</i>	15	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 3 Observer: L. Tear, D. Lester

Macrophyte Bed: High salt marsh, not planted, not enclosed

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	1.0	W	5.7	Bare	0	Sand
2	2.7	W	2.5	Bare	0	Sand
3	4.5	E	7.3	Bare	0	Sand
4	11.8	E	1.3	Bare	0	Sand
5	15.6	W	0.4	Bare	0	Sand
6	21.8	W	1.8	Bare	0	Sand
7	23.7	E	5.5	Bare	0	Sand

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 10 Observer: L. Tear, D. Lester

Macrophyte Bed: High salt marsh, planted, enclosed

Starting Point: West

Plot #	Distance (m)			Species	% Cover	Remarks
1	11.5	N	0.6	<i>Deschampsia caespitosa</i>	55	
				<i>Distichlis spicata</i>	15	
				<i>Fragaria chiloensis</i>	4	
2	19.0	N	0.5	<i>Deschampsia caespitosa</i>	45	
				<i>Fragaria chiloensis</i>	1	
				<i>Atriplex patula</i>	Trace	
				Scotch Broom	Trace	
3	28.5	N	0.5	<i>Deschampsia caespitosa</i>	65	
				Grass A (lawn grass)	50	
				<i>Agrostis</i> sp.	10	
				<i>Bromus</i> sp.	10	
				<i>Atriplex</i>	1	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 14 Observer: L. Tear, D. Lester

Macrophyte Bed: High to low salt marsh, topdressed Starting Point: East

Plot #	Distance (m)			Species	% Cover	Remarks
1	9.4	N	0.8	Bare	0	Sand & Silt
2	12.7	N	0.6	Bare	0	Silty
3	16.7	S	1.4	Bare	0	Silty
4	19.9	S	0.6	<i>Rhizochlonium</i> sp.	10	
5	22.0	N	2.2	<i>Vaucheria</i> sp.	90	Thin coverage
6	23.7	N	0.3	<i>Vaucheria</i> sp.	80	Thin coverage
7	27.8	S	1.7	<i>Vaucheria</i> sp. <i>Rhizochlonium</i> sp. <i>Enteromorpha</i>	95 1 Trace	Thin coverage

ANALYTICAL LABORATORY DATA REPORT



AmTest Inc.
14603 N.E. 87th St.
Redmond, WA
98002
Tel: 425 885 1664
Fax: 425 883 3495

September 18, 1998

Parametrix
5808 Lake Washington Blvd.
Kirkland, WA 98033
Attn. Deb Lester

Dear Deb,

On the 26th of August 1998, Am Test received a total of sixteen (16) sediment samples from the Middle Waterway Restoration project (project #55-1616-09(02)). Six (6) of the samples were analyzed for the following PSDDA parameters:

LPAH and HPAH	EPA 3550/8270
Mercury	EPA 7471
Total Solids	PSEP p17
Total Volatile Solids	PSEP p20
Total Organic Carbon	SM 5310B
Acid Volatile Sulfides	DiToro, 1990
Grain Size	PSEP p9

The remaining ten samples were analyzed for Grain Size only.

At the time of receipt, the samples were logged-in, stored, and handled in accordance with the protocols of the USEPA. There were a total of four containers submitted for each of the samples.

In order to achieve the lowest possible detection limits for the PAHs, two separate 35 gram subsamples were extracted, combined and analyzed (1 ml final extract volume). All of the samples were subjected to GPC clean up, prior to the analysis by GC/MS.

There were no major problems with any of the analyses.

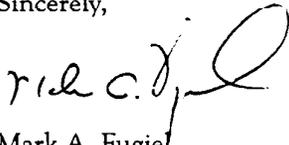
Following the analytical data, you will find the Quality Control (QC) Summary. Information in this section includes dates of analyses, sample weights, and the results for the quality control samples (i.e. Matrix Spikes, Standard Reference Materials, Triplicates).

AMTEST

All of the QC results for the Quality Control Samples were within the limits of the laboratory as well as those of the analytical methods. The appropriate raw data has been included in the data package.

Please feel free to contact me if you have any questions pertaining to the data package.

Sincerely,



Mark A. Fugiel
General Manager
Am Test Inc.

98-A11963-11978

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011963
CLIENT ID MW-A
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	57.7			
Total Volatile Solids (%)	6.7			
Total Organic Carbon (%)	5.0			
Acid Volatile Sulfides(mg/kg)	210			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	2.40
-2,	4.00	0.30
-1,	2.00	0.70
0,	1.00	2.40
+1,	0.50	15.8
+2,	0.25	19.1
+3,	0.125	13.9
+4,	0.063	3.50
+5,	0.032	7.70
+6,	0.016	13.6
+7,	0.008	6.50
+8,	0.004	4.80
+9,	0.002	1.80
+10,	0.001	0.90
>+10,	<0.001	6.60

METALS (MG/KG DRY WEIGHT)

Mercury	0.260	0.41	2.3
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AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011963
CLIENT ID MW-A
DATE SAMPLED 8/25/98

	RESULT	O	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	< 23		560	1,300
Acenaphthene	< 23		500	2,000
Anthracene	70		960	13,000
Fluorene	< 23		540	3,600
Naphthalene	< 23		2,100	2,400
Phenanthrene	240		1,500	21,000
2-Methylnaphthalene	< 23		670	1,900
HPAH				
Benzo(a)anthracene	460		1,300	5,100
Benzo(a)pyrene	460		1,600	3,600
Benzo(b)fluoranthene	600		3,200	9,900
Benzo(k)fluoranthene	470			
Benzo(ghi)perylene	260		670	3,200
Chrysene	730		1,400	21,000
Dibenzo(a,h)anthracene	75		230	1,900
Fluoranthene	650		1,700	30,000
Indeno(1,2,3-cd)pyrene	340		600	4,400
Pyrene	670		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	46.			
D-6-Phenol	61.			
D-5-Nitrobenzene	50.			
2-Fluorobiphenyl	56.			
2,4,6-Tribromophenol	87.			
D14-Terphenyl	86.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011964
CLIENT ID MW-C
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	75.7			
Total Volatile Solids (%)	2.8			
Total Organic Carbon (%)	0.60			
Acid Volatile Sulfides (mg/kg)	210			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	1.20
-2,	4.00	0.30
-1,	2.00	0.30
0,	1.00	1.60
+1,	0.50	26.4
+2,	0.25	37.1
+3,	0.125	17.2
+4,	0.063	6.30
+5,	0.032	0.90
+6,	0.016	1.30
+7,	0.008	1.60
+8,	0.004	1.60
+9,	0.002	0.20
+10,	0.001	< 0.1
>+10,	<0.001	4.00

METALS (MG/KG DRY WEIGHT)

Mercury	0.076	0.41	2.3
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AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011968
CLIENT ID MW-F
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	22		560	1,300
Acenaphthene	< 21		500	2,000
Anthracene	58		960	13,000
Fluorene	< 21		540	3,600
Naphthalene	21		2,100	2,400
Phenanthrene	250		1,500	21,000
2-Methylnaphthalene	< 21		670	1,900
HPAH				
Benzo(a)anthracene	320		1,300	5,100
Benzo(a)pyrene	370		1,600	3,600
Benzo(b)fluoranthene	380		3,200	9,900
Benzo(k)fluoranthene	240			
Benzo(ghi)perylene	220		670	3,200
Chrysene	430		1,400	21,000
Dibenzo(a,h)anthracene	77		230	1,900
Fluoranthene	480		1,700	30,000
Indeno(1,2,3-cd)pyrene	280		600	4,400
Pyrene	540		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	46.			
D-6-Phenol	61.			
D-5-Nitrobenzene	63.			
2-Fluorobiphenyl	75.			
2,4,6-Tribromophenol	88.			
D14-Terphenyl	94.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011968
CLIENT ID MW-F
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	70.0
Total Volatile Solids (%)	6.2
Total Organic Carbon (%)	3.3
Acid Volatile Sulfides(mg/kg)	< 12

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	1.30
-2,	4.00	0.30
-1,	2.00	1.60
0,	1.00	2.90
+1,	0.50	15.7
+2,	0.25	24.6
+3,	0.125	11.7
+4,	0.063	19.9
+5,	0.032	9.70
+6,	0.016	1.50
+7,	0.008	2.90
+8,	0.004	2.10
+9,	0.002	0.20
+10,	0.001	< 0.1
>+10,	<0.001	5.70

METALS (MG/KG DRY WEIGHT)

Mercury	0.160	0.41	2.3
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AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011967
CLIENT ID MW 1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	67.4			
Total Volatile Solids (%)	3.3			
Total Organic Carbon (%)	2.2			
Acid Volatile Sulfides(mg/kg)	81.			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	2.20
-2,	4.00	0.90
-1,	2.00	1.90
0,	1.00	4.20
+1,	0.50	21.1
+2,	0.25	24.9
+3,	0.125	20.6
+4,	0.063	11.6
+5,	0.032	0.90
+6,	0.016	2.80
+7,	0.008	0.90
+8,	0.004	3.10
+9,	0.002	0.50
+10,	0.001	< 0.1
>+10,	<0.001	4.50

METALS (MG/KG DRY WEIGHT)

Mercury	0.417 *	0.41	2.3
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AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011966
CLIENT ID MW-1 Duplicate
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	< 20		560	1,300
Acenaphthene	< 20		500	2,000
Anthracene	< 20		960	13,000
Fluorene	< 20		540	3,600
Naphthalene	< 20		2,100	2,400
Phenanthrene	55		1,500	21,000
2-Methylnaphthalene	< 20		670	1,900
HPAH				
Benzo(a)anthracene	75		1,300	5,100
Benzo(a)pyrene	95		1,600	3,600
Benzo(b)fluoranthene	98		3,200	9,900
Benzo(k)fluoranthene	69			
Benzo(ghi)perylene	58		670	3,200
Chrysene	120		1,400	21,000
Dibenzo(a,h)anthracene	< 20		230	1,900
Fluoranthene	130		1,700	30,000
Indeno(1,2,3-cd)pyrene	71		600	4,400
Pyrene	140		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	57.			
D-6-Phenol	73.			
D-5-Nitrobenzene	70.			
2-Fluorobiphenyl	73.			
2,4,6-Tribromophenol	93.			
D14-Terphenyl	100			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011966
CLIENT ID MW-1 Duplicate
DATE SAMPLED 8/25/98

	RESULT	O	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	72.0			
Total Volatile Solids (%)	2.7			
Total Organic Carbon (%)	3.5			
Acid Volatile Sulfides(mg/kg)	290			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	2.20		
-2,	4.00	0.60		
-1,	2.00	1.70		
0,	1.00	3.60		
+1,	0.50	15.8		
+2,	0.25	29.0		
+3,	0.125	18.9		
+4,	0.063	10.1		
+5,	0.032	7.60		
+6,	0.016	0.50		
+7,	0.008	2.40		
+8,	0.004	2.30		
+9,	0.002	0.30		
+10,	0.001	< 0.1		
>+10,	<0.001	4.90		
METALS (MG/KG DRY WEIGHT)				
	Mercury	0.207	0.41	2.3

AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011965
CLIENT ID MC-1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	44		560	1,300
Acenaphthene	45		500	2,000
Anthracene	240		960	13,000
Fluorene	52		540	3,600
Naphthalene	36		2,100	2,400
Phenanthrene	540		1,500	21,000
2-Methylnaphthalene	< 33		670	1,900
HPAH				
Benzo(a)anthracene	620		1,300	5,100
Benzo(a)pyrene	630		1,600	3,600
Benzo(b)fluoranthene	640		3,200	9,900
Benzo(k)fluoranthene	450			
Benzo(ghi)perylene	390		670	3,200
Chrysene	960		1,400	21,000
Dibenzo(a,h)anthracene	130		230	1,900
Fluoranthene	1000		1,700	30,000
Indeno(1,2,3-cd)pyrene	440		600	4,400
Pyrene	1000		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	43.			
D-6-Phenol	62.			
D-5-Nitrobenzene	56.			
2-Fluorobiphenyl	67.			
2,4,6-Tribromophenol	99.			
D14-Terphenyl	99.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011965
CLIENT ID MC-1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.I.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	43.5
Total Volatile Solids (%)	14.
Total Organic Carbon (%)	5.4
Acid Volatile Sulfides(mg/kg)	290

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	2.80
-2,	4.00	0.50
-1,	2.00	1.40
0,	1.00	2.10
+1,	0.50	3.90
+2,	0.25	6.70
+3,	0.125	6.70
+4,	0.063	6.90
+5,	0.032	29.9
+6,	0.016	12.0
+7,	0.008	7.90
+8,	0.004	6.80
+9,	0.002	1.20
+10,	0.001	< 0.1
>+10,	<0.001	11.5

METALS (MG/KG DRY WEIGHT)

Mercury	0.359	0.41	2.3
---------	-------	------	-----

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011971
CLIENT ID GS#12
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	68.6			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	0.90		
-2,	4.00	0.10		
-1,	2.00	0.60		
0,	1.00	1.60		
+1,	0.50	8.60		
+2,	0.25	23.3		
+3,	0.125	31.1		
+4,	0.063	15.6		
+5,	0.032	2.90		
+6,	0.016	4.80		
+7,	0.008	2.60		
+8,	0.004	2.40		
+9,	0.002	0.80		
+10,	0.001	0.40		
>+10,	<0.001	4.20		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011972
CLIENT ID GS#13
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	89.0			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	< 0.1		
-2,	4.00	0.10		
-1,	2.00	0.40		
0,	1.00	1.70		
+1,	0.50	13.9		
+2,	0.25	34.9		
+3,	0.125	27.4		
+4,	0.063	10.3		
+5,	0.032	4.30		
+6,	0.016	1.50		
+7,	0.008	0.80		
+8,	0.004	1.00		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	3.40		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011973
CLIENT ID GS#14
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	67.2			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	0.60		
-2,	4.00	0.10		
-1,	2.00	0.60		
0,	1.00	2.70		
+1,	0.50	25.3		
+2,	0.25	28.0		
+3,	0.125	14.9		
+4,	0.063	5.50		
+5,	0.032	10.6		
+6,	0.016	3.70		
+7,	0.008	1.60		
+8,	0.004	1.80		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	4.50		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011974
CLIENT ID GS#2
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	82.7			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	< 0.1		
-2,	4.00	0.10		
-1,	2.00	0.20		
0,	1.00	1.30		
+1,	0.50	13.3		
+2,	0.25	40.4		
+3,	0.125	24.9		
+4,	0.063	9.10		
+5,	0.032	3.90		
+6,	0.016	1.70		
+7,	0.008	0.20		
+8,	0.004	1.00		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	3.60		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011975
CLIENT ID GS#1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	100.			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.70		
-2,	4.00	< 0.1		
-1,	2.00	2.20		
0,	1.00	4.30		
+1,	0.50	26.2		
+2,	0.25	42.8		
+3,	0.125	12.8		
+4,	0.063	4.40		
+5,	0.032	1.70		
+6,	0.016	1.90		
+7,	0.008	0.10		
+8,	0.004	0.40		
+9,	0.002	0.10		
+10,	0.001	< 0.1		
>+10,	<0.001	1.50		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011976
CLIENT ID GS#5
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	81.2			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.80		
-2,	4.00	0.20		
-1,	2.00	1.20		
0,	1.00	3.20		
+1,	0.50	25.1		
+2,	0.25	30.3		
+3,	0.125	16.6		
+4,	0.063	8.40		
+5,	0.032	5.30		
+6,	0.016	2.30		
+7,	0.008	0.50		
+8,	0.004	1.10		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	3.70		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011977
CLIENT ID GS#6
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	88.8			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.00		
-2,	4.00	0.10		
-1,	2.00	1.50		
0,	1.00	4.40		
+1,	0.50	26.5		
+2,	0.25	34.2		
+3,	0.125	14.2		
+4,	0.063	5.00		
+5,	0.032	5.30		
+6,	0.016	< 0.1		
+7,	0.008	< 0.1		
+8,	0.004	0.90		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	6.80		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

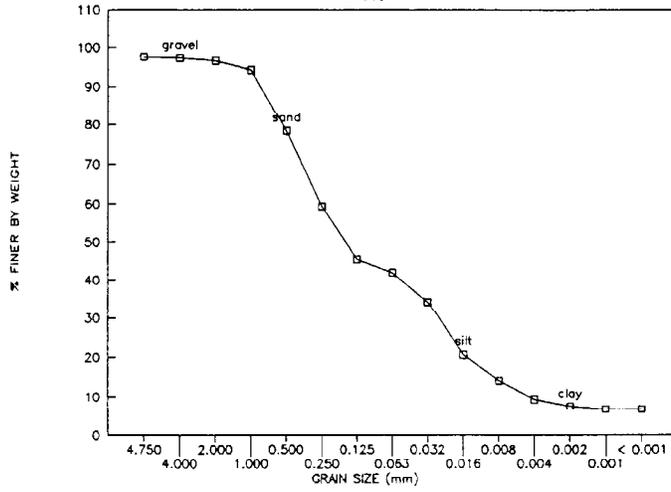
PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011978
CLIENT ID GS#7
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	99.6			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.10		
-2,	4.00	< 0.1		
-1,	2.00	2.20		
0,	1.00	7.80		
+1,	0.50	34.3		
+2,	0.25	38.4		
+3,	0.125	10.1		
+4,	0.063	2.70		
+5,	0.032	1.40		
+6,	0.016	< 0.1		
+7,	0.008	< 0.1		
+8,	0.004	0.40		
+9,	0.002	0.10		
+10,	0.001	< 0.1		
>+10,	<0.001	1.50		

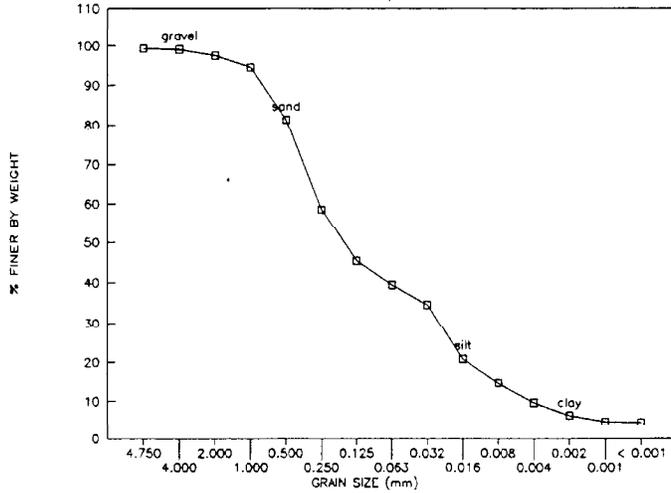
GRAIN SIZE DISTRIBUTION

11963



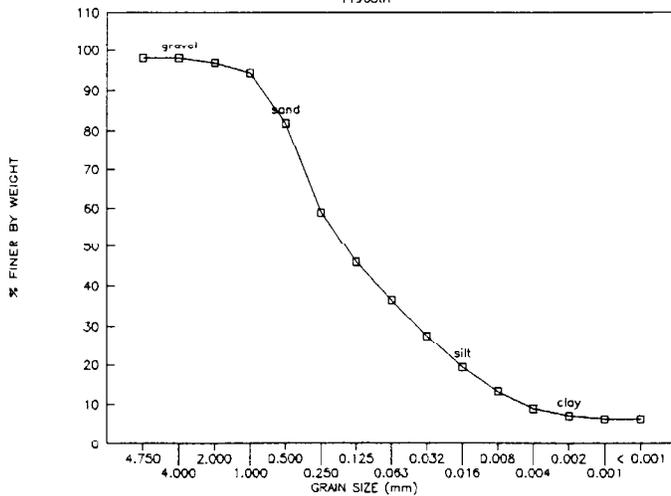
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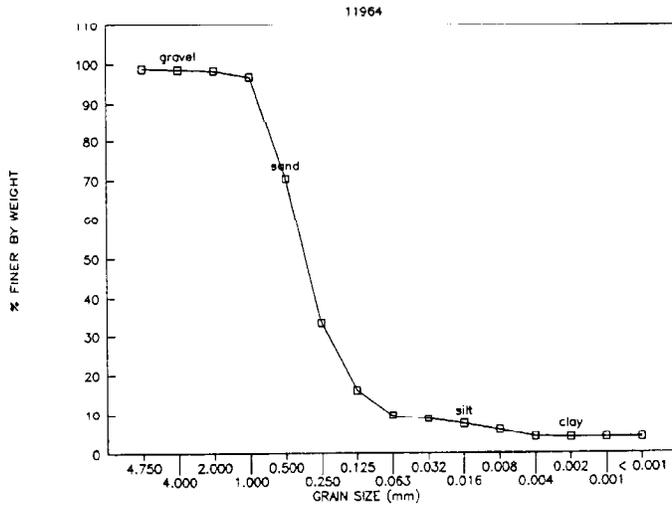


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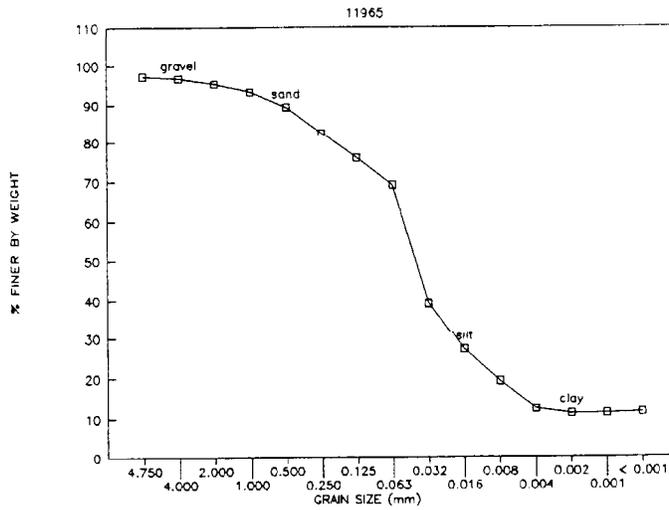
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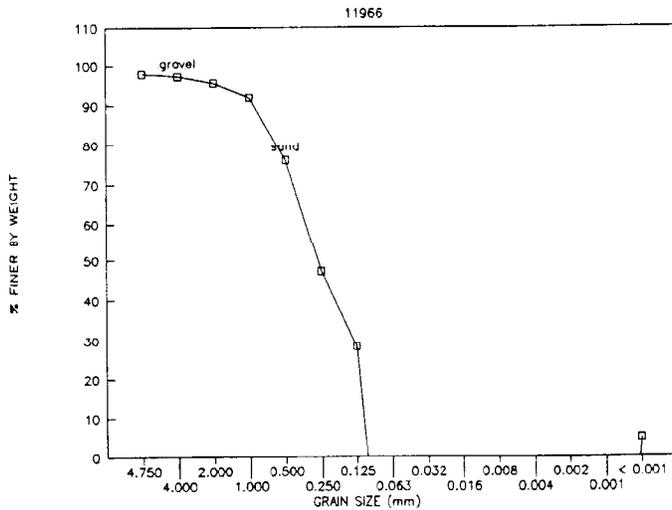
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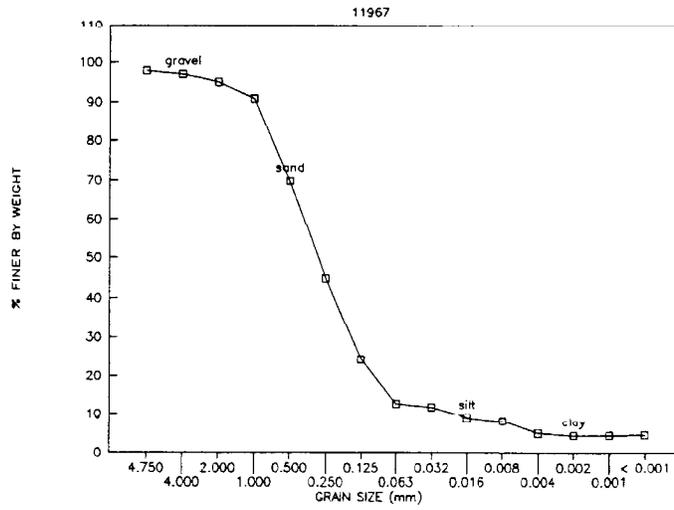
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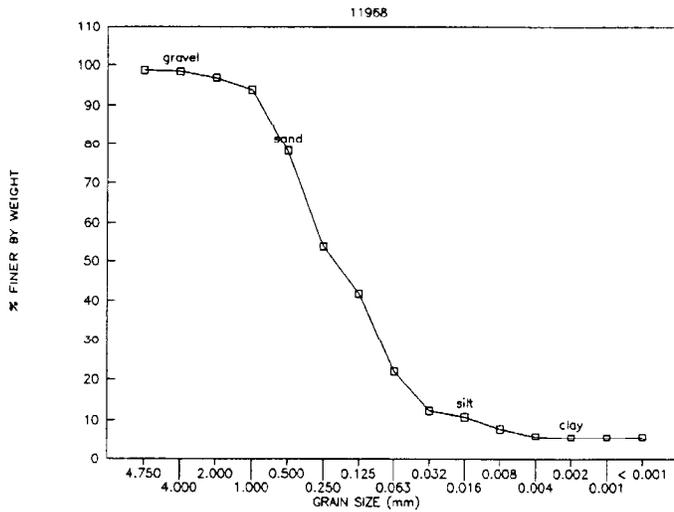
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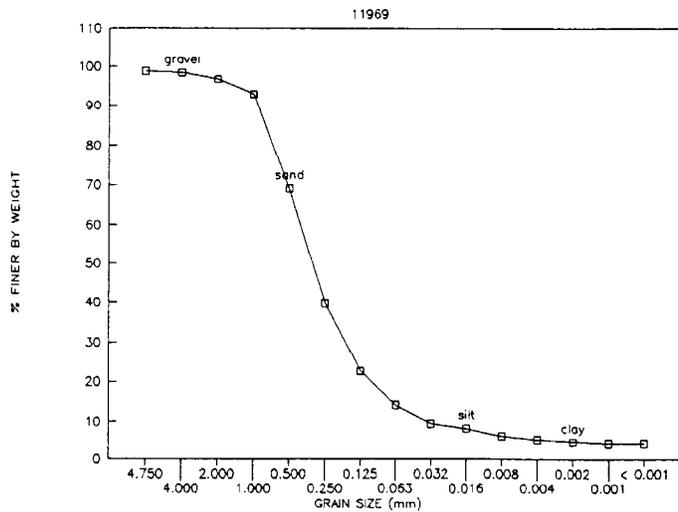
GRAIN SIZE DISTRIBUTION



GRAIN SIZE DISTRIBUTION

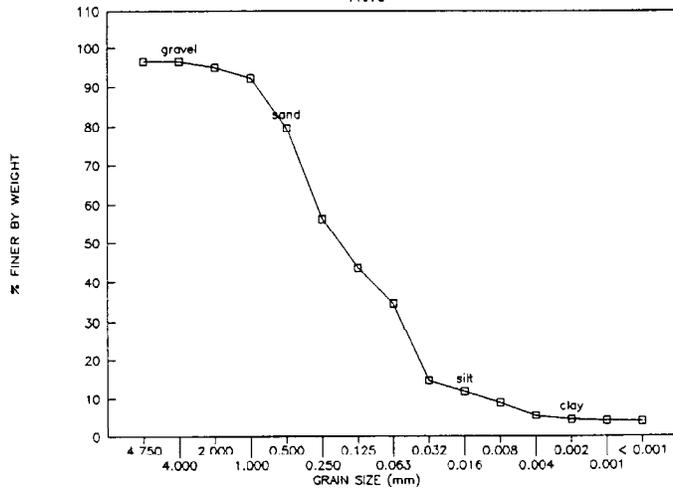


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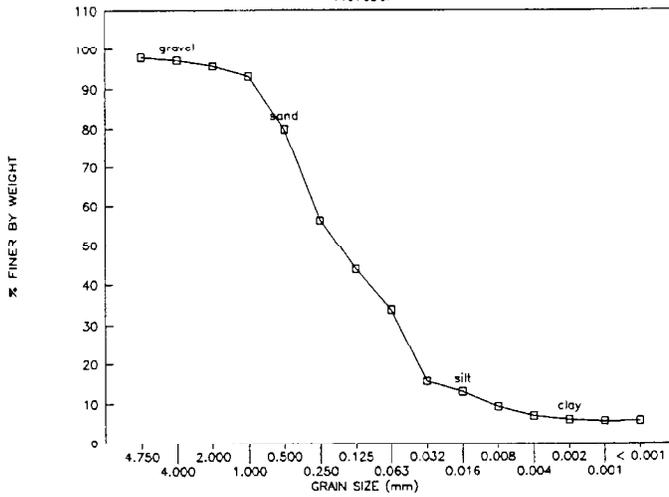
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11970



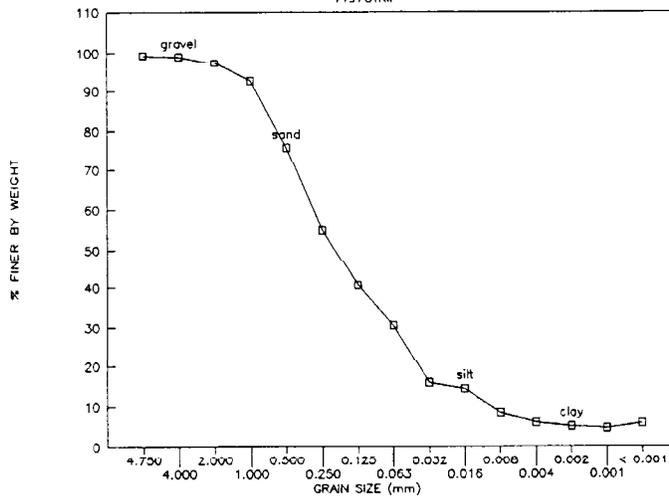
GRAIN SIZE DISTRIBUTION

11970DUP



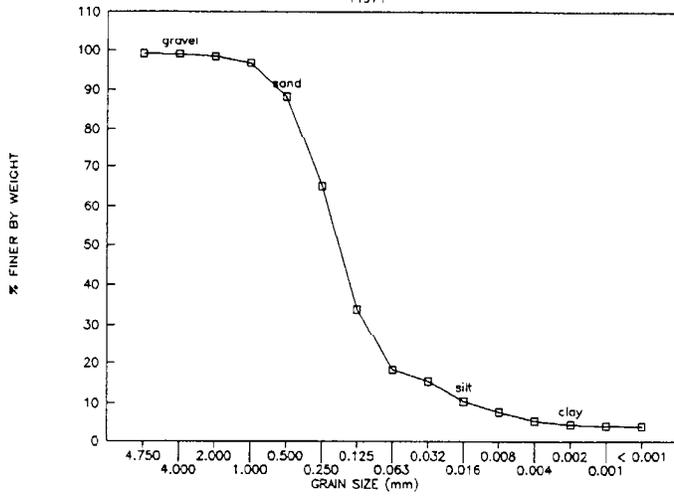
GRAIN SIZE DISTRIBUTION

11970TRIP



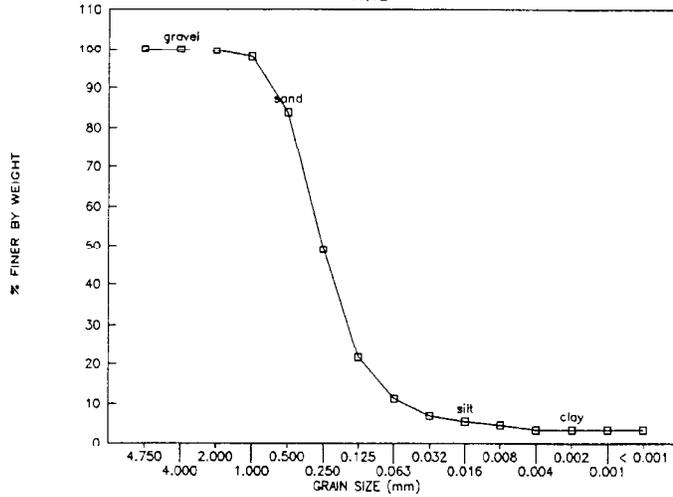
GRAIN SIZE DISTRIBUTION

11971



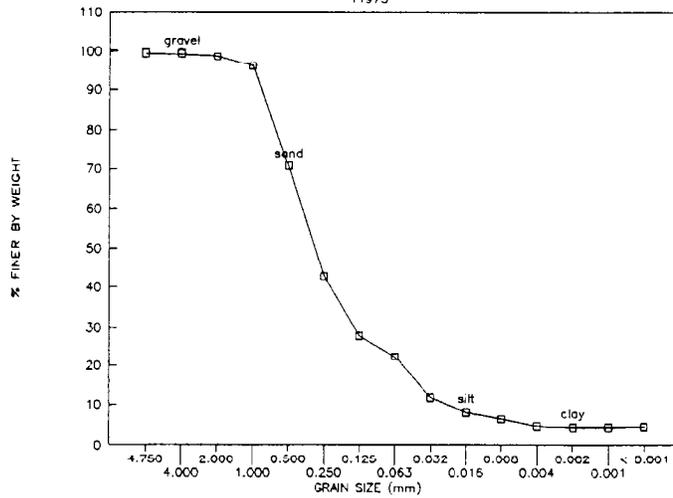
GRAIN SIZE DISTRIBUTION

11972

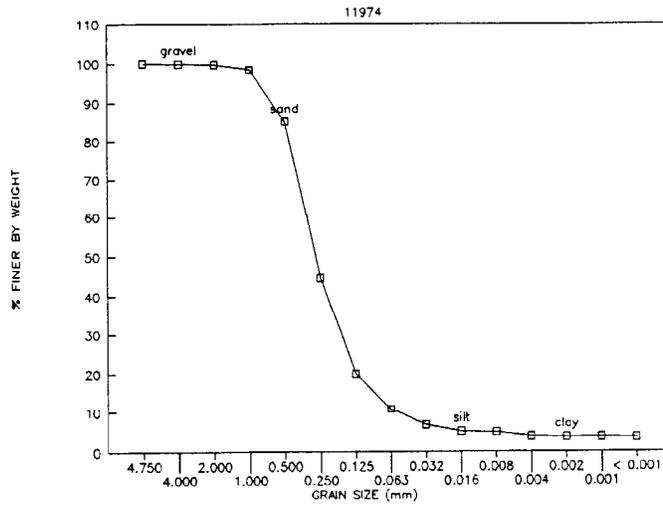


GRAIN SIZE DISTRIBUTION

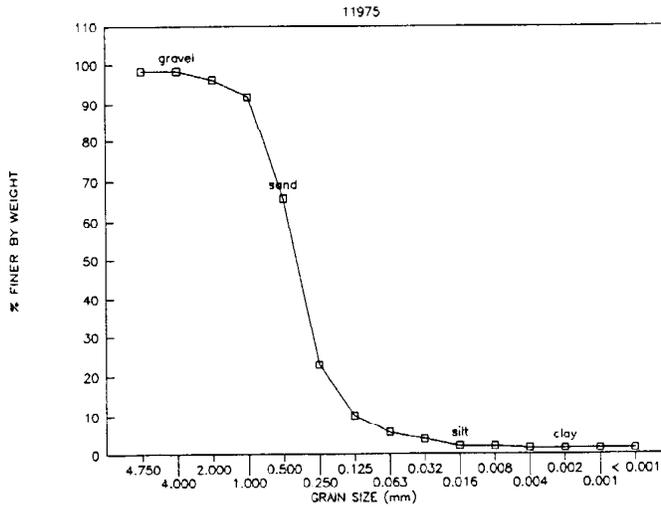
11973



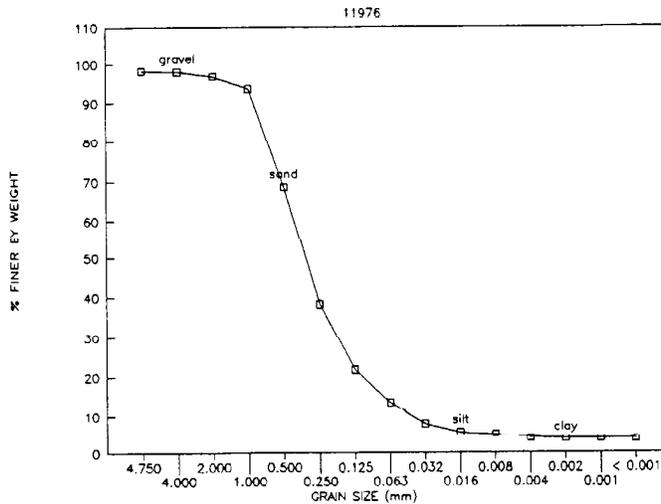
GRAIN SIZE DISTRIBUTION



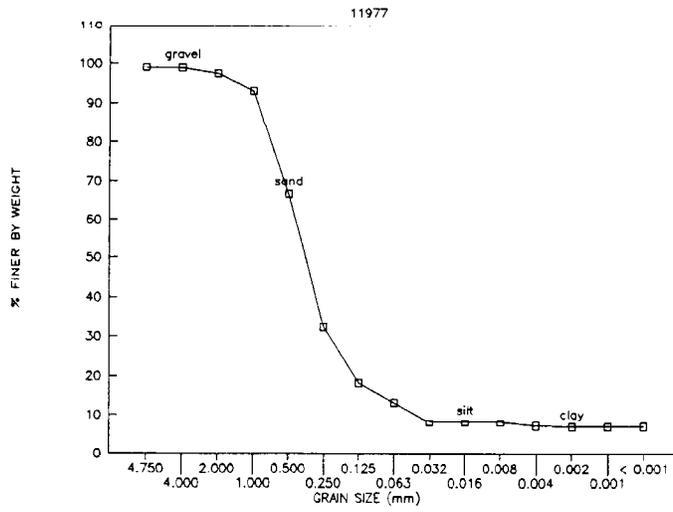
GRAIN SIZE DISTRIBUTION



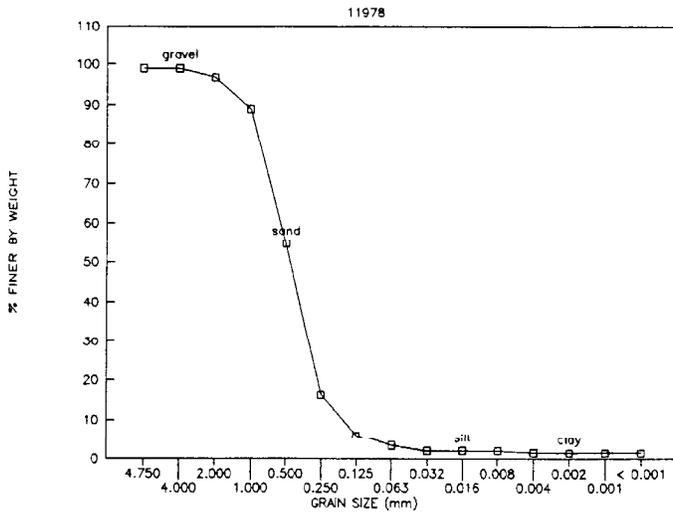
GRAIN SIZE DISTRIBUTION



GRAIN SIZE DISTRIBUTION

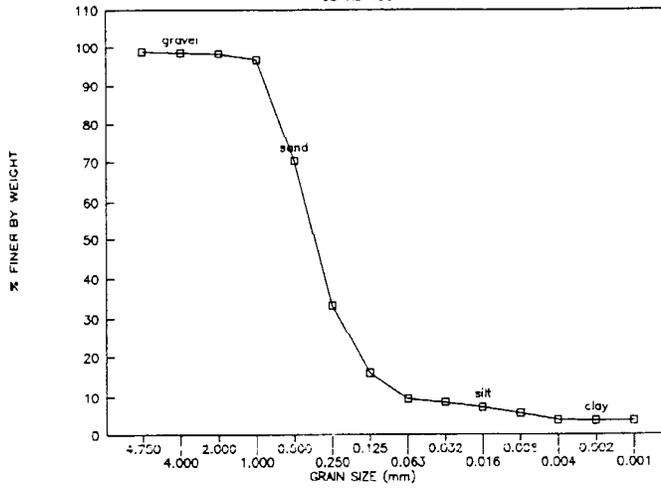


GRAIN SIZE DISTRIBUTION



GRAIN SIZE DISTRIBUTION

98-A011964

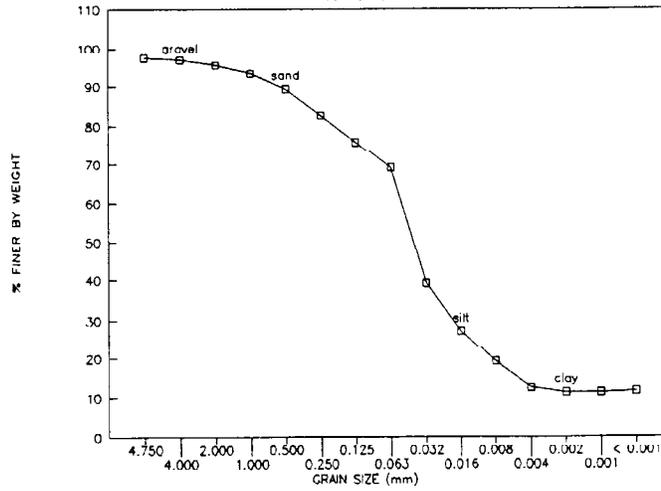


OCT 10 1998

Michael J. Nish

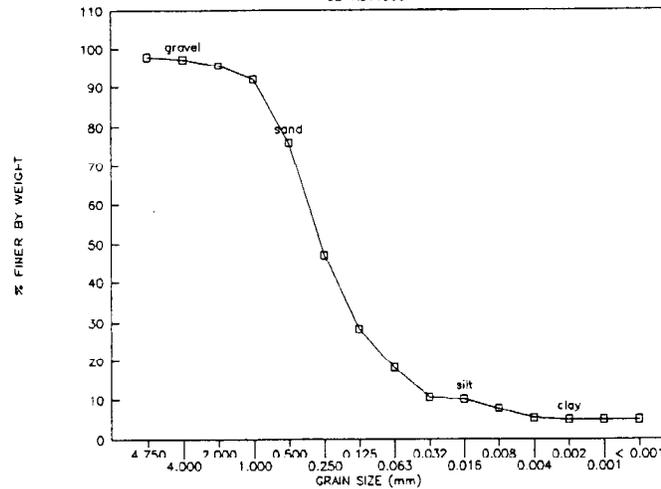
GRAIN SIZE DISTRIBUTION

98-A011955



GRAIN SIZE DISTRIBUTION

98-A011966



AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
SEMI-VOLATILES
ANALYSIS DATES*

AM TEST SAMPLE NOS.	Extraction	Analysis
98-A011963	9/8/98	9/11/98
98-A011964	9/8/98	9/11/98
98-A011965	9/8/98	9/11/98
98-A011966	9/8/98	9/11/98
98-A011967	9/8/98	9/11/98
98-A011968	9/8/98	9/11/98

SAMPLE WEIGHTS

AM TEST SAMPLE NOS.	Weight (grams)	Volume (ml)
98-A011963	70.10	1.0
98-A011964	69.90	1.0
98-A011965	70.40	1.0
98-A011966	69.81	1.0
98-A011967	69.10	1.0
98-A011968	70.50	1.0
98-A011963 MS	70.80	1.0
98-A011963 MSD	71.10	1.0
HS-3	1.00	1.0

*Includes all associated Quality Control Samples (MS/MSD, SRM, Blanks, etc.).

MS = Matrix Spike

MSD = Matrix Spike Duplicate

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
POLYNUCLEAR AROMATIC HYDROCARBONS
BLANKS

AM TEST Sample Number

BLANK
(ug/kg)

ORGANICS (ug/kg)

LPAH

Naphthalene	< 14
Acenaphthalene	< 14
Acenaphthene	< 14
Fluorene	< 14
Phenanthrene	< 14
Anthracene	< 14
2-Methylnaphthalene	< 14

HPAH

Fluoranthene	< 14
Pyrene	< 14
Benzo(a)anthracene	< 14
Chrysene	< 14
Benzo(b)fluoranthene	< 14
Benzo(k)fluoranthene	< 14
Benzo(a)pyrene	< 14
Indeno(1,2,3-cd)pyrene	< 14
Dibenzo(a,h)anthracene	< 14
Benzo(ghi)perylene	< 14

SURROGATES RECOVERIES (%)

2-Fluorophenol	50
D6-Phenol	57
D5-Nitrobenzene	59
2-Fluorobiphenyl	59
2,4,6-Tribromophenol	57
D14-Terphenyl	80

< = less than

Results are reported on a dry weight basis.

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL POLYNUCLEAR AROMATIC HYDROCARBONS MATRIX SPIKE

AM TEST Sample Number
Client ID

98-A011963
MW-A

COMPOUNDS	SAMPLE VALUE (ug/kg)	SAMPLE + SPIKE (ug/kg)	SPIKE CONCENTRATION (ug/kg)	RECOVERY (%)
LPAH				
Naphthalene	< 23	610	1200	53
Acenaphthalene	< 23	710	1200	62
Acenaphthene	< 23	750	1200	65
Fluorene	< 23	800	1200	70
Phenanthrene	240	1000	1200	66
Anthracene	70	820	1200	65
2-Methylnaphthalene	< 23	710	1200	62
HPAH				
Fluoranthene	650	1500	1200	74
Pyrene	670	1300	1200	55
Benzo (a) anthracene	460	1300	1200	73
Chrysene	730	1500	1200	67
Benzo (b) fluoranthene	600	1600	1200	87
Benzo (k) fluoranthene	470	1300	1200	72
Benzo (a) pyrene	460	1300	1200	73
Indeno (1, 2, 3-cd) pyrene	340	1100	1200	66
Dibenzo (a, h) anthracene	75	820	1200	65
Benzo (ghi) perylene	260	1000	1200	64

SURROGATES RECOVERIES (%)

2-Fluorophenol	44
D6-Phenol	57
D5-Nitrobenzene	55
2-Fluorobiphenyl	57
2,4,6-Tribromophenol	84
D14-Terphenyl	75

< = less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL POLYNUCLEAR AROMATIC HYDROCARBONS MATRIX SPIKE

AM TEST Sample Number
Client ID

98-A011963
MW-A

COMPOUNDS	SAMPLE VALUE (ug/kg)	SAMPLE + SPIKE DUPLICATE (ug/kg)	SPIKE CONCENTRATION (ug/kg)	RECOVERY (%)
I.PAH				
Naphthalene	< 23	630	1200	55
Acenaphthalene	< 23	720	1200	63
Acenaphthene	< 23	770	1200	67
Fluorene	< 23	800	1200	70
Phenanthrene	240	1000	1200	66
Anthracene	70	860	1200	69
2-Methylnaphthalene	< 23	710	1200	62
HPAH				
Fluoranthene	650	1800	1200	100
Pyrene	670	1500	1200	72
Benzo (a) anthracene	460	1200	1200	64
Chrysene	730	1600	1200	76
Benzo (b) fluoranthene	600	1500	1200	78
Benzo (k) fluoranthene	470	1200	1200	63
Benzo (a) pyrene	460	1300	1200	73
Indeno (1, 2, 3-cd) pyrene	340	1100	1200	66
Dibenzo (a, h) anthracene	75	870	1200	69
Benzo (ghi) perylene	260	1000	1200	64
SURROGATES RECOVERIES (%)				
2-Fluorophenol		37		
D6-Phenol		49		
D5-Nitrobenzene		45		
2-Fluorobiphenyl		50		
2, 4, 6-Tribromophenol		70		
D14-Terphenyl		64		

< = less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
POLYNUCLEAR AROMATIC HYDROCARBONS
MATRIX SPIKE DUPLICATES

AM TEST Sample Number
Client ID

98-A011963
MW-A

COMPOUNDS	SAMPLE VALUE (ug/kg)	DUPLICATE VALUE (ug/kg)	RELATIVE PERCENT DIFFERENCE (%)
LPAH			
Naphthalene	610	630	3.2
Acenaphthalene	710	720	1.4
Acenaphthene	750	770	2.6
Fluorene	800	800	0
Phenanthrene	1000	1000	0
Anthracene	820	860	4.8
2-Methylnaphthalene	710	710	0
HPAH			
Fluoranthene	1500	1800	18
Pyrene	1300	1500	14
Benzo(a)anthracene	1300	1200	8.0
Chrysene	1500	1600	6.5
Benzo(b)fluoranthene	1600	1500	6.5
Benzo(k)fluoranthene	1300	1200	8.0
Benzo(a)pyrene	1300	1300	0
Indeno(1,2,3-cd)pyrene	1100	1100	0
Dibenzo(a,h)anthracene	820	870	5.9
Benzo(ghi)perylene	1000	1000	0

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
GC/MS SEMI-VOLATILES
STANDARD REFERENCE MATERIAL
HS-3

Sample Date: 9/03/98
Date Analyzed: 9/15/98

COMPOUNDS	MEASURED VALUE (ug/kg)	TRUE VALUE (ug/kg)	RECOVERY (%)	LABORATORY CONTROL LIMITS (ug/kg)
Naphthalene	2,100	9,000	23	280 - 4,440
Acenaphthylene	150	300	50	28 - 310
Acenaphthene	1,600	4,500	36	428 - 3,300
Fluorene	3,900	13,300	29	1,040 - 8,050
Phenanthrene	47,000	85,000	55	7,300 - 70,800
Anthracene	2,600	13,400	19	520 - 4,500
Fluoranthene	42,000	60,000	70	6,100 - 59,700
Pyrene	22,000	39,000	56	4,500 - 35,800
Benzo (a) Anthracene	7,600	14,600	52	1,490 - 12,100
Chrysene	8,900	14,100	63	1,700 - 13,400
Benzo (a) Pyrene	3,600	7,400	49	1,600 - 5,600
Benzo (b) Fluoranthene	5,200	7,700	68	2,800 - 10,300
Benzo (k) Fluoranthene	5,300	2,800	189	430 - 7,200
Benzo (ghi) perylene	2,600	5,000	52	960 - 3,900
Dibenzo (a, h) Anthracene	710	1,300	55	240 - 1,200
Indeno (1, 2, 3-cd) Pyrene	3,100	5,400	57	1,040 - 4,020
SURROGATE RECOVERIES (%)				
2-Fluorophenol	45			
D6-Phenol	55			
D5-Nitrobenzene	56			
2-Fluorobiphenyl	62			
2,4,6-Tribromophenol	76			
D14-Terphenyl	76			

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL ANALYSIS DATES

Mercury	8/29/98
Total Solids	9/2/98
Total Volatile Solids	9/2/98
Total Organic Carbon	9/1/98
Acid Volatile Sulfides	8/31/98
Grain Size	9/2/98

MERCURY SAMPLE WEIGHTS

AM TEST SAMPLE NOS.	Weight (grams)
98-A011963	2.98
98-A011964	2.79
98-A011965	3.80
98-A011966	3.87
98-A011967	3.37
98-A011968	2.50
98-A011963 Duplicate	3.05
98-A011964 Spike	3.04
SRM	0.28

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL MERCURY DUPLICATES

COMPOUNDS	98-A011963 (mg/kg)	98-A011963 (mg/kg)	RELATIVE PERCENT DIFFERENCE (%)
Mercury	0.260	0.298	14

MATRIX SPIKES

PARAMETERS	98-A011964 VALUE (mg/kg)	98-A011964+ SPIKE (mg/kg)	SPIKE CONCENTRATION (mg/kg)	RECOVERY (%)
Mercury	0.076	0.247	0.194	88

STANDARD REFERENCE MATERIAL

COMPOUNDS	MEASURED VALUE (mg/kg)	TRUE VALUE (mg/kg)	RECOVERY (%)
Mercury	2.69	3.10	87

BLANKS

RESULTS	
Mercury	< 0.02

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
CONVENTIONALS
TRIPLICATES

	#1	#2	#3
Total Solids (%)	57.7	57.1	59.1
Total Volatile Solids (%)	6.7	6.5	8.0
Total Organic Carbon (%)	5.0	4.6	4.6
Acid Volatile Sulfides (mg/kg)	210	220	150

CONVENTIONALS
BLANKS

	RESULTS
Total Organic Carbon (%)	< 0.05
Acid Volatile Sulfides (mg/kg)	< 5.0

< less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL - CONVENTIONALS GRAIN SIZE TRIPLICATE ANALYSIS

AM TEST Sample Number
Client ID

98-A011963
MW-A

PHI	OPENING (mm)	RETENTION (%)		
		Sample	Duplicate	Triplicate
	4.75	2.4	0.7	2.0
-2	4.0	0.3	0.2	< 0.1
-1	1.7	0.7	1.6	1.2
0	1.0	2.4	3.0	2.5
+1	0.5	15.8	13.1	12.4
+2	.25	19.1	22.9	23.0
+3	.125	13.9	13.1	12.9
+4	.063	3.5	6.0	9.5
+5	.032	7.7	4.9	9.0
+6	.016	13.6	13.7	8.1
+7	.008	6.5	6.1	6.1
+8	.004	4.8	5.2	4.3
+9	.002	1.8	3.2	1.8
+10	.001	0.9	1.7	0.8
PASS	<.001	6.6	4.5	6.4

< = less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL - CONVENTIONALS GRAIN SIZE TRIPLICATE ANALYSIS

AM TEST Sample Number
Client ID

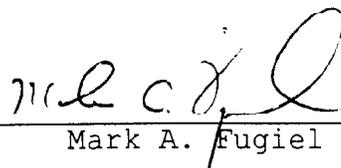
98-A011970
GS#10

PHI	OPENING (mm)	RETENTION (%)		
		Sample	Duplicate	Triplicate
	4.75	3.6	2.2	0.7
-2	4.0	0.0	0.7	0.3
-1	1.7	1.4	1.5	1.8
0	1.0	2.8	2.5	4.7
+1	0.5	12.6	13.2	16.7
+2	.25	23.3	23.7	20.9
+3	.125	12.7	12.3	14.3
+4	.063	9.1	10.1	10.2
+5	.032	19.8	18.3	14.6
+6	.016	2.9	2.6	1.5
+7	.008	2.8	3.6	4.8
+8	.004	3.4	2.4	2.5
+9	.002	1.0	0.9	0.9
+10	.001	0.3	0.4	0.4
PASS	<.001	4.2	5.7	5.8

< = less than

MAF/jb

REPORTED BY


Mark A. Fugiel

96-9182

Field Sample / Chain of Custody Record

Parametrix, Inc. · 6808 Lake Washington Blvd. · Kirkland, Washington 98033-7310 · 206-822-8880 · Fax 206-889-8808

Project Name: Middle Waterway Restoration Client: Champion Simpson
 Samplers: Deb Lester Recorder: Deb Lester

Matrix	# of Containers and Preservatives							Sample Number	Date			Analysis Required				
	Water	Tissue	Sediment	Other	Unpreserved	HCl	H2SO4		HNO3	NaOH	NaOH and Zinc		Other	Month	Day	Year
X												Aug	25	1998	2:30	Please Note: Sample containers have "Aug 24, 1998" as collection date - Samples were actually collected on Aug 25, 1998 GROUND WATER ANALYSIS ↓ GROUND WATER ANALYSIS WAT PAH / TOC / TS / TUS / HG PAH / WAT AUS PAH / TOC / TS / TUS / HG WAT AUS PAH / TOC / TS / TUS / HG WAT AUS PAH / TOC / TS / TUS / HG WAT AUS PAH / TOC / TS / TUS / HG WAT AUS
X												Aug	25	1998	3:30	
X												Aug	25	1998	2:00	
X												Aug	25	1998	1:00	
X												Aug	25	1998	12:00	
X												Aug	25	1998	12:05	
X												Aug	25	1998	2:50	
X												Aug	25	1998	2:50	
X												Aug	25	1998	3:00	
X												Aug	25	1998	3:00	
X												Aug	25	1998	12:55	
X												Aug	25	1998	1:10	
Total Containers:											12					

Chain of Custody Record (Please Print)

Relinquished By: (Name)	Date:	Time:	Received By: (Name)	Date:	Time:
<i>Deb Lester</i>	8/25/98	11:15	<i>Deb Lester</i>		

Shipping Information

Cooler#: _____
 Airbill #: _____
 _____ of _____ Coolers on this Airbill

Field Sample / Chain of Custody Record

Parametrix, Inc. • 6801 Lake Washington Blvd. • Kirkland, Washington 98033-7360 • 206-822-8880 • Fax 206-888-8808

Project Name: Middle Waterway Restoration Client: Champion / Simpson
 Samplers: Deb Lester Recorder: Deb Lester

Matrix	# of Containers and Preservatives							Sample Number	Date			Analysis Required	
	Water	Tissue	Sediment	Other	Unpreserved	HCl	H2SO4		HNO3	NaOH	NaOH and Zinc		Acetate
									Month	Day	Year	Time	
X								GS # 8	Aug	25	1998	11:00	Please Note: Sample containers have "Aug 24, 1998" as collection date - Samples were actually collected on Aug 25 1998 Grain Size Analysis
X								GS # 10				12:15	
X								GS # 12				12:30	
X								GS # 14				12:00	
X								GS # 15				11:30	
X								GS # 16				1:00	
X								GS # 17				1:30	
X								GS # 18				1:45	
X								GS # 19				3:00	
X								GS # 20				2:45	
X								GS # 21				2:50	
X								GS # 22	Aug	25	1998	3:00	Grain Size Analysis
Total Containers: 12													

Chain of Custody Record (Please Print)

Relinquished By: (Name)	Date	Time	Received By: (Name)	Date	Time
<i>Deb Lester</i>	8/25/98	11:15	<i>J. Blane</i>		

Shipping Information	
Cooler#:	
Airbill #:	
of	Coolers on this Airbill

ANALYTICAL DATA VALIDATION MEMORANDUM

MEMORANDUM

to: Project File October 19, 1998
from: Michael Kluck 55-1616-09 (02)
re: Middle Waterway Shore Restoration - Data Validation Summary

DATA REVIEW SUMMARY

Marine sediment samples were analyzed for polynuclear aromatic hydrocarbons (PAHs), mercury, and conventionals by AmTest Inc. in Redmond, Washington and reported as project number 55-1616-09(02). The analyses conducted and analytical methods used are shown in Table 1.

Table 1. Analyses conducted and methods utilized.

<u>Analysis Conducted</u>	<u>Analytical Method</u>
PAHs	EPA SW3550/8270
Mercury	EPA SW7471
Total solids (TS)	PSEP p.17
Total volatile solids (TVS)	PSEP p.20
Total organic carbon (TOC)	SM 5310B
Acid volatile sulfides (AVS)	DiToro, 1990
Grain size	PSEP p.9

Five surface sediment samples and one field duplicate sample were collected on 8/25/98 and analyzed for the parameters shown in Table 1. An additional ten sediment samples were collected on the same day, but were only analyzed for grain size and TS. Table 2 shows the sample numbers for which data were reviewed.

Table 2. Summary of samples and identification numbers.

Project Sample ID	Laboratory ID	Analyses Performed
MW-A	98-A011963	(see Table 1)
MW-C	98-A011964	(see Table 1)
MC-1	98-A011965	(see Table 1)
MW-1 Duplicate	98-A011966	(see Table 1)
MW-1	98-A011967	(see Table 1)
MW-F	98-A011968	(see Table 1)
GS#8	98-A011969	Grain size, TS
GS#10	98-A011970	Grain size, TS
GS#12	98-A011971	Grain size, TS
GS#13	98-A011972	Grain size, TS
GS#14	98-A011973	Grain size, TS
GS#2	98-A011974	Grain size, TS
GS#1	98-A011975	Grain size, TS
GS#5	98-A011976	Grain size, TS
GS#6	98-A011977	Grain size, TS
GS#7	98-A011978	Grain size, TS

The data validation was performed using the United States Environmental Protection Agency (U.S. EPA) Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (U.S. EPA 1994a,b) for guidance. Data validation included evaluation of the following (as appropriate):

- Holding Times and Sample Preservation
- Laboratory Method Blanks
- Standard Reference Sample (SRM) Recovery
- Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Recoveries
- Matrix Spike Duplicate Relative Percent Difference (RPD)
- Analytical Duplicate and Triplicate Samples
- Field Duplicate Sample RPD

DATA QUALITY SUMMARY

Summarized below is an evaluation of the quality assurance (QA) and quality control (QC) results associated with these sediment samples. Briefly, all laboratory and field QA/QC were within acceptable ranges. The field duplicate samples showed elevated RPDs for TOC, AVS, and mercury, but no validation flags were applied on this basis. Overall, there is no indication that the results for any of the parameters analyzed were significantly biased. No validation flags were applied on the basis of the QA/QC data evaluated.

GENERAL QA/QC

Two general irregularities were noted. First, to achieve lower detection limits, double the typical volume of sediment was extracted for PAH analysis. Two separate 35-gram aliquots were extracted

and the extracts combined prior to cleanup using gel permeation chromatography. Second, one of the grain size distribution plots (for sample AO11966) was missing data points for phi classes below +3. The laboratory sent a revised plot via U.S. mail that was received on October 19, 1998 and added into the original data package.

Holding Times and Blank Review

All samples were collected on August 25, 1998 and were prepared and analyzed within the holding times specified for each method.

Laboratory method blanks can provide information about systematic laboratory contamination due to reagents, glassware, etc. that may generate false positives (i.e., sample detections due to blank contamination). No contamination was detected in the laboratory blanks for these analyses.

Accuracy of Results

The percent recovery of each standard reference material (SRM) provide an indication of the laboratory's ability to measure analytes from marine sediments/sludges certified to contain metals at specified concentrations. The recovery of mercury from SRM CRM007-040 was 87%, within the predicted range. The recovery of PAHs from SRM HS-3 ranged from 19% - 189% of the certified value, but compared to the historical laboratory mean recovery were 79% - 139%. This range of recoveries was found to be acceptable, indicating that sample preparation and analysis procedures were sufficient to accurately quantify mercury and PAHs in a typical sediment/sludge matrix.

Matrix spike recoveries provide an indication of the laboratory's ability to recover spiked analytes from the sample matrix. The mercury MS recovery was 88%, within the acceptable range of 75% - 125%. The PAH MS recoveries ranged from 53% - 87%, and those for the MS duplicate (MSD) ranged from 55% - 100%. All of the MS and MSD recoveries were within the laboratory limits for acceptability. The MS relative percent differences for the PAH samples ranged from 0% - 18%, within the 20% criterion. This indicates sample preparation and analysis procedures were sufficient to accurately quantify these analytes in the actual sample matrix.

In addition, six surrogate and internal standard compounds are added during the preparation of PAH samples to account for possible losses and interferences during sample extraction, cleanup, and analysis. Recoveries of these compounds were within both U.S. EPA and laboratory recovery limits for all field and QC samples, indicating that significant sample losses did not occur and interferences were not identified.

Precision of Results

Relative standard deviations (RSDs) and/or RPDs were calculated for two pairs of QC samples, analytical duplicates/triplicates and field duplicates. The analytical duplicate and triplicate RSDs and RPDs indicate the degree of laboratory precision associated with one actual sample, and tend to provide information about sample homogenization. The field duplicate RPD indicates the degree of laboratory and field precision associated with one actual sample. Field duplicate RPDs tend to show greater variability than the RPDs associated with analytical duplicates and triplicates because they take into account both field and laboratory errors.

The analytical duplicate/triplicate RSDs were 1.8% for TS, 11.5% for TVS, 4.9% for TOC, and 19.6% for AVS. The analytical duplicate RPD for mercury was 14%. All of the analytical duplicate/triplicate results for these parameters were within acceptable ranges (<20%).

The RSDs for each of the different grain size classifications were evaluated, and no significant biases were identified. This indicates that sample homogeneity and sample matrix effects did not significantly affect the precision of the grain size results.

The field duplicate RPDs were 6.6% for TS, 20% for TVS, 45.6% for TOC, 113% for AVS, and 67.3% for mercury. For PAHs, field duplicate RPDs ranged from 0% to 58%, however, none of the results were greater than five times the practical quantitation limit (PQL). These RPDs show that the combined laboratory and field error was generally low, except for TOC, AVS, and mercury. Results for these analyses were not flagged solely on the basis of field duplicate results because the analytical duplicate results were acceptable and field duplicates are prone to greater error (such as differences in percent moisture). Also, EPA does not have promulgated criteria for evaluating field duplicate RPDs.

The RSDs for each of the different grain size classifications were evaluated, and no significant biases were identified. This indicates that field collection inconsistencies did not significantly affect the precision of the grain size results.

U.S. EPA 1994a. U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Solid Waste and Emergency Response, February 1994, EPA Publication No. 540/R-94-012.

U.S. EPA 1994b. U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Office of Solid Waste and Emergency Response, February 1994, EPA Publication No. 540/R-94-013.

cc: Deb Lester _____

DATA APPENDIX

AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011964
 CLIENT ID MW-C
 DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	< 19		560	1,300
Acenaphthene	< 19		500	2,000
Anthracene	< 19		960	13,000
Fluorene	< 19		540	3,600
Naphthalene	< 19		2,100	2,400
Phenanthrene	61		1,500	21,000
2-Methylnaphthalene	< 19		670	1,900
HPAH				
Benzo(a)anthracene	67		1,300	5,100
Benzo(a)pyrene	62		1,600	3,600
Benzo(b)fluoranthene	54		3,200	9,900
Benzo(k)fluoranthene	49			
Benzo(ghi)perylene	33		670	3,200
Chrysene	87		1,400	21,000
Dibenzo(a,h)anthracene	< 19		230	1,900
Fluoranthene	110		1,700	30,000
Indeno(1,2,3-cd)pyrene	41		600	4,400
Pyrene	120		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	39.			
D-6-Phenol	56.			
D-5-Nitrobenzene	52.			
2-Fluorobiphenyl	65.			
2,4,6-Tribromophenol	98.			
D14-Terphenyl	95.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011969
CLIENT ID GS#8
DATE SAMPLED 8/25/98

	RESULT	Q	S.I.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	83.2			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.20		
-2,	4.00	0.40		
-1,	2.00	1.70		
0,	1.00	3.80		
+1,	0.50	23.9		
+2,	0.25	29.3		
+3,	0.125	17.2		
+4,	0.063	8.30		
+5,	0.032	4.70		
+6,	0.016	1.10		
+7,	0.008	1.90		
+8,	0.004	1.00		
+9,	0.002	0.50		
+10,	0.001	0.30		
>+10,	<0.001	4.70		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011970
CLIENT ID GS#10
DATE SAMPLED 8/25/98

	RESULT	O	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	69.0			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	3.60		
-2,	4.00	< 0.1		
-1,	2.00	1.40		
0,	1.00	2.80		
+1,	0.50	12.6		
+2,	0.25	23.3		
+3,	0.125	12.7		
+4,	0.063	9.10		
+5,	0.032	19.8		
+6,	0.016	2.90		
+7,	0.008	2.80		
+8,	0.004	3.40		
+9,	0.002	1.00		
+10,	0.001	0.30		
>+10,	<0.001	4.20		

VEGETATION PLOT FIELD SURVEY DATA

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 5 Observers: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh, planted, not enclosed

Starting Point: North

Plot #	Distance (m)		Species	% Cover	Remarks
1	0.87	W 1.62	<i>Vaucheria</i> sp.	90	
2	3.00	W 1.81	<i>Vaucheria</i> sp.	75	
3	6.24	W 0.05	<i>Vaucheria</i> sp.	100	
4	9.53	W 0.43 3	<i>Vaucheria</i> sp.	100	
5	14.0 9	W 2.56	<i>Vaucheria</i> sp.	50	
6	16.4 2	E 2.02	<i>Vaucheria</i> sp. <i>Eleocharis parvula</i> Diatoms	5 15 100	
7	19.0 9	W 1.09	<i>Vaucheria</i> sp.	100	
8	24.0 2	E 1.5	<i>Vaucheria</i> sp. Diatoms	20 85	
9	25.1	E 3.68	Bare	0	
10	30.9 0	E 2.85	<i>Vaucheria</i> sp.	75	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 12 Observer: L. Tear, D. Lester

Macrophyte Bed: Mud, unplanted, undressed, south end Starting Point: West @ GS-4

Plot #	Distance (m)			Species	% Cover	Remarks
1	1.1	S	0.61	<i>Vaucheria</i> sp. <i>Rhizochlonium</i> sp.	40 65	
2	5.07	N	2.61	Diatoms	50	Thin coverage Mud
3	8.93	N	1.10	<i>Vaucheria</i> sp.	3	Mud
4	13.2 2	S	2.48	<i>Rhizochlonium</i> sp.	4	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/98 Transect: 13 Observer: L. Tear, D. Lester

Macrophyte Bed: Mud, unplanted, dressed

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	5.69	E	2.94	<i>Rhizochlonium</i> sp. <i>Vaucheria</i> sp.	100 1	
2	16.1 5	E	2.95	<i>Eleocharis parvula</i> Diatoms	75 100	
3	24.2 9	E	1.63	<i>Eleocharis parvula</i> Diatoms	45 100	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 11 **Observer:** L. Tear, D. Lester

Macrophyte Bed: Mud, unplanted, undressed

Starting Point: South

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.16	E	3.78	<i>Vaucheria</i> sp.	100	Thick
2	1.94	W	1.55	<i>Vaucheria</i> sp.	100	
3	7.09	E	4.78	<i>Vaucheria</i> sp.	75	
4	10.7 5	W	0.89	<i>Rhizochlonium</i> sp.	100	
5	16.4 6	E	3.78	<i>Vaucheria</i> sp. <i>Rhizochlonium</i> sp.	20 80	
6	22.2 7	W	0.21	<i>Vaucheria</i> sp.	100	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 9 **Observer:** L. Tear, D. Lester

Macrophyte Bed: Low salt marsh control, unplanted, unenclosed

Starting Point: South

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.4	E	4.3	Bare	0	
2	3.9	E	2.7	Bare	0	
3	10.6	W	0.19	<i>Vaucheria</i> sp.	20	Thin coverage
4	16.7	E	3.2	<i>Vaucheria</i> sp.	10	Thin coverage
5	23.2	W	4.2	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 4 **Observer:** L. Tear, D. Lester

Macrophyte Bed: High salt marsh, unplanted, with enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	3.1	W	1.7	Bare	0	Sandy
2	10.4	W	2.4	Bare	0	Sandy
3	20.2	W	0.0	Bare	0	Sandy
4	30.6	W	2.2	Bare	0	Sandy
5	34.6	W	0.3	Bare	0	Sandy

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 8 Observer: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh control, unplanted, mud base Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.2	E	3.5	<i>Vaucheria</i> sp. <i>Eleocharis parvula</i>	25 Trace	
2	7.3	W	8.6	Bare	0	
3	14.2	E	3.7	<i>Vaucheria</i> sp.	50	
4	17.3	E	0.7	<i>Vaucheria</i> sp.	50	
5	23.5	E	1.4	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 6 Observer: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh, planted, enclosure

Starting Point: South

Plot #	Distance (m)			Species	% Cover	Remarks
1	1.8	E	2.2	<i>Vaucheria</i> sp.	Trace	
2	4.4	E	0.1	Bare	0	
3	11.1	W	2.0	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 **Transect:** 1 **Observer:** L. Tear, D. Lester

Macrophyte Bed: High salt marsh, planted, enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.8	E	1.0	Bare	0	
2	2.9	W	3.9	<i>Atriplex patula</i>	7	Spindly plant, not robust
3	8.1	E	0.0	Bare	0	Silty/sand-substrate throughout transect
4	11.3	E	4.7	Bare	0	
5	16.3	E	2.2	Bare	0	
6	22.4	W	4.8	Bare	0	@ 27.4 m, 29.6 m 2 small patches of <i>Atriplex patula</i>
7	29.1	W	3.0	Bare	0	
8	33.6	E	4.5	Bare	0	
9	41.6	W	3.0	<i>Distichlis spicata</i>	2	Strips of sod remaining perpendicular to transect
10	46.7	E	1.4	Bare	0	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 7 Observer: L. Tear, D. Lester

Macrophyte Bed: Low salt marsh, planted, enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	0.7	W	0.2	Bare	0	Sand
2	4.7	W	0.9	Bare	0	Sand
3	17.4	W	0.6	Bare	0	Sand
4	21.7	W	0.25	<i>Distichlis spicata</i>	Trace	Sand
5	25.8	W	0.7	<i>Atriplex patula</i> <i>Distichlis spicata</i>	25 Trace	Sand
6	31.9	W	0.15	<i>Distichlis spicata</i> (dead)	Trace	Sand
7	42.8	W	0.55	<i>Distichlis spicata</i>	12	Sand

Notes: Random patches of *Atriplex patula* along transect from 20 m to end of transect, sods of dying *Distichlis spicata* here and there.

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 2 Observer: L. Tear, D. Lester

Macrophyte Bed: High salt marsh, planted, enclosure

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	10.5	W	1.2	<i>Atriplex patula</i> <i>Deschampsia caespitosa</i>	25 Trace	
2	19.7	W	0.5	<i>Deschampsia caespitosa</i>	Trace	
3	23.5	W	0.4	<i>Deschampsia caespitosa</i>	3	
4	33.8	W	0.3	Bare	0	
5	49.0	W	1.3	<i>Distichlis spicata</i> <i>Atriplex patula</i>	5 Trace	
6	64.9	W	1.5	<i>Distichlis spicata</i>	Trace	
7	79.7	W	1.9	<i>Deschampsia caespitosa</i>	15	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 3 Observer: L. Tear, D. Lester

Macrophyte Bed: High salt marsh, not planted, not enclosed

Starting Point: North

Plot #	Distance (m)			Species	% Cover	Remarks
1	1.0	W	5.7	Bare	0	Sand
2	2.7	W	2.5	Bare	0	Sand
3	4.5	E	7.3	Bare	0	Sand
4	11.8	E	1.3	Bare	0	Sand
5	15.6	W	0.4	Bare	0	Sand
6	21.8	W	1.8	Bare	0	Sand
7	23.7	E	5.5	Bare	0	Sand

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 10 Observer: L. Tear, D. Lester

Macrophyte Bed: High salt marsh, planted, enclosed

Starting Point: West

Plot #	Distance (m)			Species	% Cover	Remarks
1	11.5	N	0.6	<i>Deschampsia caespitosa</i>	55	
				<i>Distichlis spicata</i>	15	
				<i>Fragaria chiloensis</i>	4	
2	19.0	N	0.5	<i>Deschampsia caespitosa</i>	45	
				<i>Fragaria chiloensis</i>	1	
				<i>Atriplex patula</i>	Trace	
				Scotch Broom	Trace	
3	28.5	N	0.5	<i>Deschampsia caespitosa</i>	65	
				Grass A (lawn grass)	50	
				<i>Agrostis</i> sp.	10	
				<i>Bromus</i> sp.	10	
				<i>Atriplex</i>	1	

**HERBACEOUS VEGETATION COVER DATA
MIDDLE WATERWAY SHORE RESTORATION
WETLAND MITIGATION MONITORING**

Date: 9/09/1998 Transect: 14 Observer: L. Tear, D. Lester

Macrophyte Bed: High to low salt marsh, topdressed Starting Point: East

Plot #	Distance (m)			Species	% Cover	Remarks
1	9.4	N	0.8	Bare	0	Sand & Silt
2	12.7	N	0.6	Bare	0	Silty
3	16.7	S	1.4	Bare	0	Silty
4	19.9	S	0.6	<i>Rhizochlonium</i> sp.	10	
5	22.0	N	2.2	<i>Vaucheria</i> sp.	90	Thin coverage
6	23.7	N	0.3	<i>Vaucheria</i> sp.	80	Thin coverage
7	27.8	S	1.7	<i>Vaucheria</i> sp. <i>Rhizochlonium</i> sp. <i>Enteromorpha</i>	95 1 Trace	Thin coverage

ANALYTICAL LABORATORY DATA REPORT



AmTest Inc.
14603 N.E. 87th St.
Redmond, WA
98002
Tel: 425 885 1664
Fax: 425 883 3495

September 18, 1998

Parametrix
5808 Lake Washington Blvd.
Kirkland, WA 98033
Attn. Deb Lester

Dear Deb,

On the 26th of August 1998, Am Test received a total of sixteen (16) sediment samples from the Middle Waterway Restoration project (project #55-1616-09(02)). Six (6) of the samples were analyzed for the following PSDDA parameters:

LPAH and HPAH	EPA 3550/8270
Mercury	EPA 7471
Total Solids	PSEP p17
Total Volatile Solids	PSEP p20
Total Organic Carbon	SM 5310B
Acid Volatile Sulfides	DiToro, 1990
Grain Size	PSEP p9

The remaining ten samples were analyzed for Grain Size only.

At the time of receipt, the samples were logged-in, stored, and handled in accordance with the protocols of the USEPA. There were a total of four containers submitted for each of the samples.

In order to achieve the lowest possible detection limits for the PAHs, two separate 35 gram subsamples were extracted, combined and analyzed (1 ml final extract volume). All of the samples were subjected to GPC clean up, prior to the analysis by GC/MS.

There were no major problems with any of the analyses.

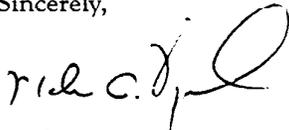
Following the analytical data, you will find the Quality Control (QC) Summary. Information in this section includes dates of analyses, sample weights, and the results for the quality control samples (i.e. Matrix Spikes, Standard Reference Materials, Triplicates).

AMTEST

All of the QC results for the Quality Control Samples were within the limits of the laboratory as well as those of the analytical methods. The appropriate raw data has been included in the data package.

Please feel free to contact me if you have any questions pertaining to the data package.

Sincerely,



Mark A. Fugiel
General Manager
Am Test Inc.

98-A11963-11978

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011963
CLIENT ID MW-A
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	57.7			
Total Volatile Solids (%)	6.7			
Total Organic Carbon (%)	5.0			
Acid Volatile Sulfides(mg/kg)	210			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	2.40
-2,	4.00	0.30
-1,	2.00	0.70
0,	1.00	2.40
+1,	0.50	15.8
+2,	0.25	19.1
+3,	0.125	13.9
+4,	0.063	3.50
+5,	0.032	7.70
+6,	0.016	13.6
+7,	0.008	6.50
+8,	0.004	4.80
+9,	0.002	1.80
+10,	0.001	0.90
>+10,	<0.001	6.60

METALS (MG/KG DRY WEIGHT)

Mercury	0.260	0.41	2.3
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AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011963
CLIENT ID MW-A
DATE SAMPLED 8/25/98

	RESULT	O	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	< 23		560	1,300
Acenaphthene	< 23		500	2,000
Anthracene	70		960	13,000
Fluorene	< 23		540	3,600
Naphthalene	< 23		2,100	2,400
Phenanthrene	240		1,500	21,000
2-Methylnaphthalene	< 23		670	1,900
HPAH				
Benzo(a)anthracene	460		1,300	5,100
Benzo(a)pyrene	460		1,600	3,600
Benzo(b)fluoranthene	600		3,200	9,900
Benzo(k)fluoranthene	470			
Benzo(ghi)perylene	260		670	3,200
Chrysene	730		1,400	21,000
Dibenzo(a,h)anthracene	75		230	1,900
Fluoranthene	650		1,700	30,000
Indeno(1,2,3-cd)pyrene	340		600	4,400
Pyrene	670		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	46.			
D-6-Phenol	61.			
D-5-Nitrobenzene	50.			
2-Fluorobiphenyl	56.			
2,4,6-Tribromophenol	87.			
D14-Terphenyl	86.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011964
CLIENT ID MW-C
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	75.7			
Total Volatile Solids (%)	2.8			
Total Organic Carbon (%)	0.60			
Acid Volatile Sulfides (mg/kg)	210			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	1.20
-2,	4.00	0.30
-1,	2.00	0.30
0,	1.00	1.60
+1,	0.50	26.4
+2,	0.25	37.1
+3,	0.125	17.2
+4,	0.063	6.30
+5,	0.032	0.90
+6,	0.016	1.30
+7,	0.008	1.60
+8,	0.004	1.60
+9,	0.002	0.20
+10,	0.001	< 0.1
>+10,	<0.001	4.00

METALS (MG/KG DRY WEIGHT)

Mercury	0.076	0.41	2.3
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AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011968
CLIENT ID MW-F
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	22		560	1,300
Acenaphthene	< 21		500	2,000
Anthracene	58		960	13,000
Fluorene	< 21		540	3,600
Naphthalene	21		2,100	2,400
Phenanthrene	250		1,500	21,000
2-Methylnaphthalene	< 21		670	1,900
HPAH				
Benzo(a)anthracene	320		1,300	5,100
Benzo(a)pyrene	370		1,600	3,600
Benzo(b)fluoranthene	380		3,200	9,900
Benzo(k)fluoranthene	240			
Benzo(ghi)perylene	220		670	3,200
Chrysene	430		1,400	21,000
Dibenzo(a,h)anthracene	77		230	1,900
Fluoranthene	480		1,700	30,000
Indeno(1,2,3-cd)pyrene	280		600	4,400
Pyrene	540		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	46.			
D-6-Phenol	61.			
D-5-Nitrobenzene	63.			
2-Fluorobiphenyl	75.			
2,4,6-Tribromophenol	88.			
D14-Terphenyl	94.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011968
CLIENT ID MW-F
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	70.0
Total Volatile Solids (%)	6.2
Total Organic Carbon (%)	3.3
Acid Volatile Sulfides(mg/kg)	< 12

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	1.30
-2,	4.00	0.30
-1,	2.00	1.60
0,	1.00	2.90
+1,	0.50	15.7
+2,	0.25	24.6
+3,	0.125	11.7
+4,	0.063	19.9
+5,	0.032	9.70
+6,	0.016	1.50
+7,	0.008	2.90
+8,	0.004	2.10
+9,	0.002	0.20
+10,	0.001	< 0.1
>+10,	<0.001	5.70

METALS (MG/KG DRY WEIGHT)

Mercury	0.160	0.41	2.3
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AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011967
CLIENT ID MW 1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	67.4			
Total Volatile Solids (%)	3.3			
Total Organic Carbon (%)	2.2			
Acid Volatile Sulfides(mg/kg)	81.			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	2.20
-2,	4.00	0.90
-1,	2.00	1.90
0,	1.00	4.20
+1,	0.50	21.1
+2,	0.25	24.9
+3,	0.125	20.6
+4,	0.063	11.6
+5,	0.032	0.90
+6,	0.016	2.80
+7,	0.008	0.90
+8,	0.004	3.10
+9,	0.002	0.50
+10,	0.001	< 0.1
>+10,	<0.001	4.50

METALS (MG/KG DRY WEIGHT)

Mercury	0.417 *	0.41	2.3
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AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011966
CLIENT ID MW-1 Duplicate
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	< 20		560	1,300
Acenaphthene	< 20		500	2,000
Anthracene	< 20		960	13,000
Fluorene	< 20		540	3,600
Naphthalene	< 20		2,100	2,400
Phenanthrene	55		1,500	21,000
2-Methylnaphthalene	< 20		670	1,900
HPAH				
Benzo(a)anthracene	75		1,300	5,100
Benzo(a)pyrene	95		1,600	3,600
Benzo(b)fluoranthene	98		3,200	9,900
Benzo(k)fluoranthene	69			
Benzo(ghi)perylene	58		670	3,200
Chrysene	120		1,400	21,000
Dibenzo(a,h)anthracene	< 20		230	1,900
Fluoranthene	130		1,700	30,000
Indeno(1,2,3-cd)pyrene	71		600	4,400
Pyrene	140		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	57.			
D-6-Phenol	73.			
D-5-Nitrobenzene	70.			
2-Fluorobiphenyl	73.			
2,4,6-Tribromophenol	93.			
D14-Terphenyl	100			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011966
CLIENT ID MW-1 Duplicate
DATE SAMPLED 8/25/98

	RESULT	O	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	72.0			
Total Volatile Solids (%)	2.7			
Total Organic Carbon (%)	3.5			
Acid Volatile Sulfides(mg/kg)	290			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	2.20		
-2,	4.00	0.60		
-1,	2.00	1.70		
0,	1.00	3.60		
+1,	0.50	15.8		
+2,	0.25	29.0		
+3,	0.125	18.9		
+4,	0.063	10.1		
+5,	0.032	7.60		
+6,	0.016	0.50		
+7,	0.008	2.40		
+8,	0.004	2.30		
+9,	0.002	0.30		
+10,	0.001	< 0.1		
>+10,	<0.001	4.90		
METALS (MG/KG DRY WEIGHT)				
	Mercury	0.207	0.41	2.3

AMTEST

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011965
CLIENT ID MC-1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
ORGANICS (UG/KG DRY WEIGHT)				
LPAH				
Acenaphthylene	44		560	1,300
Acenaphthene	45		500	2,000
Anthracene	240		960	13,000
Fluorene	52		540	3,600
Naphthalene	36		2,100	2,400
Phenanthrene	540		1,500	21,000
2-Methylnaphthalene	< 33		670	1,900
HPAH				
Benzo(a)anthracene	620		1,300	5,100
Benzo(a)pyrene	630		1,600	3,600
Benzo(b)fluoranthene	640		3,200	9,900
Benzo(k)fluoranthene	450			
Benzo(ghi)perylene	390		670	3,200
Chrysene	960		1,400	21,000
Dibenzo(a,h)anthracene	130		230	1,900
Fluoranthene	1000		1,700	30,000
Indeno(1,2,3-cd)pyrene	440		600	4,400
Pyrene	1000		2,600	16,000
SURROGATES (% RECOVERY)				
2-Fluorophenol	43.			
D-6-Phenol	62.			
D-5-Nitrobenzene	56.			
2-Fluorobiphenyl	67.			
2,4,6-Tribromophenol	99.			
D14-Terphenyl	99.			

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/17/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011965
CLIENT ID MC-1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.I.
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CONVENTIONALS (DRY WEIGHT)

Total Solids (%)	43.5			
Total Volatile Solids (%)	14.			
Total Organic Carbon (%)	5.4			
Acid Volatile Sulfides(mg/kg)	290			

GRAIN SIZE DISTRIBUTION

PHI	OPENING (MM)	% RETENTION
	4.75	2.80
-2,	4.00	0.50
-1,	2.00	1.40
0,	1.00	2.10
+1,	0.50	3.90
+2,	0.25	6.70
+3,	0.125	6.70
+4,	0.063	6.90
+5,	0.032	29.9
+6,	0.016	12.0
+7,	0.008	7.90
+8,	0.004	6.80
+9,	0.002	1.20
+10,	0.001	< 0.1
>+10,	<0.001	11.5

METALS (MG/KG DRY WEIGHT)

Mercury	0.359	0.41	2.3
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AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011971
CLIENT ID GS#12
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	68.6			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	0.90		
-2,	4.00	0.10		
-1,	2.00	0.60		
0,	1.00	1.60		
+1,	0.50	8.60		
+2,	0.25	23.3		
+3,	0.125	31.1		
+4,	0.063	15.6		
+5,	0.032	2.90		
+6,	0.016	4.80		
+7,	0.008	2.60		
+8,	0.004	2.40		
+9,	0.002	0.80		
+10,	0.001	0.40		
>+10,	<0.001	4.20		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011972
CLIENT ID GS#13
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	89.0			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	< 0.1		
-2,	4.00	0.10		
-1,	2.00	0.40		
0,	1.00	1.70		
+1,	0.50	13.9		
+2,	0.25	34.9		
+3,	0.125	27.4		
+4,	0.063	10.3		
+5,	0.032	4.30		
+6,	0.016	1.50		
+7,	0.008	0.80		
+8,	0.004	1.00		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	3.40		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011973
CLIENT ID GS#14
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	67.2			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	0.60		
-2,	4.00	0.10		
-1,	2.00	0.60		
0,	1.00	2.70		
+1,	0.50	25.3		
+2,	0.25	28.0		
+3,	0.125	14.9		
+4,	0.063	5.50		
+5,	0.032	10.6		
+6,	0.016	3.70		
+7,	0.008	1.60		
+8,	0.004	1.80		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	4.50		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011974
CLIENT ID GS#2
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	82.7			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	< 0.1		
-2,	4.00	0.10		
-1,	2.00	0.20		
0,	1.00	1.30		
+1,	0.50	13.3		
+2,	0.25	40.4		
+3,	0.125	24.9		
+4,	0.063	9.10		
+5,	0.032	3.90		
+6,	0.016	1.70		
+7,	0.008	0.20		
+8,	0.004	1.00		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	3.60		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011975
CLIENT ID GS#1
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	100.			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.70		
-2,	4.00	< 0.1		
-1,	2.00	2.20		
0,	1.00	4.30		
+1,	0.50	26.2		
+2,	0.25	42.8		
+3,	0.125	12.8		
+4,	0.063	4.40		
+5,	0.032	1.70		
+6,	0.016	1.90		
+7,	0.008	0.10		
+8,	0.004	0.40		
+9,	0.002	0.10		
+10,	0.001	< 0.1		
>+10,	<0.001	1.50		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011976
CLIENT ID GS#5
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	81.2			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.80		
-2,	4.00	0.20		
-1,	2.00	1.20		
0,	1.00	3.20		
+1,	0.50	25.1		
+2,	0.25	30.3		
+3,	0.125	16.6		
+4,	0.063	8.40		
+5,	0.032	5.30		
+6,	0.016	2.30		
+7,	0.008	0.50		
+8,	0.004	1.10		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	3.70		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011977
CLIENT ID GS#6
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	88.8			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.00		
-2,	4.00	0.10		
-1,	2.00	1.50		
0,	1.00	4.40		
+1,	0.50	26.5		
+2,	0.25	34.2		
+3,	0.125	14.2		
+4,	0.063	5.00		
+5,	0.032	5.30		
+6,	0.016	< 0.1		
+7,	0.008	< 0.1		
+8,	0.004	0.90		
+9,	0.002	0.20		
+10,	0.001	< 0.1		
>+10,	<0.001	6.80		

AMTEST

Parametrix
5808 Lake Washington Blvd. N.E.
Kirkland, WA 98033
Attention: Deb Lester

Date Received: 8/26/98
Date Reported: 9/18/98

Project Name: Middle Waterway
Project #: 55-1616-09(02)

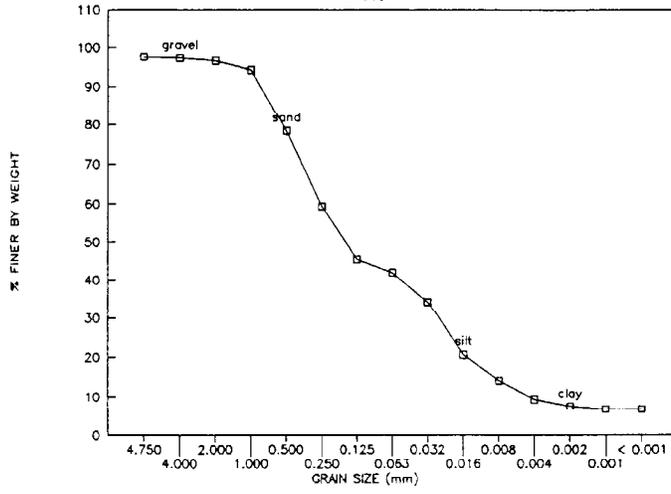
PSDDA CHEMICALS OF CONCERN

AM TEST ID 98-A011978
CLIENT ID GS#7
DATE SAMPLED 8/25/98

	RESULT	Q	S.L.	M.L.
CONVENTIONALS (DRY WEIGHT)				
Total Solids (%)	99.6			
GRAIN SIZE DISTRIBUTION				
PHI	OPENING (MM)	% RETENTION		
	4.75	1.10		
-2,	4.00	< 0.1		
-1,	2.00	2.20		
0,	1.00	7.80		
+1,	0.50	34.3		
+2,	0.25	38.4		
+3,	0.125	10.1		
+4,	0.063	2.70		
+5,	0.032	1.40		
+6,	0.016	< 0.1		
+7,	0.008	< 0.1		
+8,	0.004	0.40		
+9,	0.002	0.10		
+10,	0.001	< 0.1		
>+10,	<0.001	1.50		

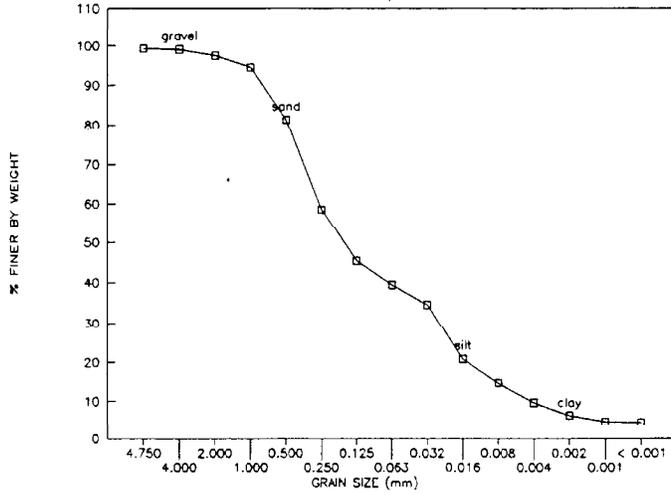
GRAIN SIZE DISTRIBUTION

11963



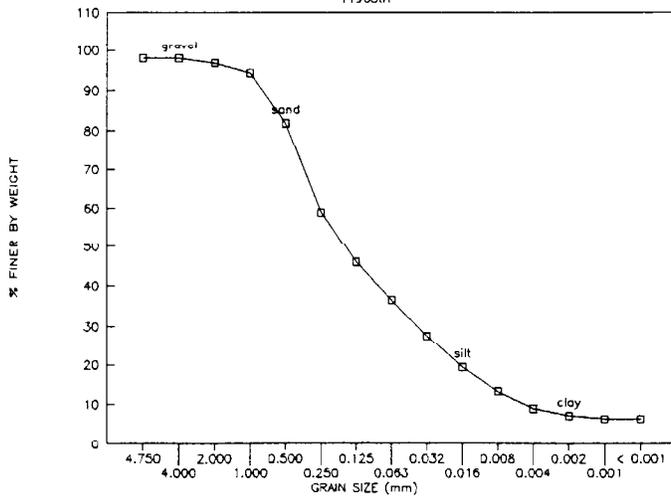
GRAIN SIZE DISTRIBUTION

11963dup

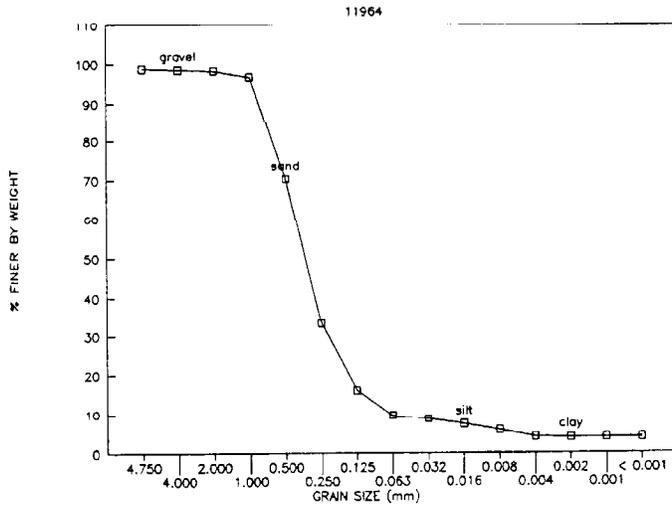


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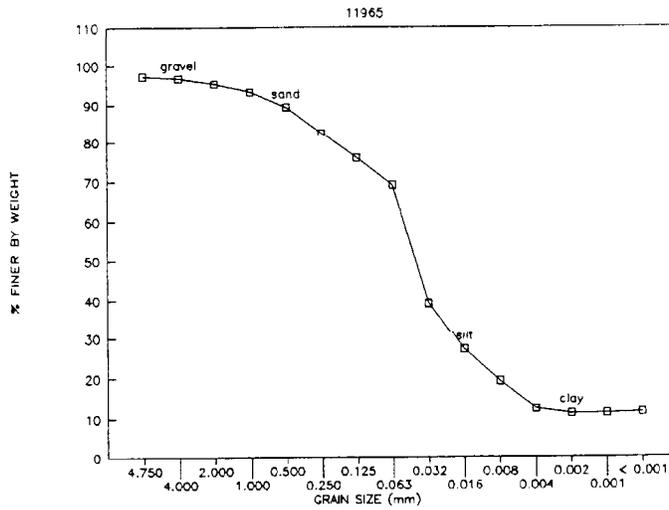
11963tri



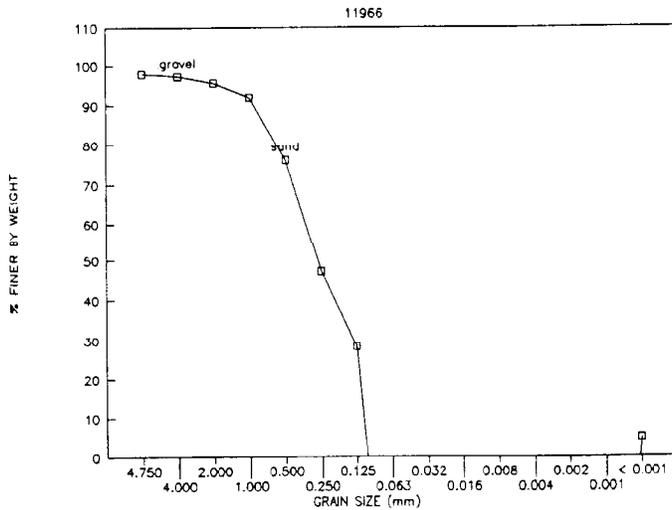
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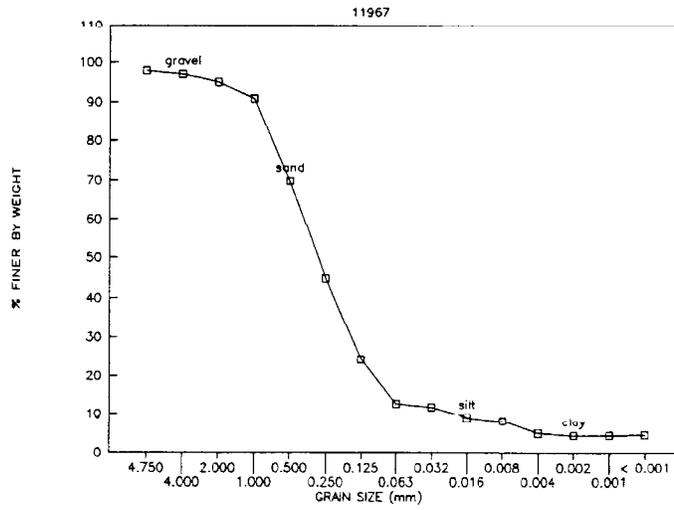
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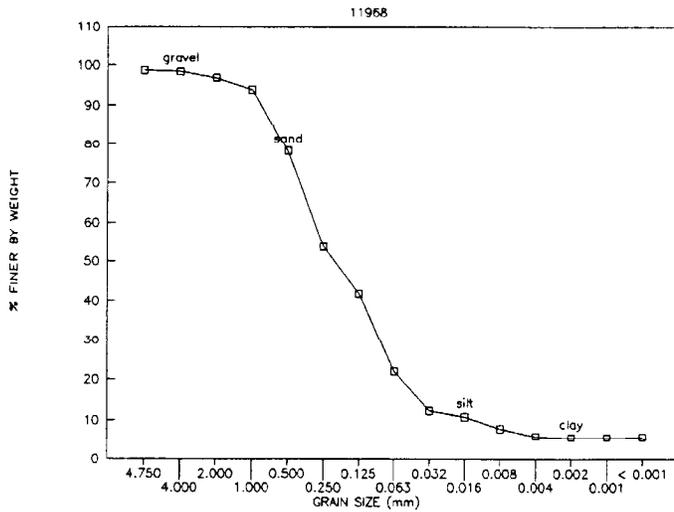
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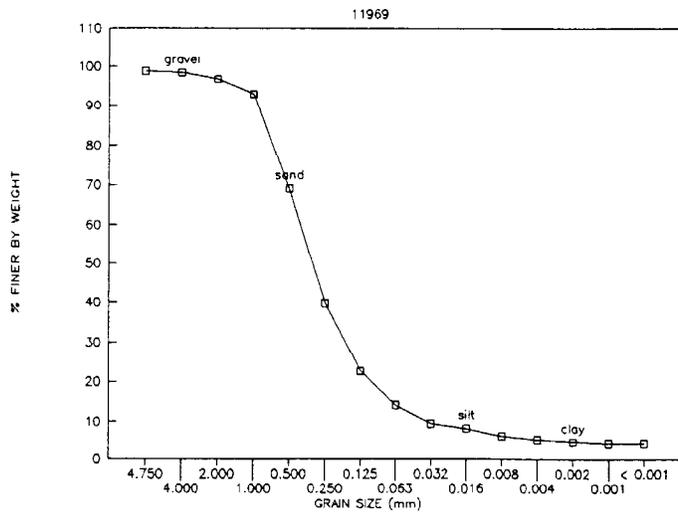
GRAIN SIZE DISTRIBUTION



GRAIN SIZE DISTRIBUTION

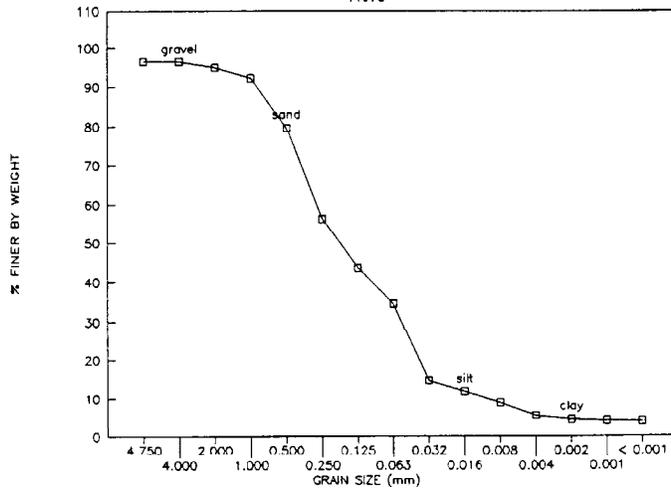


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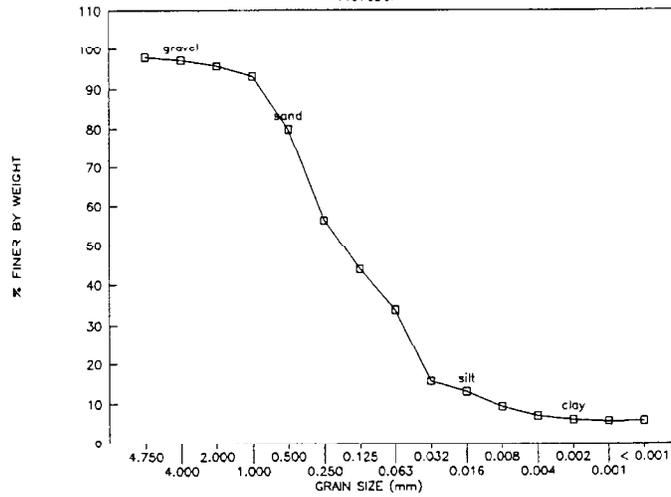
GRAIN SIZE DISTRIBUTION

11970



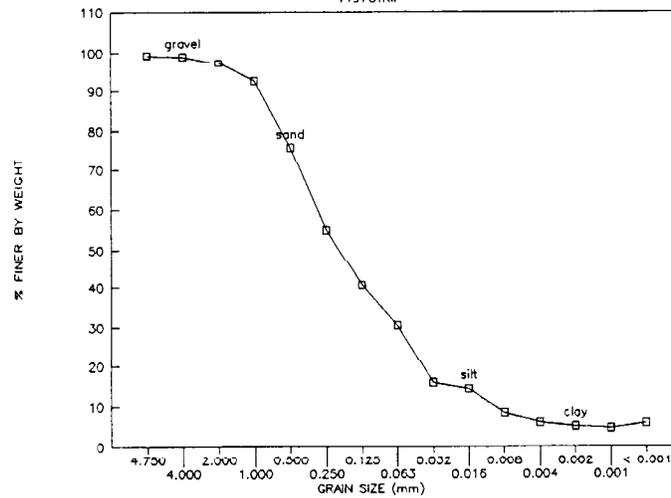
GRAIN SIZE DISTRIBUTION

11970DUP



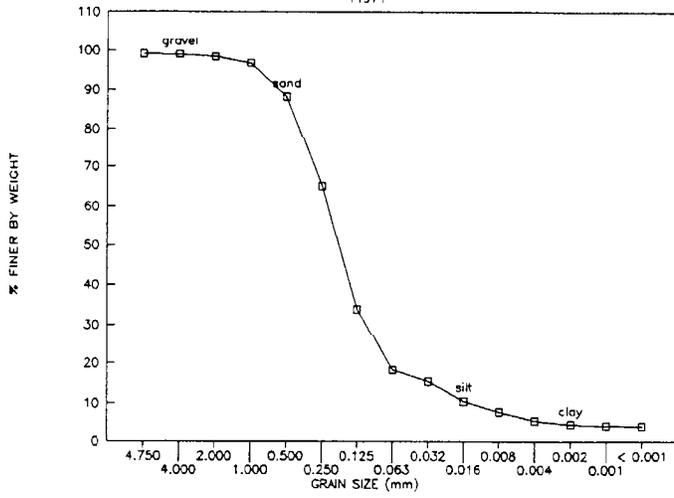
GRAIN SIZE DISTRIBUTION

11970TRIP



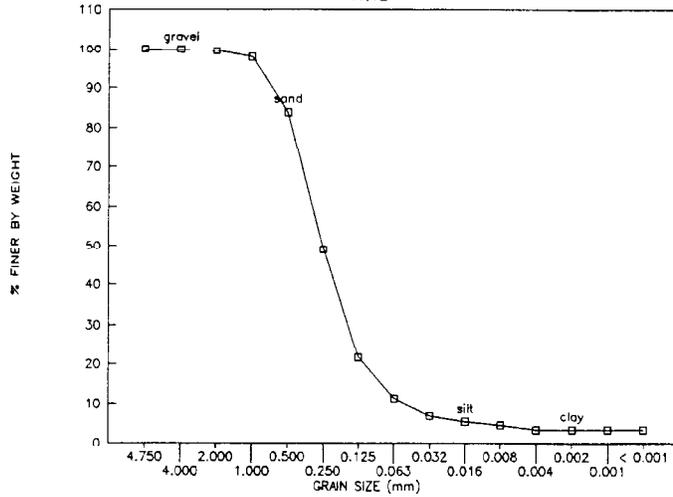
GRAIN SIZE DISTRIBUTION

11971



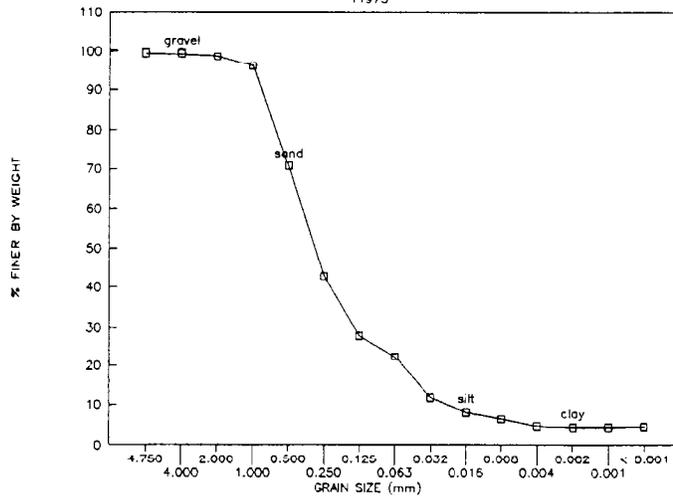
GRAIN SIZE DISTRIBUTION

11972

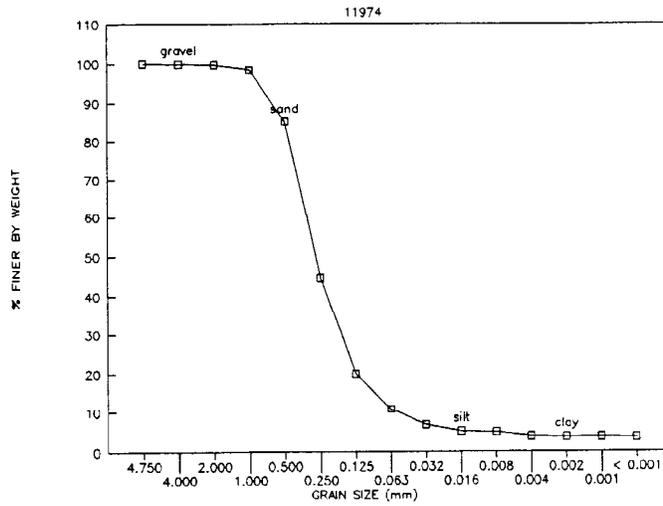


GRAIN SIZE DISTRIBUTION

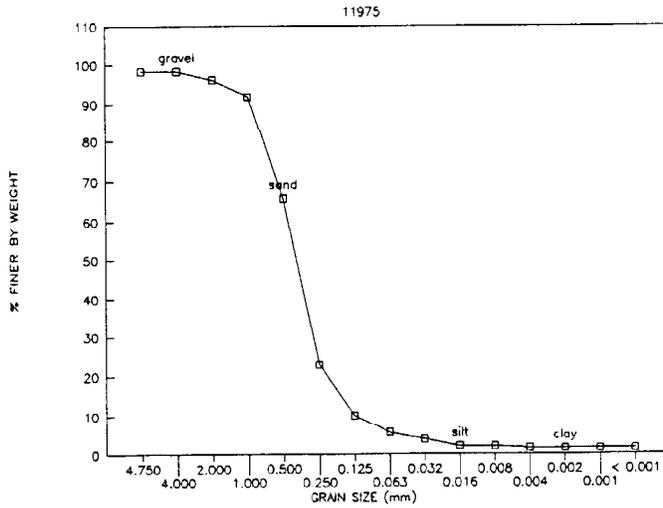
11973



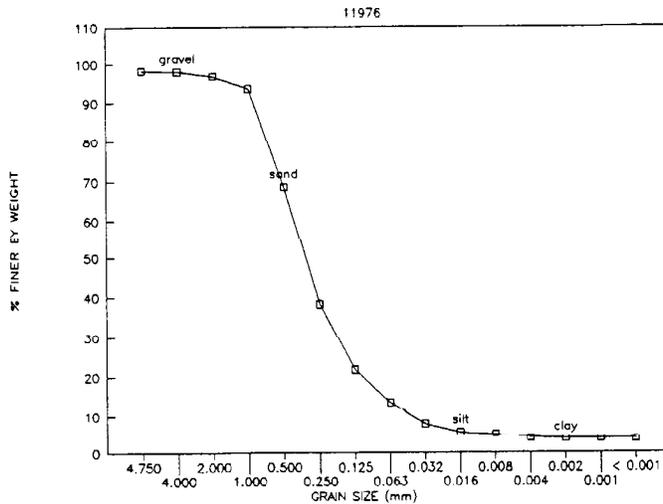
GRAIN SIZE DISTRIBUTION



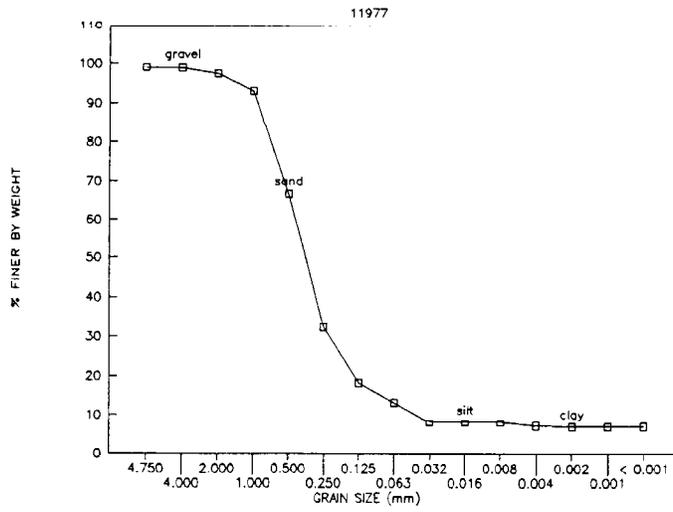
GRAIN SIZE DISTRIBUTION



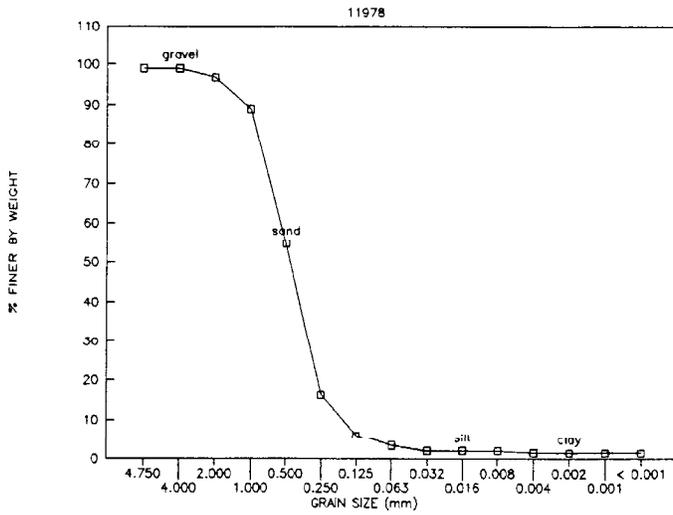
GRAIN SIZE DISTRIBUTION



GRAIN SIZE DISTRIBUTION

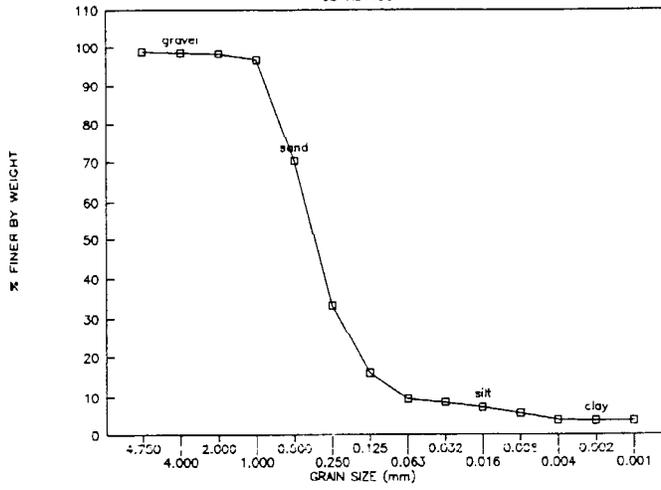


GRAIN SIZE DISTRIBUTION



GRAIN SIZE DISTRIBUTION

98-A011964

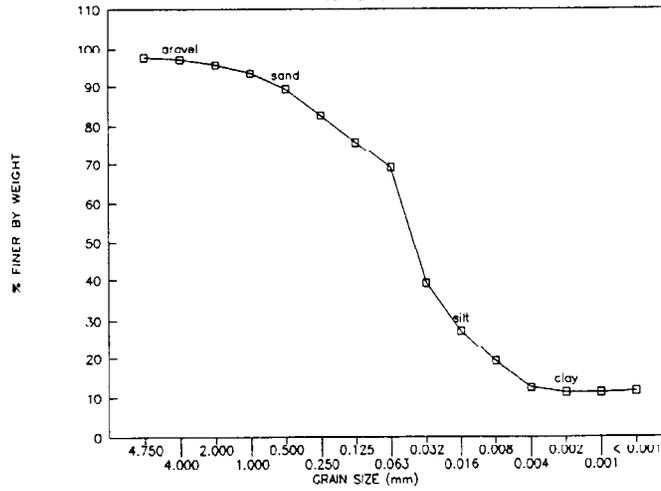


OCT 10 1998

Michael J. Nish

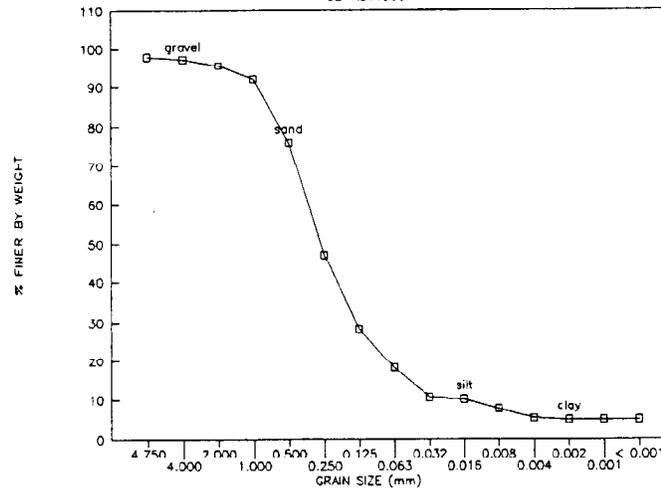
GRAIN SIZE DISTRIBUTION

98-A011955



GRAIN SIZE DISTRIBUTION

98-A011966



AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
SEMI-VOLATILES
ANALYSIS DATES*

AM TEST SAMPLE NOS.	Extraction	Analysis
98-A011963	9/8/98	9/11/98
98-A011964	9/8/98	9/11/98
98-A011965	9/8/98	9/11/98
98-A011966	9/8/98	9/11/98
98-A011967	9/8/98	9/11/98
98-A011968	9/8/98	9/11/98

SAMPLE WEIGHTS

AM TEST SAMPLE NOS.	Weight (grams)	Volume (ml)
98-A011963	70.10	1.0
98-A011964	69.90	1.0
98-A011965	70.40	1.0
98-A011966	69.81	1.0
98-A011967	69.10	1.0
98-A011968	70.50	1.0
98-A011963 MS	70.80	1.0
98-A011963 MSD	71.10	1.0
HS-3	1.00	1.0

*Includes all associated Quality Control Samples (MS/MSD, SRM, Blanks, etc.).

MS = Matrix Spike

MSD = Matrix Spike Duplicate

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
POLYNUCLEAR AROMATIC HYDROCARBONS
BLANKS

AM TEST Sample Number

BLANK
(ug/kg)

ORGANICS (ug/kg)

LPAH

Naphthalene	< 14
Acenaphthalene	< 14
Acenaphthene	< 14
Fluorene	< 14
Phenanthrene	< 14
Anthracene	< 14
2-Methylnaphthalene	< 14

HPAH

Fluoranthene	< 14
Pyrene	< 14
Benzo(a)anthracene	< 14
Chrysene	< 14
Benzo(b)fluoranthene	< 14
Benzo(k)fluoranthene	< 14
Benzo(a)pyrene	< 14
Indeno(1,2,3-cd)pyrene	< 14
Dibenzo(a,h)anthracene	< 14
Benzo(ghi)perylene	< 14

SURROGATES RECOVERIES (%)

2-Fluorophenol	50
D6-Phenol	57
D5-Nitrobenzene	59
2-Fluorobiphenyl	59
2,4,6-Tribromophenol	57
D14-Terphenyl	80

< = less than

Results are reported on a dry weight basis.

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL POLYNUCLEAR AROMATIC HYDROCARBONS MATRIX SPIKE

AM TEST Sample Number
Client ID

98-A011963
MW-A

COMPOUNDS	SAMPLE VALUE (ug/kg)	SAMPLE + SPIKE (ug/kg)	SPIKE CONCENTRATION (ug/kg)	RECOVERY (%)
LPAH				
Naphthalene	< 23	610	1200	53
Acenaphthalene	< 23	710	1200	62
Acenaphthene	< 23	750	1200	65
Fluorene	< 23	800	1200	70
Phenanthrene	240	1000	1200	66
Anthracene	70	820	1200	65
2-Methylnaphthalene	< 23	710	1200	62
HPAH				
Fluoranthene	650	1500	1200	74
Pyrene	670	1300	1200	55
Benzo (a) anthracene	460	1300	1200	73
Chrysene	730	1500	1200	67
Benzo (b) fluoranthene	600	1600	1200	87
Benzo (k) fluoranthene	470	1300	1200	72
Benzo (a) pyrene	460	1300	1200	73
Indeno (1, 2, 3-cd) pyrene	340	1100	1200	66
Dibenzo (a, h) anthracene	75	820	1200	65
Benzo (ghi) perylene	260	1000	1200	64

SURROGATES RECOVERIES (%)

2-Fluorophenol	44
D6-Phenol	57
D5-Nitrobenzene	55
2-Fluorobiphenyl	57
2,4,6-Tribromophenol	84
D14-Terphenyl	75

< = less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL POLYNUCLEAR AROMATIC HYDROCARBONS MATRIX SPIKE

AM TEST Sample Number
Client ID

98-A011963
MW-A

COMPOUNDS	SAMPLE VALUE (ug/kg)	SAMPLE + SPIKE DUPLICATE (ug/kg)	SPIKE CONCENTRATION (ug/kg)	RECOVERY (%)
I.PAH				
Naphthalene	< 23	630	1200	55
Acenaphthalene	< 23	720	1200	63
Acenaphthene	< 23	770	1200	67
Fluorene	< 23	800	1200	70
Phenanthrene	240	1000	1200	66
Anthracene	70	860	1200	69
2-Methylnaphthalene	< 23	710	1200	62
HPAH				
Fluoranthene	650	1800	1200	100
Pyrene	670	1500	1200	72
Benzo (a) anthracene	460	1200	1200	64
Chrysene	730	1600	1200	76
Benzo (b) fluoranthene	600	1500	1200	78
Benzo (k) fluoranthene	470	1200	1200	63
Benzo (a) pyrene	460	1300	1200	73
Indeno (1, 2, 3-cd) pyrene	340	1100	1200	66
Dibenzo (a, h) anthracene	75	870	1200	69
Benzo (ghi) perylene	260	1000	1200	64
SURROGATES RECOVERIES (%)				
2-Fluorophenol		37		
D6-Phenol		49		
D5-Nitrobenzene		45		
2-Fluorobiphenyl		50		
2, 4, 6-Tribromophenol		70		
D14-Terphenyl		64		

< = less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
POLYNUCLEAR AROMATIC HYDROCARBONS
MATRIX SPIKE DUPLICATES

AM TEST Sample Number
Client ID

98-A011963
MW-A

COMPOUNDS	SAMPLE VALUE (ug/kg)	DUPLICATE VALUE (ug/kg)	RELATIVE PERCENT DIFFERENCE (%)
LPAH			
Naphthalene	610	630	3.2
Acenaphthalene	710	720	1.4
Acenaphthene	750	770	2.6
Fluorene	800	800	0
Phenanthrene	1000	1000	0
Anthracene	820	860	4.8
2-Methylnaphthalene	710	710	0
HPAH			
Fluoranthene	1500	1800	18
Pyrene	1300	1500	14
Benzo(a)anthracene	1300	1200	8.0
Chrysene	1500	1600	6.5
Benzo(b)fluoranthene	1600	1500	6.5
Benzo(k)fluoranthene	1300	1200	8.0
Benzo(a)pyrene	1300	1300	0
Indeno(1,2,3-cd)pyrene	1100	1100	0
Dibenzo(a,h)anthracene	820	870	5.9
Benzo(ghi)perylene	1000	1000	0

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
GC/MS SEMI-VOLATILES
STANDARD REFERENCE MATERIAL
HS-3

Sample Date: 9/03/98
Date Analyzed: 9/15/98

COMPOUNDS	MEASURED VALUE (ug/kg)	TRUE VALUE (ug/kg)	RECOVERY (%)	LABORATORY CONTROL LIMITS (ug/kg)
Naphthalene	2,100	9,000	23	280 - 4,440
Acenaphthylene	150	300	50	28 - 310
Acenaphthene	1,600	4,500	36	428 - 3,300
Fluorene	3,900	13,300	29	1,040 - 8,050
Phenanthrene	47,000	85,000	55	7,300 - 70,800
Anthracene	2,600	13,400	19	520 - 4,500
Fluoranthene	42,000	60,000	70	6,100 - 59,700
Pyrene	22,000	39,000	56	4,500 - 35,800
Benzo (a) Anthracene	7,600	14,600	52	1,490 - 12,100
Chrysene	8,900	14,100	63	1,700 - 13,400
Benzo (a) Pyrene	3,600	7,400	49	1,600 - 5,600
Benzo (b) Fluoranthene	5,200	7,700	68	2,800 - 10,300
Benzo (k) Fluoranthene	5,300	2,800	189	430 - 7,200
Benzo (ghi) perylene	2,600	5,000	52	960 - 3,900
Dibenzo (a, h) Anthracene	710	1,300	55	240 - 1,200
Indeno (1, 2, 3-cd) Pyrene	3,100	5,400	57	1,040 - 4,020
SURROGATE RECOVERIES (%)				
2-Fluorophenol	45			
D6-Phenol	55			
D5-Nitrobenzene	56			
2-Fluorobiphenyl	62			
2,4,6-Tribromophenol	76			
D14-Terphenyl	76			

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL ANALYSIS DATES

Mercury	8/29/98
Total Solids	9/2/98
Total Volatile Solids	9/2/98
Total Organic Carbon	9/1/98
Acid Volatile Sulfides	8/31/98
Grain Size	9/2/98

MERCURY SAMPLE WEIGHTS

AM TEST SAMPLE NOS.	Weight (grams)
98-A011963	2.98
98-A011964	2.79
98-A011965	3.80
98-A011966	3.87
98-A011967	3.37
98-A011968	2.50
98-A011963 Duplicate	3.05
98-A011964 Spike	3.04
SRM	0.28

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL MERCURY DUPLICATES

COMPOUNDS	98-A011963 (mg/kg)	98-A011963 (mg/kg)	RELATIVE PERCENT DIFFERENCE (%)
Mercury	0.260	0.298	14

MATRIX SPIKES

PARAMETERS	98-A011964 VALUE (mg/kg)	98-A011964+ SPIKE (mg/kg)	SPIKE CONCENTRATION (mg/kg)	RECOVERY (%)
Mercury	0.076	0.247	0.194	88

STANDARD REFERENCE MATERIAL

COMPOUNDS	MEASURED VALUE (mg/kg)	TRUE VALUE (mg/kg)	RECOVERY (%)
Mercury	2.69	3.10	87

BLANKS

RESULTS	
Mercury	< 0.02

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL
CONVENTIONALS
TRIPLICATES

	#1	#2	#3
Total Solids (%)	57.7	57.1	59.1
Total Volatile Solids (%)	6.7	6.5	8.0
Total Organic Carbon (%)	5.0	4.6	4.6
Acid Volatile Sulfides (mg/kg)	210	220	150

CONVENTIONALS
BLANKS

	RESULTS
Total Organic Carbon (%)	< 0.05
Acid Volatile Sulfides (mg/kg)	< 5.0

< less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL - CONVENTIONALS GRAIN SIZE TRIPLICATE ANALYSIS

AM TEST Sample Number
Client ID

98-A011963
MW-A

PHI	OPENING (mm)	RETENTION (%)		
		Sample	Duplicate	Triplicate
	4.75	2.4	0.7	2.0
-2	4.0	0.3	0.2	< 0.1
-1	1.7	0.7	1.6	1.2
0	1.0	2.4	3.0	2.5
+1	0.5	15.8	13.1	12.4
+2	.25	19.1	22.9	23.0
+3	.125	13.9	13.1	12.9
+4	.063	3.5	6.0	9.5
+5	.032	7.7	4.9	9.0
+6	.016	13.6	13.7	8.1
+7	.008	6.5	6.1	6.1
+8	.004	4.8	5.2	4.3
+9	.002	1.8	3.2	1.8
+10	.001	0.9	1.7	0.8
PASS	<.001	6.6	4.5	6.4

< = less than

AMTEST

Parametrix
Attn: Deb Lester

Date Received: 08/26/98
Date Reported: 09/17/98

Project Name: Middle Waterway

QUALITY CONTROL - CONVENTIONALS GRAIN SIZE TRIPLICATE ANALYSIS

AM TEST Sample Number
Client ID

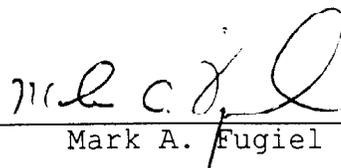
98-A011970
GS#10

PHI	OPENING (mm)	RETENTION (%)		
		Sample	Duplicate	Triplicate
	4.75	3.6	2.2	0.7
-2	4.0	0.0	0.7	0.3
-1	1.7	1.4	1.5	1.8
0	1.0	2.8	2.5	4.7
+1	0.5	12.6	13.2	16.7
+2	.25	23.3	23.7	20.9
+3	.125	12.7	12.3	14.3
+4	.063	9.1	10.1	10.2
+5	.032	19.8	18.3	14.6
+6	.016	2.9	2.6	1.5
+7	.008	2.8	3.6	4.8
+8	.004	3.4	2.4	2.5
+9	.002	1.0	0.9	0.9
+10	.001	0.3	0.4	0.4
PASS	<.001	4.2	5.7	5.8

< = less than

MAF/jb

REPORTED BY


Mark A. Fugiel

96-9182

Field Sample / Chain of Custody Record

Parametrix, Inc. · 6808 Lake Washington Blvd. · Kirkland, Washington 98033-7310 · 206-822-8880 · Fax 206-889-8808

Project Name: Middle Waterway Restoration Client: Champion Simpson
 Samplers: Deb Lester Recorder: Deb Lester

Matrix	# of Containers and Preservatives							Sample Number	Date			Analysis Required				
	Water	Tissue	Sediment	Other	Unpreserved	HCl	H2SO4		HNO3	NaOH	NaOH and Zinc		Other	Month	Day	Year
X												Aug	25	1998	2:30	Please Note: Sample containers have "Aug 24, 1998" as collection date - Samples were actually collected on Aug 25, 1998 GROUND WATER ANALYSIS ↓ GROUND WATER ANALYSIS WAT PAH / TOC / TS / TUS / HG PAH / WAT AUS PAH / TOC / TS / TUS / HG WAT AUS PAH / TOC / TS / TUS / HG WAT AUS PAH / TOC / TS / TUS / HG WAT AUS PAH / TOC / TS / TUS / HG WAT AUS
X												Aug	25	1998	3:30	
X												Aug	25	1998	2:00	
X												Aug	25	1998	1:00	
X												Aug	25	1998	12:00	
X												Aug	25	1998	12:05	
X												Aug	25	1998	2:50	
X												Aug	25	1998	2:50	
X												Aug	25	1998	3:00	
X												Aug	25	1998	3:00	
X												Aug	25	1998	12:55	
X												Aug	25	1998	1:10	
Total Containers:												12				

Chain of Custody Record (Please Print)

Relinquished By: (Name)	Date	Time	Received By: (Name)	Date	Time
<i>Deb Lester</i>	8/25/98	11:15	<i>Deb Lester</i>		

Shipping Information

Cooler#: _____
 Airbill #: _____
 _____ of _____ Coolers on this Airbill

Field Sample / Chain of Custody Record

Parametrix, Inc. • 6801 Lake Washington Blvd. • Kirkland, Washington 98033-7360 • 206-822-8880 • Fax 206-888-8808

Project Name: Middle Waterway Restoration Client: Champion / Simpson
 Samplers: Deb Lester Recorder: Deb Lester

Matrix	# of Containers and Preservatives							Sample Number	Date			Analysis Required	
	Water	Tissue	Sediment	Other	Unpreserved	HCl	H2SO4		HNO3	NaOH	NaOH and Zinc		Acetate
X									Aug	25	1998	11:00	Please Note: Sample containers have "Aug 24, 1998" as collection date - Samples were actually collected on Aug 25 1998 Grain Size Analysis
X								GS # 8				12:15	
X								GS # 10				12:30	
X								GS # 12				12:00	
X								GS # 14				11:30	
X								GS # 16				1:00	
X								GS # MW-1				1:30	
X								GS # 13				1:45	
X								GS # 14				3:00	
X								GS # 2				2:45	
X								GS # 1				2:50	
X								GS # 6				3:00	
X								GS # MET	Aug	25	1998	3:00	Grain Size Analysis
Total Containers: 12													

Chain of Custody Record (Please Print)

Relinquished By: (Name)	Date	Time	Received By: (Name)	Date	Time
<i>Deb Lester</i>	8/25/98	11:15	<i>J. Blane</i>		

Shipping Information	
Cooler#:	
Airbill #:	
of _____ Coolers on this Airbill	

ANALYTICAL DATA VALIDATION MEMORANDUM

MEMORANDUM

to: Project File October 19, 1998
from: Michael Kluck 55-1616-09 (02)
re: Middle Waterway Shore Restoration - Data Validation Summary

DATA REVIEW SUMMARY

Marine sediment samples were analyzed for polynuclear aromatic hydrocarbons (PAHs), mercury, and conventionals by AmTest Inc. in Redmond, Washington and reported as project number 55-1616-09(02). The analyses conducted and analytical methods used are shown in Table 1.

Table 1. Analyses conducted and methods utilized.

<u>Analysis Conducted</u>	<u>Analytical Method</u>
PAHs	EPA SW3550/8270
Mercury	EPA SW7471
Total solids (TS)	PSEP p.17
Total volatile solids (TVS)	PSEP p.20
Total organic carbon (TOC)	SM 5310B
Acid volatile sulfides (AVS)	DiToro, 1990
Grain size	PSEP p.9

Five surface sediment samples and one field duplicate sample were collected on 8/25/98 and analyzed for the parameters shown in Table 1. An additional ten sediment samples were collected on the same day, but were only analyzed for grain size and TS. Table 2 shows the sample numbers for which data were reviewed.

Table 2. Summary of samples and identification numbers.

Project Sample ID	Laboratory ID	Analyses Performed
MW-A	98-A011963	(see Table 1)
MW-C	98-A011964	(see Table 1)
MC-1	98-A011965	(see Table 1)
MW-1 Duplicate	98-A011966	(see Table 1)
MW-1	98-A011967	(see Table 1)
MW-F	98-A011968	(see Table 1)
GS#8	98-A011969	Grain size, TS
GS#10	98-A011970	Grain size, TS
GS#12	98-A011971	Grain size, TS
GS#13	98-A011972	Grain size, TS
GS#14	98-A011973	Grain size, TS
GS#2	98-A011974	Grain size, TS
GS#1	98-A011975	Grain size, TS
GS#5	98-A011976	Grain size, TS
GS#6	98-A011977	Grain size, TS
GS#7	98-A011978	Grain size, TS

The data validation was performed using the United States Environmental Protection Agency (U.S. EPA) Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (U.S. EPA 1994a,b) for guidance. Data validation included evaluation of the following (as appropriate):

- Holding Times and Sample Preservation
- Laboratory Method Blanks
- Standard Reference Sample (SRM) Recovery
- Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Recoveries
- Matrix Spike Duplicate Relative Percent Difference (RPD)
- Analytical Duplicate and Triplicate Samples
- Field Duplicate Sample RPD

DATA QUALITY SUMMARY

Summarized below is an evaluation of the quality assurance (QA) and quality control (QC) results associated with these sediment samples. Briefly, all laboratory and field QA/QC were within acceptable ranges. The field duplicate samples showed elevated RPDs for TOC, AVS, and mercury, but no validation flags were applied on this basis. Overall, there is no indication that the results for any of the parameters analyzed were significantly biased. No validation flags were applied on the basis of the QA/QC data evaluated.

GENERAL QA/QC

Two general irregularities were noted. First, to achieve lower detection limits, double the typical volume of sediment was extracted for PAH analysis. Two separate 35-gram aliquots were extracted

and the extracts combined prior to cleanup using gel permeation chromatography. Second, one of the grain size distribution plots (for sample AO11966) was missing data points for phi classes below +3. The laboratory sent a revised plot via U.S. mail that was received on October 19, 1998 and added into the original data package.

Holding Times and Blank Review

All samples were collected on August 25, 1998 and were prepared and analyzed within the holding times specified for each method.

Laboratory method blanks can provide information about systematic laboratory contamination due to reagents, glassware, etc. that may generate false positives (i.e., sample detections due to blank contamination). No contamination was detected in the laboratory blanks for these analyses.

Accuracy of Results

The percent recovery of each standard reference material (SRM) provide an indication of the laboratory's ability to measure analytes from marine sediments/sludges certified to contain metals at specified concentrations. The recovery of mercury from SRM CRM007-040 was 87%, within the predicted range. The recovery of PAHs from SRM HS-3 ranged from 19% - 189% of the certified value, but compared to the historical laboratory mean recovery were 79% - 139%. This range of recoveries was found to be acceptable, indicating that sample preparation and analysis procedures were sufficient to accurately quantify mercury and PAHs in a typical sediment/sludge matrix.

Matrix spike recoveries provide an indication of the laboratory's ability to recover spiked analytes from the sample matrix. The mercury MS recovery was 88%, within the acceptable range of 75% - 125%. The PAH MS recoveries ranged from 53% - 87%, and those for the MS duplicate (MSD) ranged from 55% - 100%. All of the MS and MSD recoveries were within the laboratory limits for acceptability. The MS relative percent differences for the PAH samples ranged from 0% - 18%, within the 20% criterion. This indicates sample preparation and analysis procedures were sufficient to accurately quantify these analytes in the actual sample matrix.

In addition, six surrogate and internal standard compounds are added during the preparation of PAH samples to account for possible losses and interferences during sample extraction, cleanup, and analysis. Recoveries of these compounds were within both U.S. EPA and laboratory recovery limits for all field and QC samples, indicating that significant sample losses did not occur and interferences were not identified.

Precision of Results

Relative standard deviations (RSDs) and/or RPDs were calculated for two pairs of QC samples, analytical duplicates/triplicates and field duplicates. The analytical duplicate and triplicate RSDs and RPDs indicate the degree of laboratory precision associated with one actual sample, and tend to provide information about sample homogenization. The field duplicate RPD indicates the degree of laboratory and field precision associated with one actual sample. Field duplicate RPDs tend to show greater variability than the RPDs associated with analytical duplicates and triplicates because they take into account both field and laboratory errors.

The analytical duplicate/triplicate RSDs were 1.8% for TS, 11.5% for TVS, 4.9% for TOC, and 19.6% for AVS. The analytical duplicate RPD for mercury was 14%. All of the analytical duplicate/triplicate results for these parameters were within acceptable ranges (<20%).

The RSDs for each of the different grain size classifications were evaluated, and no significant biases were identified. This indicates that sample homogeneity and sample matrix effects did not significantly affect the precision of the grain size results.

The field duplicate RPDs were 6.6% for TS, 20% for TVS, 45.6% for TOC, 113% for AVS, and 67.3% for mercury. For PAHs, field duplicate RPDs ranged from 0% to 58%, however, none of the results were greater than five times the practical quantitation limit (PQL). These RPDs show that the combined laboratory and field error was generally low, except for TOC, AVS, and mercury. Results for these analyses were not flagged solely on the basis of field duplicate results because the analytical duplicate results were acceptable and field duplicates are prone to greater error (such as differences in percent moisture). Also, EPA does not have promulgated criteria for evaluating field duplicate RPDs.

The RSDs for each of the different grain size classifications were evaluated, and no significant biases were identified. This indicates that field collection inconsistencies did not significantly affect the precision of the grain size results.

U.S. EPA 1994a. U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Solid Waste and Emergency Response, February 1994, EPA Publication No. 540/R-94-012.

U.S. EPA 1994b. U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Office of Solid Waste and Emergency Response, February 1994, EPA Publication No. 540/R-94-013.

cc: Deb Lester _____