Appendix

H

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

Malins, D.C., B.B. McCain, D.W. Brown, A.K. Sparks, H.O. Hodgins, and S-L Chan, 1982, Chemical Contaminants and Abnormalities in Fish and Invertebrates from Puget Sound, NOAA Technical Memorandum OMPA-19, National Oceanic and Atmospheric Administration, Rockville, Maryland.

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WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
International Specialists in the Environment

EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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ATTACHMENTS

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1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The document reviewed presented a summary of results from a 3-year study of Puget Sound, beginning in the Spring of 1978, and concluding in the Spring of 1981. The study was conducted by the National Oceanic and Atmospheric Administration (NOAA). Participating agency parties included the Office of Marine Pollution Assessment, through its Marine Ecosystem Analysis (MESA) Puget Sound Project, and the National Marine Fisheries Service.

The overall objectives of the investigation were to use an integrated, multidisciplinary approach to document the following:

- o "The occurrence and fluxes of contaminants of special concern",
- o "The dynamic processes influencing the physical and chemical transport and fate" of identified contaminants, and
- o Effects of contaminants on the biological and chemical integrity of the Sound.

To this end, the investigators established sampling stations in a number of embayments within Puget Sound that were considered to be influenced by urbanization ("urban areas") and in others that were less likely to be impacted by the activities of man ("reference" or "non-urban areas"). Locations of studied embayments are provided in Attachment A (Figure 1 from the document).

A total of 73 sediment samples and 148 biological (fish, epibenthic invertebrates, and infaunal invertebrates) samples were collected during the study period for chemical analyses. Activities associated with these samples and others for biological work included the following:

- o Chemical analysis of sediments and selected biological tissues;
- o Fish and invertebrate pathology;
- o Fish, epibenthic crustacean, and benthic invertebrate ecology;
- o Crab and mollusc exposure effects studies; and
- o Benthic invertebrate recolonization studies.

Details of each of these aspects of the investigation are provided in the appropriate sections throughout the remainder of this review. Reviewer summaries and information provided herein have been focused, when possible, on results obtained for Port Gardner area, which includes stations in the East Waterway. Much of the biological work conducted or reported in the reviewed document was not specific to these areas of interest; consequently, although reviewed thoroughly, this work will be discussed in general terms. Information related to biological effects of toxicants in Everett Harbor was presented by Chapman et al. (1984) (see review for document D). The biological results provided by the investigators do establish a good baseline of information for the Sound in general, and the reader is referred to the document for more specific details regarding this work.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

It was suggested by the authors that rentene and ferruginol detected in sediment samples in various areas including the Port Gardner embayment were most likely associated with waste product from the wood pulp industry. There was no discussion of whether these were associated with point or non-point sources.

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

See comments in Section 5.0 above.

7.0 CHEMICAL DATA

Methods

Sample Collection. Most sampling stations were selected to reflect "worse-case" conditions. As possible, they were located in close proximity to point source discharges and in areas which exhibited sediments with high percentages of silt and clay (i.e., areas with high deposition rates). These selection criteria were used to maximize the potential for encountering measurable contamination. Both organic and inorganic contaminants are known to accumulate in finer grained sediments and occur in higher concentrations where contaminants are discharged into depositional environments.

Collection techniques for biota and sediments were the same for both the chemical and biological analyses. These techniques are described below and will not be repeated in the biological data section of this review.

Fish, in most locations, and epibenthic invertebrates were collected using a 10.8-m long otter trawl of conventional construction. Blackmouth salmon, coho salmon, and Pacific cod were captured by hook and line in Commencement and Elliott bays and Point Jefferson. Fish species selected for chemical and pathobiological analyses were species

known to be distributed throughout the Sound, have life stages associated with the sediments (e.g., bottom feeders), and have previously documented abnormalities.

A 0.1 m^2 Van Veen grab was used to collect infaunal invertebrates and sediments. Field measurements at each station included temperature, salinity, and dissolved oxygen which were taken at or near the bottom.

Chemical Analyses. Selected "toxic" organic and inorganic chemical concentrations were measured in biota and sediments (see Tables 2 and 3, Attachment B). Chemical classes included aromatic hydrocarbons (AHs), polychlorinated biphenyls (PCBs), chlorinated butadienes (CBDs), and "several" chlorinated pesticides. Methods used for chemical analyses are detailed in Malins et al. (1980), a document not reviewed as a part of this task, and only briefly described in this reviewed report. In general, organic analyses were performed using gas chromatography/mass spectra techniques based upon methods published in the scientific literature that was current at the time of the study. Metals analyses were not discussed in any detail.

Statistical Methods. No statistical test were performed using chemical data. However, Cluster analyses were used to evaluate sediment chemistry and the relationships of 40 MESA stations. No Port Gardner or East Waterway stations were used as a part of these procedures.

Results

Results and discussions provided in the report specifically related to Port Gardner and East Waterway were limited to sediment chemistry. Data summary tables for total AHs, PCBs, total CBDs, hexachlorobenze (HCB), mercury, lead, arsenic, silver, and cadmium are provided in Attachment B. These tables were taken directly from the document.

Sediment Chemistry. In general, measured organic contaminants (AHs, PCBs, and CBDs) were found to be widely distributed throughout the Sound but in divergent concentrations among embayments. For the most part, the highest concentrations were found to be closely associated with urban embayments. Lead was found to be high in both the urban and reference embayments, while mercury and arsenic were found to be high only in the urban areas.

The table below, prepared by the reviewer using the data presented in the report appendices, compares average concentrations (ppb, dry weight) of sediment contaminants in the Port Gardner and East Waterway embayment with those measured in Port Susan (PS), a reference area, and Commencement Bay (CB), a highly urbanized area.

Chemical Contaminant	Area Average Concentration PS	PG	CB
*Total AHs	250	2700	9700
*PCBs	10	41	270
*Total CBDs	6	21	1600
*HCB	0.3	0.2	74
Mercury	470	160	360
Lead	22,000	23,000	130,000
Arsenic	15,000	15,000	85,000
Cadmium	800	1,500	4,500

* East Waterway sample was not analyzed.

For the period of the study (10 years ago), Port Gardner/East Waterway stations had concentrations notably elevated above the PS reference for total AHs and cadmium and were well below the CB area. Generally, the station located in the East Waterway exhibited higher concentrations than those measured at the Port Gardner Station. Data for PCBs, CBDs, and HCB were not available for the East Waterway Station.

Chemicals in Biota. Demersal species (e.g., English sole) generally were found to have higher concentrations of contaminants than the pelagic and semidemersal species analyzed during the study. Many of the contaminants found in the demersal, pelagic, and benthic organisms examined from Commencement and Elliott bays were found in the sediments. The authors concluded that these findings may be attributable to differences in concentrations of contaminants in prey organisms and varying affinities to the sediments on the parts of the predators (i.e., benthic vs. pelagic feeding fish).

Data Quality

The authors stated that quality assurance (quality control) procedures "included analyses of replicate samples and blanks, interlaboratory comparisons, and the use of recovery and internal standards." While the data appear to have been collected in a very competent manner, this assumption cannot be verified because only data summaries were included in the report. See the recommendations section of this review (Section 15.0) for data availability. Comments were also included that indicated that many of the organic compounds encountered were not verified by mass spectra (see Section 15.0).

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

Methods

Fish Pathology. Fish pathology procedures included necropsy, histology, histopathology, and hematology and blood chemistry. The necropsy procedures included standard measurements of: total length,

total weight, sex determinations, age determinations (otolith technique), description of gross appearance, and collection of samples and tissues for the other procedures. Fish pathology data specifically related to Port Gardner and the East Waterway were not presented. As a result, further discussions of this aspect of the study will be of a general nature.

Invertebrate Pathology. Invertebrate pathology procedures, performed on shrimp and crabs captured in the epibenthic trawls, included necropsy, histology, and histopathology. Invertebrate necropsy was essentially the same as that performed on fish. Data specific to the East Waterway and surrounding vicinity were not presented. Discussion of these results will also be of a general format.

Fish and Epibenthic Crustacean Ecology. Techniques used for ecological characterization of fish populations included the following:

- o Taxonomic identification of captured species;
- o Enumeration of tow captures by species;
- o Total catch weight measurements;
- o Calculation of catch per unit effort based on a single unit 5-min tow at each station;
- o Calculation of species richness and diversity (Shannon-Weaver) indices; and
- o Weight/length measurements.

Characterizations of target fish populations (those selected for chemical and pathobiological analyses) included those pertinent measurements obtained from the necropsy.

Only target species of crabs and shrimp were enumerated from each trawl.

Benthic Invertebrate Ecology. Three Van Veen grabs per station were collected for ecological characterization of infaunal benthic invertebrate communities. Two core samples with a surface area of 100 cm^2 were collected to a depth of 10 cm from each grab. Cores were wet sieved through 1 mm mesh stainless steel sieves and then sorted to remove infaunal organisms. Subsequent analyses of these organisms included:

- o Taxonomy;
- o Wet weight biomass measurements for molluscs, crustaceans, annelids, and ophiuroids;
- o Dry weight biomass calculations for the above groups;

- o Preparation of a reference collection;
- o Calculation of community composition indices:
  - Infaunal Trophic Index,
  - Richness, and
  - Shannon-Weaver diversity index.

Crab and Mollusc Exposure Effects Studies. Crab and mollusc exposure studies consisted of 60 and 71 day in situ caging experiments, respectively. These experiments were performed by placing a known number of test organisms in a caging device and placing them on the bottom in the area to be tested. Following the period of exposure, the fish and molluscs, which were caged separately and exposed over different periods of time, were removed and measurements of survival and gross damage were taken. In addition, mollusc tissues were dissected from surviving organisms and subjected to chemical and histopathological analyses. Caging experiments were not conducted in Port Gardner or the East Waterway.

Benthic Invertebrate recolonization **Studies.** In situ recolonization studies were conducted by collecting sediments from the test and reference areas, defaunating these sediments by freezing them, and then returning both sets of samples to the test environment for a prespecified period of time. The longest exposure period for these experiments was 24 weeks. Exposed samples were caged to prevent significant predation. Following the exposure period, sediments were retrieved, sieved through both 1.0 and 0.5 mm mesh sieves, and preserved. In the laboratory, benthic infauna were removed from the sediments, enumerated, and identified. Specifics of preservation, sorting, enumeration, and identification techniques were not discussed in the report. Taxonomic keys used to identify species for both the recolonization and benthic invertebrate ecology studies were referenced and appear to be appropriate to the tasks. Recolonization studies were not performed in Port Gardner or the East Waterway.

Results

Fish Pathology. Because English and rock sole were the most abundant and widely distributed species encountered during the study, these species were used for comparative purposes to delineate deferences and similarities among study embayments. In general, liver neoplasms were found in both species of fish from the most chemically contaminated areas. The authors suggest that this is indicative of a relationship between concentrations of chemical contaminants and the occurrence of this type of lesion. Occurrences of "preneoplastic" and specific degenerative/necrotic, the two other types of hepatic lesions, appeared to mimic liver neoplasm distributions with the exception of their discovery in a few organisms from the reference areas. "Preneoplastic" hepatic lesions were the most common type of lesion encountered during the study. The relationship of age/weight/length with idiopathic lesions and comparisons with other studies were discussed by the author. The reader is referred to the document for detailed discussions of fish pathology.

Invertebrate Pathology. Both gill and hepatopancreatic lesions were found to occur in shrimp and crabs captured during the study. Occurrences of these lesions appeared to be closely associated with high concentrations of chemical contamination. However, numbers of organisms captured and examined during the study were too low to form definitive conclusions regarding this matter. The reader is referred to the document for detailed discussions of invertebrate pathology.

Fish and Epibenthic and Benthic (Infaunal) Invertebrate Ecology. Characterizations of these communities in the Port Gardner embayment were not included as a part of this study. The reader is referred to the document for information relative to those areas that were sampled.

Crab and Mollusc Exposure Studies. Results from these experiments were not definitive.

Benthic Invertebrate recolonization **Studies.** Results of the recolonization study were not discussed in any detail in report. Rather, the reader was referred to the ecology sections.

Data Quality

Quality assurance procedures for biological methods were not discussed in the document.

9.0 DATA QUALITY

Methodology for this study was, for the most part, based upon published scientific literature. Although data quality appears to be very good, the actual quality cannot be verified unless raw data, including quality control results, can be obtained from NOAA.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

There were 110 pages of tables and figures included in the document used to present the data. Most of this information was only briefly discussed in this review, because it was not specific to the Port Gardner/East waterway area. Although these data are over a decade old, it is important in that it provides an important baseline of both biological and chemical data which can be used for comparative purposes when evaluating changes that may have occurred over time. Also, the data allow comparison of historical conditions in Port Gardner and the East Waterway with other locations in the Sound. There is a notation in the document that all of the data are available from the NOAA National Oceanographic Data Center, 2001 Wisconsin Avenue Northwest, Washington, D.C. 20235. Needed data should be retrieved and validated prior to use in any future Remedial Investigation/Feasibility Study (RI/FS) or sediment cleanup operations in the East Waterway. It is not known whether the results of quality control procedures are contained in the NOAA data base. During any data validation effort, a comparison of the cited methods with currently acceptable methods should be made. It should be noted that the authors stated that many of the organic compounds encountered during their study could not be confirmed because mass spectra had not yet been published. Many of the compounds were not identified because mass spectra could not be obtained, a result of their complexity.

Fish and benthic invertebrate (epifaunal and infaunal) communities in the Port Gardner embayment were not characterized as a part of this study, and comprehensive characterization of these communities has not been encountered yet during this review task. If information regarding the current status of these communities cannot be verified though literature reviews, it may be necessary to conduct additional field work during any future RI/FS or sediment cleanup study at the East Waterway Site.

As stated in other review recommendation sections, a comprehensive assessment of contaminant sources should be conducted.

16.0 FINAL COMMENTS

N/A

Attachment A

MAPS

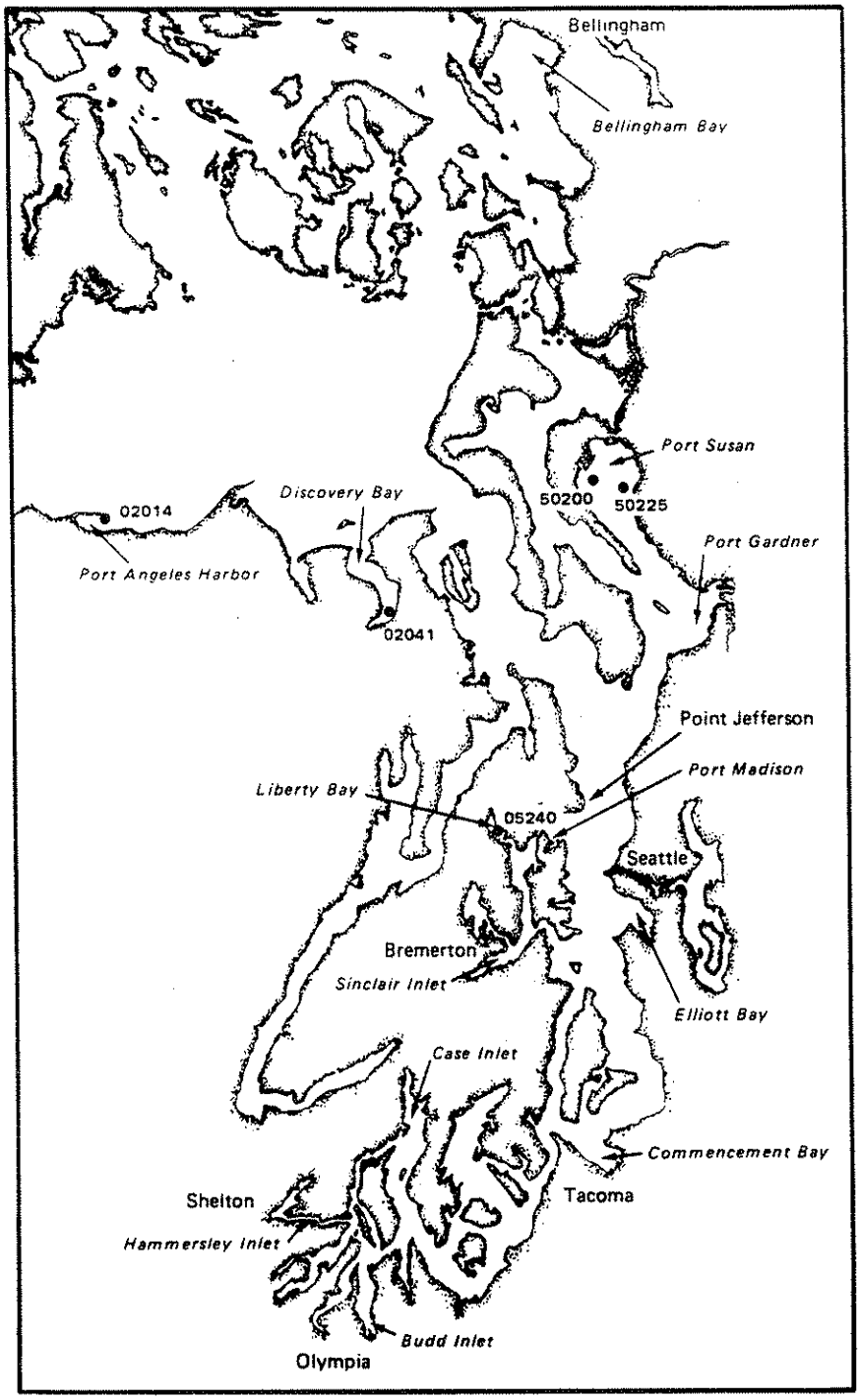
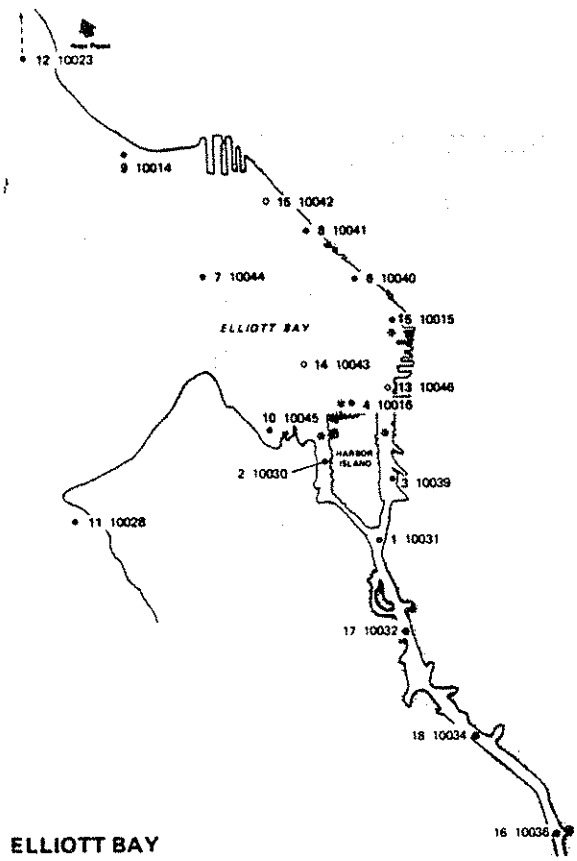


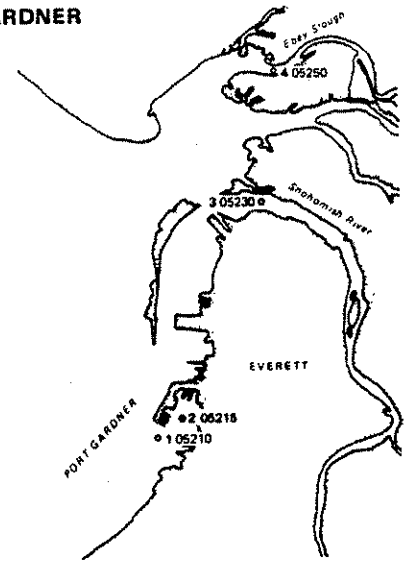
Figure 1. Locations of embayments studied. With the exception of Port Angeles Harbor (Station 02014, depth 13 m), Liberty Bay (Station 05240, depth 13 m), Discovery Bay (Station 02041, depth 32 m), and Port Susan (Station 50200, depth 14 m; and Station 50225, depth 25 m), the sampling areas are displayed in greater detail in Figure 2.



ELLIOTT BAY

1 Duwamish Waterway, near lumber mill (10–20m)
2 Duwamish Waterway, west channel (15–20m)
3 Duwamish Waterway, east channel (12–16m)
4 Harbor Island, north end (12–50m)
5 Pier 54 (20–60m)
6 Pier 70 (20–60m)
7 Midway from Pier 91 to Duwamish Head (120–170m)
8 North of Pier 71 (15–65m)
9 Magnolia Bluff (15–60m)
10 Duwamish Head, southeast side (12–50m)
11 Alki Point, south side (15–60m)
12 West Point, north side (10–50m)
13 Pier 42 (20–60m)
14 Corps dump site (70–85m)
15 Pier 86 (30–50m)
16 Duwamish Waterway, 14th Ave. bridge (10m)
17 Duwamish Waterway, south of Kellogg Is. (12m)
18 Duwamish Waterway, south of 1st. Ave. S. bridge (10m)

PORT GARDNER



1 Near Pier 1, mid-channel (13m)
2 Near Scott Plant, mid-channel, due west of Scott silver bldg. (10m)
3 Snohomish River, below green bridges, near Preston Point (5m)
4 Ebey Slough (4m)

Figure 2. (continued) Elliott Bay and Port Gardner.

Attachment B

TARGET COMPOUNDS

Table 2. Target organic compounds analyzed in sediment and biota from Puget Sound, plus internal and recovery standards.

Aromatic Hydrocarbons (AHs):

1. Isopropylbenzene
2. *n*-Propylbenzene
3. Indan
4. 1,2,3,4-Tetramethylbenzene
5. Naphthalene
6. Benzothiophene [1]
7. 2-Methylnaphthalene
8. 1-Methylnaphthalene
9. Biphenyl
10. 2,6-Dimethylnaphthalene
11. Acenaphthene
12. 2,3,5-Trimethylnaphthalene
13. Fluorene
14. Dibenzothiophene [1]
15. Phenanthrene
16. Anthracene
17. 1-Methylphenanthrene
18. 3,6-Dimethylphenanthrene
19. Fluoranthene
20. Pyrene
21. Benz[a]anthracene
22. Chrysene
23. Benzo[e]pyrene
24. Benzo[a]pyrene
25. Perylene
26. Dibenzanthracene
27. Benzofluoranthene

Chlorinated Pesticides:

Hexachlorobenzene (HCB)
Lindane (γ- BHC)
Heptachlor
Aldrin
o,p'-DDE
α-Chlordane
trans-Nonachlor
p,p'-DDE
o,p'-DDD
m,p'-DDD
p,p'-DDD
o,p'-DDT
p,p'-DDT

Dichlorobiphenyls)
Trichlorobiphenyls)
Tetrachlorobiphenyls)
Pentachlorobiphenyls) PCBs
Hexachlorobiphenyls)
Heptachlorobiphenyls)
Ochtachlorobiphenyls)
Nonachlorobiphenyls)

Dichlorobutadienes
Trichlorobutadienes (3CBD))
Tetrachlorobutadienes (TCBD)) CBDs
Pentachlorobutadienes (PCBD))
Hexachlorobutadienes (HCBD))

Internal and Recovery Standards

D8-Naphthalene (D8N)
D10-Acenaphthene (D10A)
D12-Perylene (D12P)
D4-1,4-Dichlorobenzene (D4D)
Triisopropylbenzene (TPB)
Hexamethylbenzene (HMB)
n-Decylcyclohexane (DCH)
Technazene (TEC)

[1] A heteroaromatic compound (aromatic ring contains a nonpolar sulfur moiety)

Table 3. Metals analyzed by either inductively coupled argon plasma emission spectroscopy (Group A) or atomic absorption spectroscopy (Group B).

GROUP A

Aluminum[1]	Al	Mercury[2]	Hg
Antimony	Sb	Molybdenum	Mo
Arsenic	As	Nickel[1,2]	Ni
Barium	Ba	Phosphorus[1]	P
Beryllium	Be	Potassium	K
Bismuth	Bi	Scandium	Sc
Boron[1]	B	Selenium	Se
Cadmium[1]	Cd	Silicon	Si
Calcium	Ca	Silver[2]	Ag
Chromium[1]	Cr	Sodium	Na
Cobalt	Co	Strontium[1]	Sr
Copper[1]	Cu	Tin	Sn
Gallium	Ga	Titanium	Ti
Germanium	Ge	Tungsten	W
Iron[1]	Fe	Vanadium[1]	Va
Lead[1]	Pb	Yttrium	Y
Lithium[1]	Li	Zinc[1,2]	Zn
Magnesium[1]	Mg	Zirconium	Zr
Manganese[1]	Mn		

GROUP B

Aluminum	Lead[1,2]
Arsenic[1,2]	Manganese
Cadmium[1,2]	Mercury[1,2]
Chromium[1,2]	Selenium[1,2]
Copper[1]	Zinc[1,2]
Iron	

[1] Determined in tissue
[2] An EPA Priority Pollutant

Attachment C

SEDIMENT CHEMISTRY DATA SUMMARIES

Table 7. The ΣAHs (ppb, dry weight) in sediment at sampling stations given in Figures 1 and 2. Multiple concentrations are different samples obtained at different times.

Area	Mean Conc. (ppb)	Sampling stations 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	13,000	9,600 11,000	30,000	4,800	18,000	63,000 36,000	2,700	3,900	4,800	1,200	5,700	150	49,000	230 4,700	2,500	6,300	1,500
2. Commencement Bay	9,700	14,000 9,500 21,000	50,000 7,900 5,500	7,000 3,400	2,700 5,300	57,000 18,000 11,000	410 220	890	2,900 1,400	280	630	740	15,000 2,200	17,000 2,700	1,900 2,600		
3. Sinclair Inlet	6,400	1,500	3,300	2,600	18,000												
4. Budd Inlet	940	1,100	620	1,100													
5. Case Inlet	350	650	60														
6. Port Madison	480	720	240														
7. Port Susan	250	240	260														
8. Everett	2,700	2,900	5,100	32													
9. Bellingham	4,000	3,300	4,600														
10. Shelton		310															
11. Port Angeles		970															
12. Liberty Bay		860															
13. Ebey Slough		26															
14. Discovery Bay		49															

Table 11. The concentrations of PCBs (ppb, dry weight) in sediment at indicated sampling stations. The location of sampling stations are given in Figures 1 and 2. Multiple concentrations are from different samples obtained at different times. N designates that PCBs were not present at measurable concentrations.

Area	Mean Conc. (ppb)	Sampling Stations 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	380	530 490	670	340	170	490 2,100	310	140	160	35	99	N	61	N	240 65	170	450
2. Commencement Bay	270	1,200 980 [1]	27 [1] [1]	35 54	61 100	380 670 290	15 .7	[1]	406 180	N	.1	1.8	280 130	990 100	22 59		
3. Sinclair Inlet	130	180	220	77	28												
4. Budd Inlet	13	19	15	5													
5. Case Inlet	3	4	1														
6. Port Madison	6	9	3														
7. Port Susan	10	7.8	13														
8. Everett	41	80	[1]	1.2													
9. Bellingham		[1]	100														
10. Shelton		2.3															
11. Port Angeles		9.4															
12. Liberty Bay		32															
13. Ebey Slough		.88															
14. Discovery Bay		1.4															

[1] PCBs were not determined for sample due to interferences by other compounds

Table 14. The ΣCBDs in sediment (ppb, dry weight). The locations of sampling stations, are given in Figures 1 and 2. N designates that CBDs were not present at measurable concentrations. Multiple concentrations are from samples obtained at different times.

Area	Mean Conc. (ppb)	Sampling Stations															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	12	1.2 4.2	7.2	3.1	10	18 53	15	42	7.4	3.8	6.7	2.8	2.9	N 5.2	7.6	11	N
2. Commencement Bay	1600	540 600 1,000	70 6,500 20,000	40 51	23 26	52 69 120	4.8 N	260	1,000 190	17	30	36	300 250	9,000 260	18 31		
3. Sinclair Inlet	57	19	68	90	51												
4. Budd Inlet	4	2.5	5.3	2.7													
5. Case Inlet	7.5	7.5	N														
6. Port Madison	2	1.9	2.8														
7. Port Susan	6	2.7	10														
8. Everett	21	21	[1]	N	N												
9. Bellingham		[1]	N														
10. Shelton		.79															
11. Port Angeles		.51															
12. Liberty Bay		12															
13. Ebey Slough		N															
14. Discovery Bay		N															

[1] Sample was not analyzed for CBDs

Table 15. The concentrations of HCB in sediment (ppb, dry weight). The locations of sampling stations, are given in Figures 1 and 2. N designates that HCB was not detected at measurable concentrations. Multiple concentrations are from samples obtained at different times.

Area	Mean Conc. (ppb)	Sampling Stations 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	0.24	0.2 .72	0.4	0.2	0.1	0.3 .78	0.2	0.2	0.3	0.07	0.07	0.02	0.03	N 0.11	0.1	0.5	0.1
2. Commencement Bay	74	20 30 50	0.6 150 1300	3 2.8	2 2.9	3 3.2 6.2	1 .14	10	60 16	0.1	0.2	1	50 33	250 2.7	2 2.1		
3. Sinclair Inlet	0.25	0.2	0.4	0.2	0.2												
4. Budd Inlet	0.07	0.1	0.1	0.01													
5. Case Inlet	0.03	0.04	0.01														
6. Port Madison	0.07	0.1	0.03														
7. Port Susan	.30	0.29	0.31														
8. Everett	.2	.38	[1]	.01	.01												
9. Bellingham		[1]	13														
10. Shelton		0.03															
11. Port Angeles		1.9															
12. Liberty Bay		.13															
13. Ebey Slough		.01															
14. Discovery Bay		.03															

[1] Sample was not analyzed for HCB

Table 19. The concentrations of mercury in sediment (ppb, dry weight). Locations of sampling stations are given in Figures 1 and 2. Multiple concentrations are from samples obtained at different times. N designates that mercury was not present at measurable concentrations.

Area	Mean Conc. (ppb)	Sampling Stations															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	460	380 100	800	350	1,400	1,200 620	630	450	1,100	100	150	30	100	30 280	420	360	250
2. Commencement Bay	360	790 220 1,200	430 280 320	130 260	490 260	1,000 970 620	65 23	110	170 N	100	260	63	200 310	340 210	160 N		
3. Sinclair Inlet	910	1,100	1,000	1,200	320												
4. Budd Inlet	240	330	120	280													
5. Case Inlet	70	120	20														
6. Port Madison	75	110	40														
7. Port Susan	470	580	360														
8. Everett	160	190	260	27													
9. Bellingham	1,400	1,900	870														
10. Shelton		26															
11. Port Angeles		75															
12. Liberty Bay		290															
13. Ebey Slough		48															
14. Discovery Bay		30															

Table 20. The concentrations of lead in sediment (ppb, dry weight). Locations of sampling stations are given in Figures 1 and 2. Multiple concentrations are from samples obtained at different times. N designates that lead was not present at measurable concentrations.

Area	Mean Conc. (ppb)	Sampling Stations															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	130,000	270,000 250,000	630,000	160,000	61,000	110,000 280,000	89,000	78,000	74,000	37,000	110,000	13,000	16,000	8,200 45,000	65,000	73,000	40,000
2. Commencement Bay	130,000	164,000 150,000 170,000	110,000 77,000 130,000	43,000 49,000	790,000 340,000	270,000 270,000 170,000	14,000 N	28,000	40,000 44,000	29,000	65,000	18,000	50,000 45,000	170,000 160,000	49,000 64,000		
3. Sinclair Inlet	100,000	98,000	140,000	130,000	44,000												
4. Budd Inlet	44,000	60,000	23,000	49,000													
5. Case Inlet	16,000	24,000	7,900														
6. Port Madison	15,000	20,000	10,000														
7. Port Susan	22,000	22,000	21,000														
8. Everett	23,000	30,000	36,000	3,300													
9. Bellingham	65,000	34,000	95,000														
10. Shelton	1,350	3,600															
11. Port Angeles		8,200															
12. Liberty Bay		32,000															
13. Ebey Slough		2,300															
14. Discovery Bay		N															

Table 21. The concentrations of arsenic in sediment (ppb, dry weight). Locations of sampling stations are given in Figures 1 and 2. Multiple concentrations are from samples obtained at different times. N designated that arsenic was not detected at measurable concentrations. Only real values were used to calculate means.

Area	Mean Conc. (ppb)	Sampling Stations															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	90,000	95,000 44,000	84,000	280,000	N	N 28,000	N	N	N	N	N	N	N	N 8,800	N	N	N
2. Commencement Bay	85,000	N 170,000 110,000	N 31,000 50,000	N 60,000	470,000 89,000	N 38,000 55,000	N 1,600	N	N 18,000	N	N	N	N 16,000	N 31,000	N 47,000		
3. Sinclair Inlet		N	N	N	N												
4. Budd Inlet	99,000	140,000	N	57,000													
5. Case Inlet		N	N														
6. Port Madison		N	N														
7. Port Susan	15,000	15,000	14,000														
8. Everett	15,000	19,000	19,000	6,000													
9. Bellingham	16,000	20,000	11,000														
10. Shelton		4,100															
11. Port Angeles		4,000															
12. Liberty Bay		12,000															
13. Ebey Slough		5,700															
14. Discovery Bay		2,600															

Table 23. The concentrations of cadmium in sediment (ppb, dry weight). Locations of sampling stations are given in Figures 1 and 2. Multiple concentrations are from different samples obtained at different times. N designates that cadmium was not present at measurable concentrations.

Area	Mean Conc. (ppb)	Sampling Stations 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Elliott Bay	7,100	12,000 1,900	11,000	18,000	5,700	8,600 2,200	7,000	8,200	6,500	4,500	7,300	3,800	4,700	4,600 N	6,500	7,400	8,300
2. Commencement Bay	4,500	9,600 1,200 3,000	6,800 390 1,500	5,400 N	16,000 1,800	9,100 3,200 500	5,200 N	5,600	6,000 920	4,200	5,800	4,700	6,100 1,300	5,600 1,100	6,000 670		
3. Sinclair Inlet	7,000	8,100	7,700	7,100	5,200												
4. Budd Inlet	9,600	11,000	8,200	9,500													
5. Case Inlet	5,400	7,600	3,200														
6. Port Madison	4,700	6,300	3,100														
7. Port Susan	880	907	860														
8. Everett	1,500	1,300	1,700	N													
9. Bellingham	1,100	930	1,300														
10. Shelton		N															
11. Port Angeles		N															
12. Liberty Bay		940															
13. Ebey Slough		N															
14. Discovery Bay		390															

Appendix

I

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

Malins, D.C., M.M. Krahn, D.W. Brown, L.D. Rhodes, M.S. Myers, B.B. McCain, and S-L Chan, 1985, Toxic Chemicals in Marine Sediment and Biota from Mukilteo, Washington: Relationships with Hepatic Neoplasms and Other Hepatic Lesions in English Sole (Parophrys vetulus), J. Natl. Cancer Institute, 74:487-494.

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Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
International Specialists in the Environment

EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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	Section 16.0	FINAL COMMENTS

ATTACHMENTS

Attachment A - Site Map
Attachment B - Chemical and Histopathological Data

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

Previous studies of bottom-dwelling fish from areas with highly contaminated sediments have shown the presence of neoplasms and lesions. The study reviewed provides corroborating evidence of pathologic conditions in English sole captured at Mukilteo, Washington, located approximately 8 km south of East Waterway, Everett (see Attachment A). Mukilteo is essentially a nonindustrial area, but the waterfront includes a major fuel storage depot, ferry terminal, abandoned boat ramp, and municipal wastewater outfall. Benthic invertebrates, ingested by the English sole, are identified as a source of toxic chemicals. (Because the Mukilteo site is located 8 km south of East Waterway, the information presented in this journal article may not be directly applicable to activities or effects on those biota present in East Waterway. The presence of an oil storage facility at Mukilteo appears to be the main source of chemical contaminants affecting English sole.)

Similar studies of fish histopathology in Puget Sound that have preceded this report include:

- Malins, D.C., B.B. McCain, D.W. Brown et al., 1984, Chemical Pollutants in Sediments and Diseases of Bottom-Dwelling Fish in Puget Sound, Washington, Environ. Sci. Technol., 18:705-713.

- McCain, B.B., K.V. Pierce, S.R. Wellings, and B.S. Miller, 1977, Hepatomas in Marine Fish From an Urban Estuary, Bull. Environ. Contam. Toxicol., 18:1-2.

- McCain, B.B., M.S. Myers, U. Varnasi, et al., February 1982, Pathology of Two Species of Flat Fish From Urban Estuaries in Puget Sound, Interagency Energy-Environment Research and Development Program Report, EPA-600/7-82-001, United States Environmental Protection Agency, Washington D.C.

- Pierce, K.V., B.B. McCain, and S.R. Wellings, 1978, Pathology of Hepatomas and Other Liver Abnormalities in English Sole (Parophrys vetulus) from the Duwamish River Estuary, Seattle, Washington, J. Natl. Cancer Institute, 60:1445-1453.

2.0 LEGAL AND REGULATORY ISSUES

N/A

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

N/A

7.0 CHEMICAL DATA

English sole corresponding to length classes of 2 years or older were collected for examination from Mukilteo and President Point, a control site located 19 nautical miles west of Mukilteo. Fish tissue, including liver and bile as well as stomach contents, were analyzed for chemistry. (Liver, kidney, and gill tissue was examined by histopathologic techniques.) Sediments were also collected using a 0.1 m2 van Veen grab and analyzed for organics. Methods of analysis were cited as Malins et al. (1980). Those target compounds analyzed and results are presented in Table 1 (Attachment B).

Mukilteo sediments exhibited concentrations of aromatic hydrocarbons (AH) of 7,800 to 33,000 ppb (near a wastewater outfall and near a fuel tank farm, respectively) while control sediments at President Point were lower (i.e., 1,100 ppb AH).

Metals were said to be similar at all sites except for lead, 9.8 to 69 ppm at Mukilteo and 7.9 to 24 ppm at reference sites. (No tabular data for metals were presented.)

Tissue concentrations of AH showed that while sediments at Mukilteo contained AH, carbazole, and chlorinated butadienes (CBD), these were not detected in English sole liver tissue (Attachment B). Polychlorinated biphenyl concentrations in sole livers from Mukilteo were 3,400 ppb (or 17 times the sediment concentration) versus 1,000 ppb at President Point (or at least 500 times the sediment concentration of <2 ppb).

Stomach contents from both sites were found to contain AH including naphthalene, phenanthrene, BA, and BaP but were much higher at Mukilteo (15,000 ppb) versus President Point (680 ppb).

Examination of bile showed the presence of BaP-like and naphthalene-like metabolites at sixfold and threefold higher concentrations at Mukilteo versus President Point.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

English sole were collected using an otter trawl at Mukilteo and President Point. Mukilteo fish averaged 27 ± 4.0 cm and President Point fish averaged 29 ± 3.8 cm.

Food organisms were examined through a taxonomic investigation of stomach contents of 10 fish captured. (It is not clear from the report if the stomach contents from 10 fish from each site were examined.) Wet weights of organisms were determined after samples were allowed to dry on blotter paper after 3 minutes. Results indicated that organisms present were classified into four major taxonomic groups: Annelida, 68%; Mollusca, 17%; Crustacea, 11%; and Echinodermata, 4%.

Histopathology

Fish tissues were processed by standard histologic procedures, then embedded in parafin, sectioned at 5 µm, and stained. Five major categories of idiopathic lesions were detected in this study.

The predominant neoplasms found in sole liver tissue from Mukilteo were hepatocellular carcinomas. Higher percentages of other lesions such as degenerative and necrotic conditions were found in the Mukilteo than in President Point fish (Table 4, Attachment A). A manuscript identifying these was stated to be in preparation. The morphologic characteristics of the hepatic lesions observed in fish from Mukilteo were said to be similar to previously reported findings in other areas of Puget Sound for English sole.

The study indicates that many of the organic chemical contaminants present in sediments are bioavailable through the diet. Results suggest that English sole from Mukilteo had accumulated both diaromatic and polyaromatic metabolites in the bile. The high prevalence of neoplasms in Mukilteo fish was said to clearly suggest an association between chemical pollution and liver disease.

The study findings are said to add support to statistical relationships showing that sediment AH are associated with the occurrence of hepatic neoplasms in English sole. But the study also notes that despite the associations, definitive information still does not exist about which environmental chemicals or groups of chemicals may be responsible for any of the observed hepatic diseases, although synergistic-antagonistic interactions are no doubt involved.

9.0 DATA QUALITY

Because only summary data and methodologies are presented, the quality of the data cannot be verified based on this report alone. The citation given for the methods for chemical analysis of sediment and tissues was:

o Malins, D.C., B.B. McCain, D.W. Brown, A.K, Sparks, and H.O. Hodgins, 1980, Chemical Contaminants and Biological Abnormalities in Central and Southern Puget Sound, National Oceanic and Atmospheric Administration Technical Memorandum OMPA-2.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

This report may have limited value as a document that characterizes sediment or biological conditions for East Waterway, Everett. However, the topic covered can be considered indirectly applicable to future investigations or activities that may occur at East Waterway, Everett.

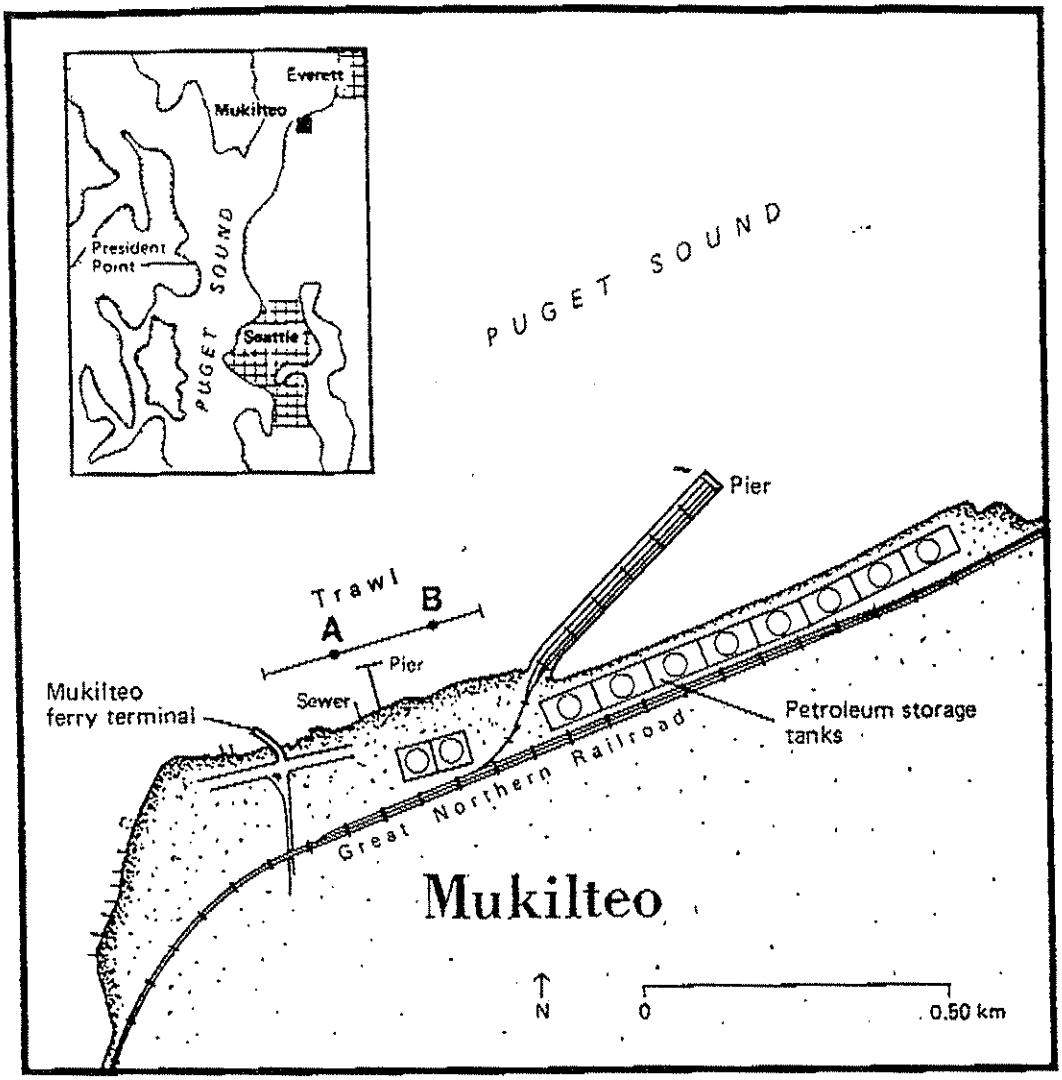
16.0 FINAL COMMENTS

N/A

Attachment A

SITE MAP

TEXT-FIGURE 1.—Map of Mukilteo, WA, showing sediment-sampling sites A and B and fish trawling area. *Inset* shows the location of Mukilteo with respect to the reference site, President Point.



Attachment B

CHEMICAL AND HISTOPATHOLOGICAL DATA

TABLE 1.—*Concentrations of chemicals (ng/g, dry wt) in sediments from Mukilteo and President Point in Puget Sound, WA*

Chemicals	CAS No.	Concentration in sediments from: Near sewer outlet at Mukilteo (site A)	Near fuel tanks at Mukilteo (site B)	President Point[a]
AH				
Naphthalene	91-20-3	230	3,800	8.9
2-Methylnaphthalene	91-57-6	89	1,400	<3.5
1-Methylnaphthalene	90-12-0	52	1,200	<3.5
Biphenyl	92-52-4	26	310	<2.0
2,6-Dimethylnaphthalene	—	34	520	<2.0
Acenaphthene	83-32-9	83	920	<2.0
2,3,5-Trimethylnaphthalene	—	30	540	<2.0
Fluorene	86-73-7	150	1,100	34
Phenanthrene	85-01-8	580	4,300	150
Anthracene	120-12-7	200	510	150
1-Methylphenanthrene	832-69-9	81	550	<2.0
3,6-Dimethylphenanthrene	—	37	170	<7.0
Fluoranthene	206-44-0	2,000	4,700	220
Pyrene	129-00-0	1,500	4,100	93
BA	56-55-3	450	1,200	71
Chrysene	218-01-9	710	2,100	140
Benzo[e]pyrene	192-97-2	360	1,100	43
BaP	50-32-8	170	550	41
Perylene	198-55-0	51	190	17
Dibenz[a,h]anthracene	53-70-3	34	100	8.3
Benzofluoranthenes	—	670	1,900	100
Indenopyrene	193-39-5	71	370	30
Benzo[g,h,i]perylene	191-24-2	89	320	23
CH				
PCB	—	29	200	<2.0
HCB	118-74-1	5.2	<0.2	<0.1
CBD	—	14	320	<2.0
Hexachlorobutadiene	87-68-3	1.0	32	<2.0
Heterocycles: carbazole	86-74-8	61	460	<10
Wet weight of samples		101.2	101.3	20.0
Percent dry weight		79	47	78

[a] A "<" indicates the chemical was not detected, and the number following is the detection limit.

TABLE 2.—*Concentrations of chemicals (ng/g dry wt) in stomach contents and livers of English sole* (Parophrys vetulus) *from Mukilteo and President Point in Puget Sound, WA.*

Chemicals	Concentration in stomach contents[a]		Concentration in livers[a]	
	Mukilteo[b]	President Point[c]	Mukilteo[d]	President Point[e]
AH				
Napththalene	610	70	<25	68
2-Methylnaphthalene	85	98	<25	<45
1-Methylnaphthalene	60	61	<25	<43
Biphenyl	<87	<12	<25	<38
2,6-Dimethylanaphthalene	<94	35	<25	<39
Acenaphthene	130	<11	<25	<39
2,3,5-Trimethylnaphthalene	<100	<12	<25	<40
Fluorene	200	<12	<25	<32
Phenanthrene	1,400	56	<20	<34
Anthracene	460	13	<22	<32
1-Methylphenanthrene	85	11	<20	<34
3,6-Dimethylphenanthrene	<78	<10	<20	<30
Fluoranthene	4,800	89	<20	<34
Pyrene	2,300	93	<20	<22
BA	1,000	9	<21	<28
Chrysene	1,500	15	<22	<23
Benzo[*e*]pyrene	840	39	<25	<24
BaP	570	30	<20	<18
Perylene	75	15	<20	<26
Dibenz[*a,h*]anthracene	<100	<11	<25	<15
Benzofluoranthenes	490	35	<20	<26
Idenopyrene	150	13	<25	<26
Benzo[*g,h,i*]perylene	75	<8	<25	<26
CH				
PCB	800	280	3,400[f]	1,000
HCB	<5	<2	10	<4
CBD	11	<8	<3	<75
Hexachlorabutadiene	<10	<5	<3	<9
Heterocycles: carbazole	<120	<8	<30	<34
Wet weight of samples	2.8	3.1	10.1	3.1
Percent dry weight	18	21	24	26

[a] A "<" indicates the chemical was not detected, and the number following is the detection limit.
[b] Average of 2 composites of contents of 3 stomachs each.
[c] One composite of 6 stomachs.
[d] Average of 2 composites; 6 livers in one and 7 in the other.
[e] Average of 2 composites; 5 livers in one and 4 in the other.
[f] Dichlorobiphenyls, trichlorobiphenyls, and tetrachlorobiphenyls were not determined because of interference and thus are not included in the data for PCB.

TABLE 4.—*Prevalences of hepatic lesions in English sole* (Parophrys vetulus) *from Puget Sound*

Lesion type	Prevalence, %	
	Mukilteo[a]	President Point[b]
Neoplasms		
Minimum deviation nodules	1.5	
Liver cell adenoma	3.0	
Hepatocellular carcinoma	4.6	
Cholangiocellular carcinoma	1.5	
One or more types of neoplasms[c]	7.5	0
Foci of cellular alteration		
Eosinophilic foci	12.1	
Hyperbasophilic foci	4.6	
One or more types of foci of cellular alteration[c]	16.7	0
Idiopathic degeneration and necrosis	40.9	10.0
Steatosis–hemosiderosis	10.6	17.5
Hepatocellular regenerative foci	10.6	5.0
Fish with no lesions	48.5	67.5

[a] Mean length=268±40 mm. There were 66 fish.
[b] Mean length=291±38 mm. There were 40 fish.
[c] In some cases, individual fish had more than one type of lesion.

Appendix

J

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

PTI Environmental Services, March 1989, Puget Sound Estuary Program, Everett Harbor Action Program: 1989 Action Plan, prepared for United States Protection Agency 910/9-89-006.

Contract No. C0089007

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January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
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EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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ATTACHMENTS

Attachment A - Maps
Attachment B - Site-Specific Action Plan Table
Attachment C - Acknowledgements List

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

Representatives of the Washington State Department of Ecology (Ecology), United States Environmental Protection Agency (EPA), City of Everett, Interagency Work Group (IAWG), and Citizens Advisory Committee (CAC) form the Everett Harbor Action Program (EHAP) team. The EHAP is a specific component of the Urban Bay Action Program which is a primary element of the Puget Sound Estuary Program (PSEP). PSEP received formal recognition by EPA under the National Estuary Program in February 1988. The PSEP is co-managed by EPA, Ecology, and the Puget Sound Water Quality Authority (PSWQA). The 1989 Puget Sound Water Quality Management Plan, developed by PSWQA, is recognized as a component of the comprehensive conservation and management plan (CCMP) required under the federal National Estuary Program.

The directive of the Urban Bay Action Program is to identify and reduce contaminant releases into the marine environment "...through a series of coordinated actions by government agencies and private parties (e.g., industries and businesses). Pollution control activities may include improvement of drainage or treatment systems for stormwater and sewage; implementation and, where appropriate, revision of permit conditions for wastewater dischargers; enforcement of hazardous materials regulations; and implementation of best management practices or cleanup measures at sites of concern."

The EHAP objectives in particular were listed as follows:

- Identify specific toxic areas of concern in sediments of the project area based on chemical contamination and associated adverse biological effects;
- Identify historical and ongoing sources of contamination;
- Rank toxic problem areas and sources (to the extent possible) in terms of priority for development of corrective actions; and
- Implement corrective actions to reduce or eliminate sources of ongoing pollution and restore polluted areas to support natural resources and beneficial uses.

The 1989 Action Plan document was prepared through funding approved by the EPA Office of Marine and Estuarine Protection. The plan was intended to describe corrective actions developed for specific sites within the Everett Harbor project area, including East Waterway. The plan was organized according to problem areas defined in prior EHAP study documents, including Tetra Tech 1988 and PTI/Tetra Tech 1988. Both of these documents were included as part of the E & E technical document review process and can be located within the compendium.

The efforts of the 1989 Action Plan focused on three primary problem areas: a portion of East Waterway; the south Port Garner shoreline near Mukilteo; and near the industrial and marina area of the Snohomish River (see maps presented in Attachment A). For the purposes

of the EHAP, "... Everett Harbor is defined as the area east of a line joining Elliott Point in Mukilteo with the western point of Mission Beach at the entrance of Tulalip Bay. The Snohomish River delta and the estuary east to Interstate 5 are within the project area."

A listing of the problem areas identified, current corrective actions, recommended corrective actions, implementing agencies, and approximate schedules were presented in a table presented as Attachment B in this document.

2.0 LEGAL AND REGULATORY ISSUES

The 1989 Action Plan was intended to serve "...as a blueprint for field investigations, permit review, site cleanup, and other activities intended to control pollutant sources." The Everett Harbor Action Team, working in conjunction with Ecology, also intends to be actively involved in:

- Coordination of sediment remedial work;
- Oversight and coordination of 1989 Action Plan activities, for which local jurisdictions are primarily responsible;
- Source identifications;
- Permitting coordination with Ecology's Industrial Section; and
- Directing quarterly Interagency Work Group meetings involving Action Plan issues.

The 1989 Action Plan identified Ecology as the primary regulatory authority responsible for conducting site inspections and permitting. The plan identified the City of Everett as the primary local authority responsible for all permitting linked to their sewer and storm water treatment systems.

The 1989 Action Plan also briefly described related government programs whose actions influence control planning. The following programs relevant to East Waterway were described:

EPA Superfund

In addition to the Urban Bay Action Program, the federal-lead program identified as relevant and appropriate to the plan objectives was the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). At the time the 1989 Action Plan was prepared, there were no National Priority List (NPL) sites in the project area, though several sites were listed in the Superfund Comprehensive Environmental Response and Compensation Law Information System (CERCLIS) database.

National Pollutant Discharge Elimination System (NPDES)

For East Waterway, Scott Paper Company was identified as the only NPDES-permitted facility. It was noted in the Action Plan that current NPDES regulations require property owners and tenants in certain land use categories to submit data regarding surface water runoff, and that Ecology was to review that information to assess the need for additional permitting.

Resource Conservation and Recovery Act (RCRA)

The state-delegated RCRA program regulates the generation, handling, and disposal of hazardous wastes through the RCRA inspection and permitting process. No specific priorities were described.

Sediment Standards

The emerging Ecology marine sediment quality standards will impact effluent particulate controls, confined dredged disposal standards, and remedial actions.

Snohomish Conservation District

The district provides planning assistance to the farmers of Snohomish County. Working within the boundaries of the Snohomish River watershed, the district has focused on the identification and management of agricultural non-point source contamination.

Snohomish Health District

As a regulatory agency, the Health District responsibilities include regulating and monitoring solid waste disposal and facilities, and permitting private sewage treatment systems.

City of Everett

Three programs were identified which the city has implemented to reduce contaminant input into the Everett Harbor area. The city's program includes the following primary elements.

Combined Sewer Overflow (CSO) Control Plan. Developed in 1987, the plan calls for a 10-year implementation period, and will include the installation of new interceptor lines, inflow controls, construction of siphon and oxidation ponds, and improving stormwater/sewer separation at selected CSOs. A portion of the plan, approved by Ecology, "...provides that control efforts for CSOs discharging to the sound (i.e., E006, E007, E008, E009, E011, E012, and E013) will not begin until at least 1993." The city will first prioritize Snohomish River CSOs which discharge significantly greater volumes (see maps in Attachment A).

Industrial Pretreatment Program. The program includes industrial waste surveys, establishing discharge limitations, enforcement monitoring, and public participation. As of September 1988, the city was in the process of identifying facilities requiring permits, and had issued two.

Municipal Wastewater Treatment Plant. Plans for construction of a mechanical treatment plant by 1991 were mentioned. Also identified was a completed study on ambient lead concentrations in the Snohomish River.

Puget Sound Water Quality Authority

Implementation of the PSWQA Plan has resulted in the adoption of new state regulations and state/local programs important to the EHAP. The most important identified were the requirements for Ecology to adopt sediment quality standards, to enhance controls over permitted dischargers, and the development of stormwater controls. The 1989 PSWQA Management Plan also identified three new initiatives in the areas of monitoring, research, and education/public involvement.

U.S. Army Corps of Engineers (COE) - Puget Sound Dredged Disposal Analysis (PSDDA)

The COE serves as the lead agency for PSDDA which is responsible for: isolating acceptable sites (PSDDA sites) for open-water unconfined disposal of dredged materials; establishing evaluation procedures; and formulating disposal site management plans. Under the Phase I portion of the PSDDA regulatory development process addressing central Puget Sound, the Port Gardner unconfined aquatic disposal site was established in 1988.

3.0 DEMOGRAPHICS AND LAND USE

Historically, several industries along the Everett - Port Gardner waterfront reportedly existed in the late 1800s, including a smelter with an arsenic concentrating facility; a wood preserving plant; several lumber mills; a steel barge works; and a pulp and paper mill. The locations and specific nature of these facilities were not presented or referenced.

Current land use issues discussed in the plan and directly relevant to East Waterway included activities related to the Port of Everett and the United States Navy Homeport project.

Port of Everett

Plans to demolish the shoreline area now occupied by a dock from the old Weyerhaeuser facility (South Terminal) was noted. The "opportunity" for the dredging and disposal of an estimated 3,800 m^3 of contaminated sediment also was introduced.

Navy Home Port

A brief summary of the Carrier Battle Group port construction project was presented. Element 1 of the project was to result in the dredging and unconfined open-water disposal of approximately 975,000 yd^3 of sediment as part of the construction of a new Carrier Pier and berths to accommodate the carrier Nimitz and six support vessels at the South Mole Wharf. All dredging and disposal was to be performed in accordance to PSDDA requirements. Planned elements 2 and 3 involve the construction of additional berths, and the dredging/disposal of contaminated sediments.

4.0 POTENTIALLY LIABLE PERSONS

The 1989 Action Plan did not directly list or address Potentially Liable Persoons (PLPs), nor was this subject included as one of the EHAP objectives.

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

Specific reference to NPDES-permitted industrial facilities discharging into East Waterway was limited to the Scott Pulp Mill.

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

City of Everett CSOs discharging into East Waterway will not be controlled under the city's CSO Plan until at least 1993. Storm drains in areas of southwest Everett also reportedly drain directly into small local streams which terminate in Port Gardner. Specific details were not presented.

7.0 CHEMICAL DATA

Previous studies performed through funding from the EHAP served as the basis for the corrective actions recommended in the 1989 Action Plan. EHAP documents describing those studies are listed in Section 15 of this document.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

The following relevant statement, specific to East Waterway, was made: "In comparison with other contaminated embayments of Puget Sound, such as Elliot Bay and Commencement Bay where contaminated areas are more widespread, the severely contaminated areas of the Everett Harbor system are highly localized, occurring mainly within the East Waterway and near Mukilteo. Liver tumors were found in approximately 9 percent of English sole (a bottom-dwelling fish) caught in contaminated areas of Everett Harbor, whereas these lesions are usually absent in fish caught

in relatively uncontaminated areas of the Sound. In addition, populations of invertebrate animals living in the bottom sediments were severely reduced in highly contaminated areas."

9.0 DATA QUALITY

Data quality was not directly addressed in the plan. Dredging discussions did refer to PSDDA authority in the context of the Navy Homeport dredging/disposal activities.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

The formation of East Waterway was the result of dike construction projects during the early 1900s which shaped the waterway's western margin, and diverted the Snohomish River flow southward. The modern river system has four main distributary channels, with the Snohomish River Channel maintaining the greatest flow. "During the dry season, tidal saltwater intrusions have been observed as far upstream as 11 kilometers from Preston Point." COE reportedly conducts maintenance dredging in the Snohomish River navigation channel and settling basins every 2 years.

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

Under the direction of COE, PSDDA is recognized as one of the principal authorities for the permitted open-water disposal of dredged noncontaminated and contaminated materials. In addition, the significance of the emerging Ecology sediment quality standards on the dredge-related regulatory matrix also was introduced.

The Port of Everett was planning to conduct dredging near the South Terminal (see Section 3.0), and discussed navigational dredging operations within the Snohomish River channel (see Section 10.0).

12.0 ENVIRONMENTAL IMPACTS

Prioritization of activities for the EHAP was accomplished using five types of environmental indicators to identify and rank problem areas. The indictors were as follows:

- Sediment Chemistry. Contaminant chemical concentrations were determined and applied to established threshold values (Apparent Effects Thresholds) based on statistically significant adverse biological effect data to determine predictable biological impacts.

- Bioaccumulation. Studies were performed to measure the pesticide, PCB, and mercury concentrations in muscle tissue of English sole.

- o Sediment Bioassays. Amphipod mortality and oyster larvae abnormality studies were listed.

- o Benthic Infauna Abundances. Polychaete, crustacean, pelecypod, and gastropod abundance categories were listed.

- o Fish Pathology. Lesion prevalence in the livers of English sole were listed.

The exact manner in which priority problem areas were ranked, and the specific data/studies from which information on the five indicators were obtained was not specified.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

As part of the EHAP, the IAWG and the CAC were formed in 1985. The IAWG is composed of the representatives from federal, state, and local government agencies. The CAC is composed of representatives from business organizations, industries in the study area, and environmental groups. Duties specific to the IAWG and CAC include reviewing program documents, proposed actions, and agency policies; supplying technical information; and disseminating EHAP information to interested parties. Included in the 1989 Action Plan was a listing of the people forming the membership at that time. Those acknowledgments are listed in Attachment C.

Reference made to three new initiatives of the 1989 Puget Sound Water Quality Management Plan included the categories of education and public involvement. The nature of these initiatives and their impact on the EHAP were not discussed.

15.0 RECOMMENDATIONS

Several site-specific actions have been identified for implementation through the members of the IAWG and is summarized in the table presented in Attachment B. Ten actions were planned specific to the East Waterway Problem Area. Ecology was assigned as the agency responsible for the implementation of five of the actions, all of which involved performing inspections of private industrial facilities. The appropriate lead regulatory enforcement programs which would perform the actions were not defined. Clarification of this strategy would be helpful. Also, the plan did not specify current or planned appropriate RCRA responsibilities.

Other subjects introduced and from which further investigation relevant to the Model Toxics Control Act (MTCA) would be appropriate include:

- o Reviewing in greater detail the reference made to historical industries in the study area dating back to the 1800s;
- o Requesting from the City of Everett technical conclusions drawn from the ambient lead study of the Snohomish River;
- o Determining the current status of the planned Port of Everett construction activity for the South Terminal;
- o Conducting additional inquiries with the City of Everett on the southwest Everett storm drains reportedly discharging directly into local streams; and
- o Clarifying of the public involvement requirements defined by the 1989 PSWQ Plan initiatives.

Relevant References

The 1989 Action Plan referred to several documents critical to establishment of EHAP goals and site-specific action plans. Of these documents the references listed below were not included on the current E & E technical document review list, and should be incorporated:

Tetra Tech Inc., 1985, Everett Harbor Toxics Action Program: Initial Data Summaries and Problem Identification, Final Report, prepared for U.S. Environmental Protection Agency Region 10, Office of Puget Sound.

Tetra Tech Inc., 1985, Sampling and Analysis Design for Development of Everett Harbor Action Plan, prepared for U.S. Environmental Protection Agency Region 10, Office of Puget Sound.

16.0 FINAL COMMENTS

It appears that the EHAP has arbitrarily defined the western margin of East Waterway problem area by a line through the middle of the waterway (see maps in Attachment A). The line sharply disconnects the extensive United States Navy Homeport project area from the program's influence. The modern and historic naval contributions to East Waterway are critical to the area's MTCA remedial planning, investigation, and cleanup.

Attachment A

MAPS

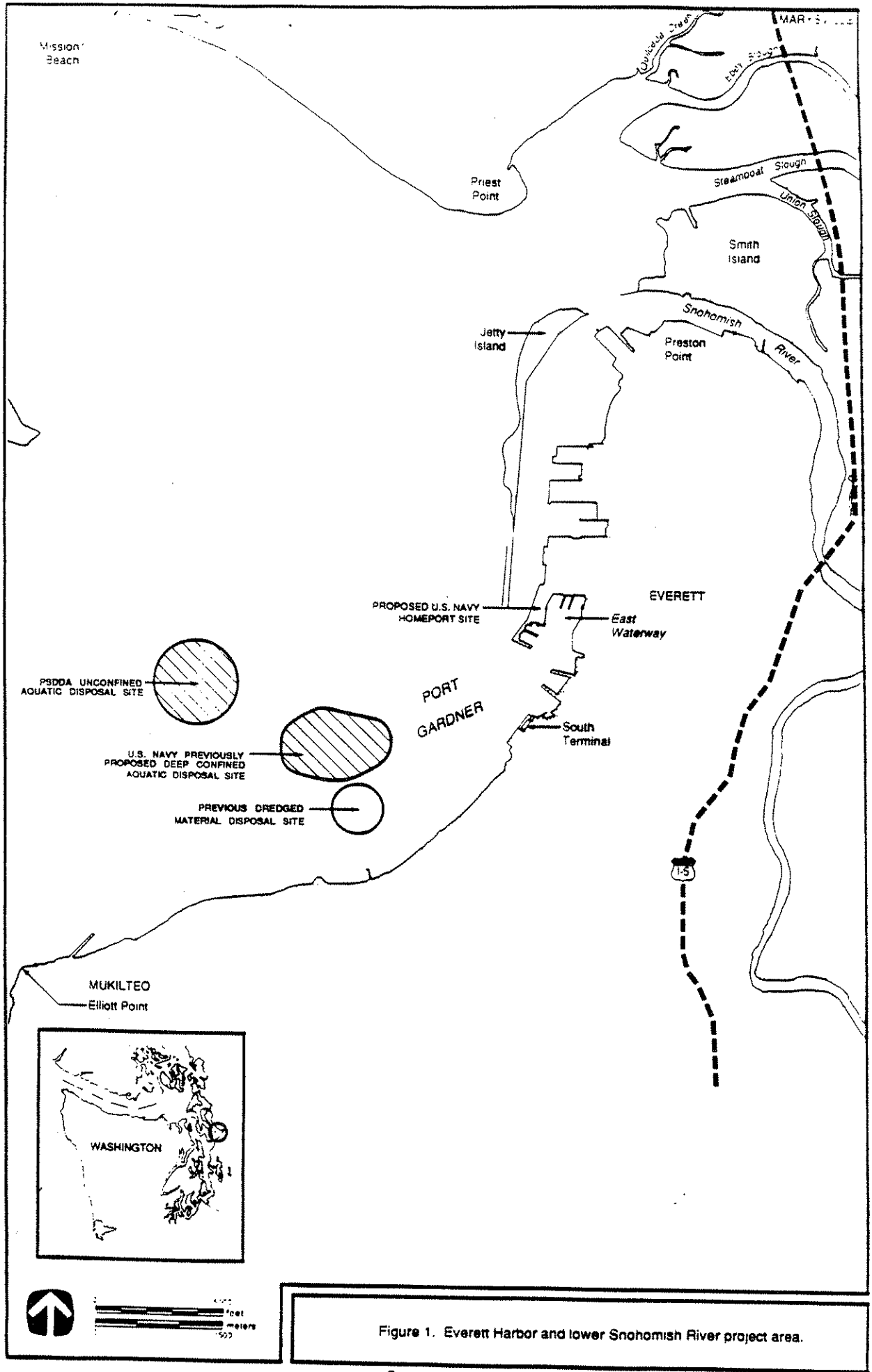

Figure 1. Everett Harbor and lower Snohomish River project area.

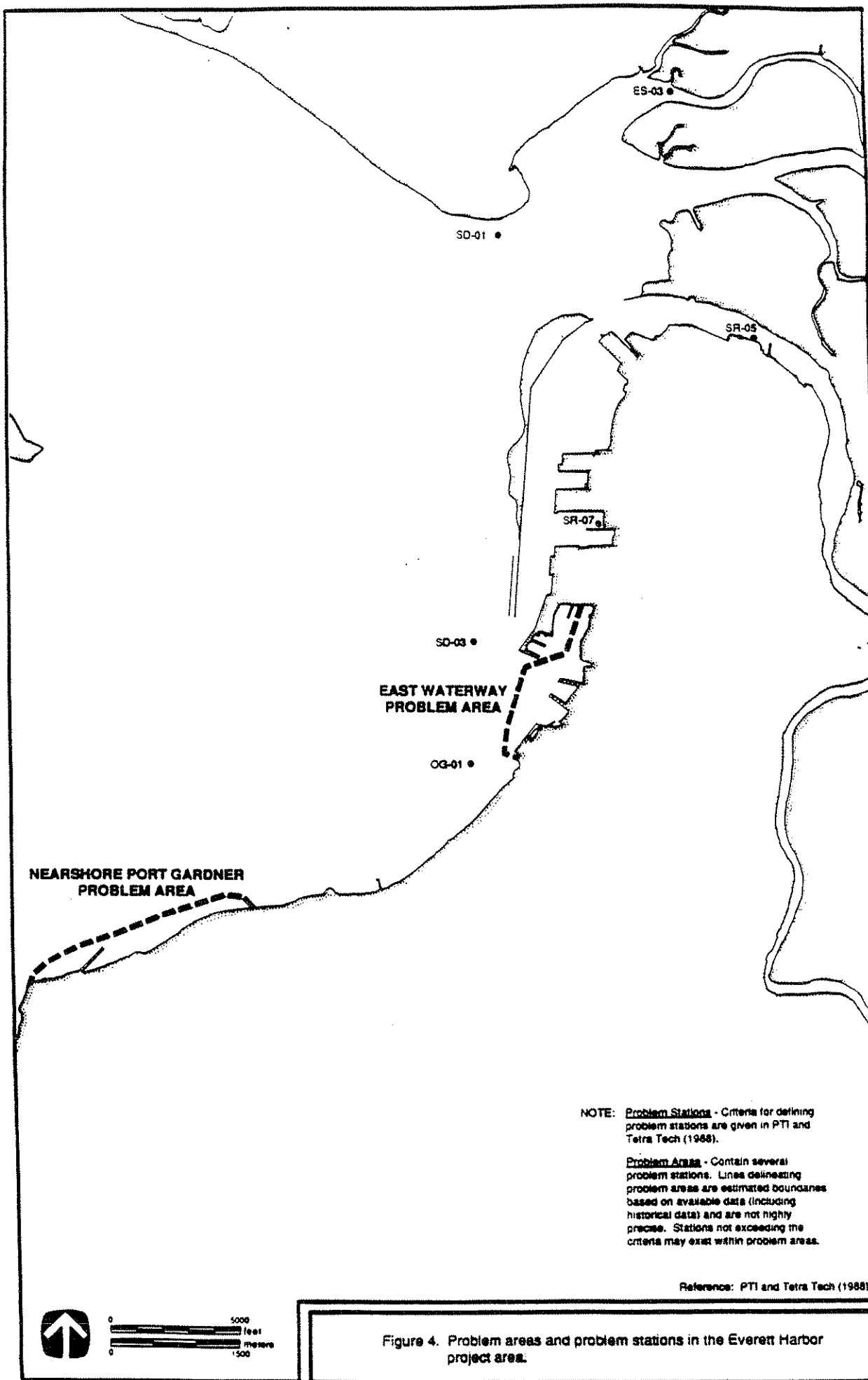

Figure 4. Problem areas and problem stations in the Everett Harbor project area.

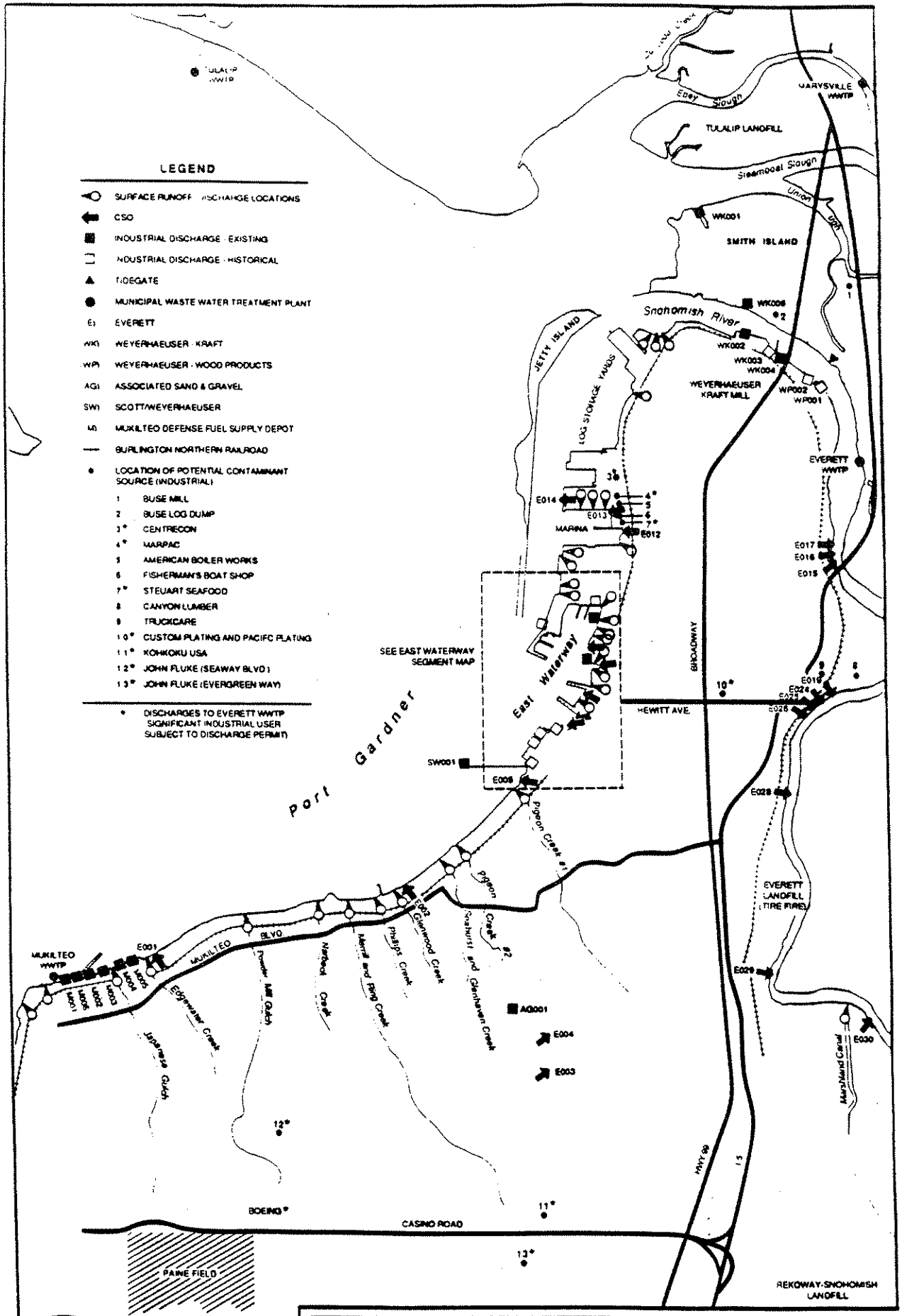

Figure 5. Locations of potential sources of contamination in the Everett Harbor project area.

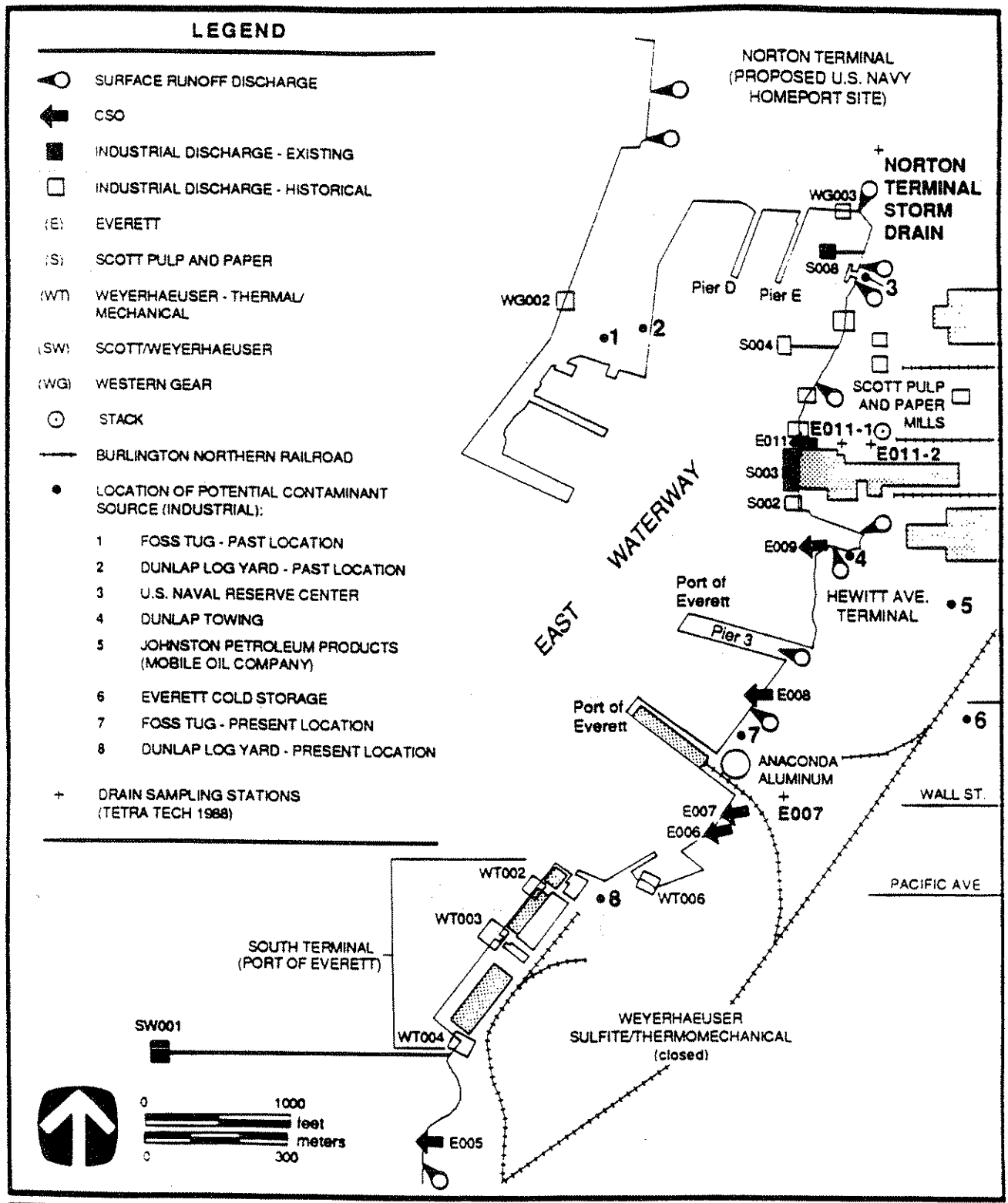

Figure 6. Locations of drain sampling stations, industrial discharge outfalls, CSOs, and storm drains in the East Waterway study area.

Attachment B

SITE-SPECIFIC ACTION PLAN TABLE

TABLE 1. SITE-SPECIFIC ACTION PLAN FOR EVERETT HARBOR PRIORITY PROBLEM AREAS

Problem Areas & Stations	Potential Source	Action	Responsible Entity	Implementation Date
East Waterway Problem Area	Norton Terminal storm drain	Develop an approach for addressing infiltration of contaminants.	Ecology/EHAT	1989
	Scott Pulp and Paper	Perform a Class II inspection and modify permit to include toxic chemical control if necessary.	Ecology	1989
	Anaconda Aluminum Dome	Inspect site and issue permit if needed.	Ecology	1989
	Everett Cold Storage	Inspect site and issue permit if needed.	Ecology	1989
	Mobil Oil Co.	Inspect site and issue permit if needed.	Ecology	1989
	Dunlap Towing	Inspect site and issue permit if needed.	Ecology	1989
	Everett Terminal Company	Inspect site and issue permit if needed.	Ecology	1989
	U.S. Naval Reserve	Issue NPDES permits for storm drains.	EPA	Ongoing
	CSO E011, E008, E009, E006, and E007[a]	To be eliminated	City of Everett	Starting date ~1993
Nearshore Port Gardner Problem Area	Defense Fuel Supply Depot	Work with EPA personnel to institute remedial activities (e.g., product recovery). Remedial investigation in progress.	Ecology/EPA	1989
	Mukilteo wastewater treatment plant	Construct pump station and transfer effluent to Olympus Terrace sewage treatment plant.	City of Mukilteo	1990
	Powdermill Gulch	Implement drainage basin plan, including sampling.	City of Everett	1989
		Conduct a reconnaissance survey for surface drainage sources.	Ecology/EHAT	1989
	Japanese Gulch	Conduct an investigation of past disposal practices and land use.	Ecology Hazardous Waste Division	1990
		Conduct sampling and analysis to characterize discharge.	Ecology/Water Quality Investigation	1989
	Snohomish County Airport - Paine Field	Investigate potential sources.	Ecology	Investigation Completed 7/88
		Continue activities to characterize, clean up, and prevent contamination.	Paine Field Cleanup Committee	Ongoing
	CSO E001/Edgewater Creek[b]	Install interceptor sewer to eliminate CSO.	City of Everett	Completed 1988
Problem Station OG-01	Scott-Weyerhaeuser deepwater diffuser	Conduct a Class II inspection and modify permit to include toxic chemical control if necessary.	Ecology	1989

TABLE 1. (Continued)

Problem Areas & Stations	Potential Source	Action	Responsible Entity	Implementation Date
Problem Station SR-05	Weyerhaeuser Kraft Mill WK002, WK004, WK005	Perform a Class II inspection and modify permit to include toxic chemical control if necessary.	Ecology	1989
	Everett wastewater treatment plant	Conduct a study for alternative outfall site and flow-paced chlorination system.	City of Everett/Ecology	Completed
		Conduct a study on ambient lead levels in the Snohomish River, including low-flow (summer) conditions.	City of Everett	Completed
		Implement pretreatment program.	City of Everett	Ongoing
		Construct recirculation channels for lagoons and dredge sediment from aeration cells.	City of Everett	6/89
		Design and construct mechanical plant.	City of Everett	1988-1991
	Log storage yards	Inspect site and issue permit if necessary.	Ecology	1989
Problem Station ES-03	Tulalip landfill	Develop financing mechanisms for placing capping material over landfill.	Tulalip Tribes	Ongoing
		Sample leachate and receiving water for pathogens.	Ecology/EHAT, EPA	Completed 1988
	Quilceda Creek	Continue conservation planning and technical assistance efforts at dairies, and continue public education/public involvement effort	Snohomish Conservation District/Tulalip Tribes	Ongoing
		Perform a regional detention facility study.	Snohomish Conservation District	1990
	Marysville wastewater treatment plant	Add eight influent aerators and three grinders.	City of Marysville	1990
	Boeing test facility	Investigate possible hazardous waste leachate to Quilceda Creek.	Boeing/Ecology	1989
Problem Station SR-07	Marina area	Investigate potential sources, including pretreatment permitted facilities, boat repair facilities, storm drains, and boat basin.	Ecology	Completed 1987
		Issue permits	Ecology	1989
	CSO E012[c]	To be eliminated	City of Everett	1992
	CSO E013[d]	To be eliminated	City of Everett	1992
	Surface runoff	Monitor	Ecology/COE	1989

[a] CSO E006-Approximately 100 meters southeast of Pier 1
CSO E007-Approximately 80 meters southeast of Pier 1
CSO E008-Approximately 100 meters southeast of Pier 3 (at the foot of Hewitt Avenue)
CSO E009-Approximately 300 meters north of Pier 3 (at the foot of 25th Street).
CSO E011-Approximately 300 meters north of CSO E009 (at the foot of 23rd Street).
[b] CSO E001-Adjacent to Eedgewater Creek.
[c] CSO E012-At the foot of 16th Street in the marina.
[d] CSO E013-At the foot of 14th Street in the marina.

Attachment C

ACKNOWLEDGEMENTS LIST

ACKNOWLEDGMENTS

This document was prepared by PTI Environmental Services under the direction of Dr. Robert A. Pastorok for the U.S. Environmental Protection Agency (EPA) in partial fulfillment of Contract No. 68D80085. This project was funded through the National Estuary Program under the authority of the Clean Water Act as amended. Funding was approved by the EPA Office of Marine and Estuarine Protection. An earlier draft of this report was prepared under contract to Tetra Tech, Inc. for EPA. Dr. Jean Jacoby was the technical monitor for Tetra Tech, Inc. Dr. Lawrence McCrone, Ms. Clare Ryan, Ms. Martha Burke, and Dr. John Armstrong served as technical monitors for EPA Region 10 throughout various phases of the project.

The primary authors of this report are Mr. Pieter Booth and Dr. Robert Pastorok of PTI Environmental Services. Dr. Thomas Ginn of PTI provided technical review comments.

The Everett Harbor Action Program has benefited from the participation of an Interagency Work Group and a Citizens Advisory Committee. Duties of the Everett Harbor Interagency Work Group and Citizens Advisory Committee members included the following: 1) reviewing program documents, agency policies, and proposed actions; 2) providing data reports and other technical information to the U.S. Environmental Protection Agency; and 3) disseminating information to interest groups or constituencies. The past and continuing efforts of the Everett Harbor Interagency Work Group and Citizens Advisory Committee members are greatly appreciated. Special thanks are due to Ms. Joan Thomas, Mr. David Murdock, Mr. David Nunnallee, and Mr. John Williams for chairing the Everett Harbor Interagency Work Group and to Mr. Gary Wold for chairing the Everett Harbor Citizens Advisory Committee. Members of the Everett Harbor Interagency Work Group and Citizens Advisory Committee are listed below.

Everett Harbor Interagency Work Group

Name	Affiliation
Mr. Chuck Dunn	U.S. Fish and Wildlife Service
Ms. Katherine Fletcher	Puget Sound Water Quality Authority
Dr. Jack Gakstatter	U.S. Environmental Protection Agency
Mr. Dennis Gregoire	Port of Everett
Mr. Nathan Jacobson	Snohomish Conservation District
Dr. David Jamison	Washington Department of Natural Resources
Mr. Edward Long	National Oceanic and Atmospheric Administration
Mr. Edward Lukjanowicz	U.S. Navy Homeporting Office
Mr. David Peterson	Snohomish Health District
Dr. Lawrence McCrone	Washington Department of Ecology
Mr. William Moore	Mayor of Everett
Mr. David Murdock	Washington Department of Ecology
Mr. Thomas Niemann	Snohomish County Planning Department
Mr. David Nunnallee	Washington Department of Ecology
Mr. Clair Olivers	City of Everett
Ms. Sandra O'Neil	Washington Department of Fisheries

Name	Affiliation

Everett Harbor Interagency Work Group (continued)

Mr. David Peterson	Snohomish Health District
Ms. Clare Ryan	Washington Department of Ecology
Mr. Carl Sagerser	Washington Department of Social and Health Services
Mr. David Somers	Tulalip Tribes
Ms. Joan Thomas	Washington Department of Ecology
Mr. Ron Thomas	City of Everett
Mr. James Thornton	Washington Department of Ecology
Mr. John Underwood	U.S. Environmental Protection Agency
Mr. Frank Urabeck	U.S. Army Corps of Engineers, Seattle District
Mr. John Williams	Washington Department of Ecology
Mr. Harry Winder	Port of Everett
Mr. William Yake	Washington Department of Ecology
Lt. Cmdr. Greg Yaroch	Port Marine Safety Office

Everett Harbor Citizens Advisory Committee

Name	Affiliation
Mr. Dennis Atkinson	Everett Chamber of Commerce
Mr. Timothy Bechtel	Scott Paper Company
Mr. Ronald Brown	Friends of the Snohomish River
Mr. William Brust	Citizens for Everett's Future
Mr. T.M. Burns	Everett Chamber of Commerce
Mr. Carl Cady	Weyerhaeuser Company
Mr. Michael Deller	Snohomish County Economic Development Council
Mr. Alan Friedman	Sierra Club
Ms. Anne Grubb	Pilchuck Audubon Society
Ms. Lorena Havens	Friends of Snohomish Delta
Mr. James Heil	Puget Sound Alliance
Mr. Mark Houser	Port Gardner Information League
Mr. Peter Hurley	Evergreen Coalition
Mr. Henry Kral	Everett Mountaineers
Mr. Donald Kusler	Pilchuck Audubon Toxics
Ms. Sally Van Niel	Washington Environmental Council
Mr. Gary Wold	Trout Unlimited

Appendix

K

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

SAIC, 1989, Summary Technical Memorandum Review of Scott Everett Pulp and Paper Mill, 304 (l) Technical Assistance (Region 10), draft, prepared for U.S. Environmental Protection Agency, Region 10, 27 pp.

Contract No. C0089007

Document Control No. WD4030.1.0-K

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
International Specialists in the Environment

EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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X	Section 2.0	LEGAL AND REGULATORY ISSUES
	Section 3.0	DEMOGRAPHICS AND LAND USE
X	Section 4.0	POTENTIALLY LIABLE PERSONS
X	Section 5.0	IDENTIFICATION OF POLLUTION POINT SOURCES
X	Section 6.0	IDENTIFICATION OF POLLUTION NON-POINT SOURCES
X	Section 7.0	CHEMICAL DATA
X	Section 8.0	BIOLOGICAL DATA (FLORA/FAUNA)
X	Section 9.0	DATA QUALITY
	Section 10.0	HYDROLOGIC AND HYDRODYNAMIC INFORMATION
	Section 11.0	DREDGING AND DISPOSAL ISSUES AND DATA
	Section 12.0	ENVIRONMENTAL IMPACTS
	Section 13.0	INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES
	Section 14.0	COMMUNITY RELATIONS INFORMATION
X	Section 15.0	RECOMMENDATIONS
	Section 16.0	FINAL COMMENTS

ATTACHMENTS

Attachment A - Location of Scott Outfalls and Other Discharges to East Waterway
Attachment B - Water Quality Data Summary
Attachment C - Raw Water Quality Data
Attachment D - Whole Effluent Toxicity Summary Data
Attachment E - Sediment Toxicity Data

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

Amendments to the Clean Water Act in 1987 required states to develop lists [304(l)(1)(b) short lists] of navigable waters impaired primarily as a result of the discharge of Section 307(a) toxic pollutants and which, after the application of effluent limitations, could not reasonably be expected to meet water quality standards. For each segment of the water bodies included on these lists, the states were to identify specific point sources discharging such toxic pollutants. For each segment determined to be contributing to the water body impairment, the states were to develop individual control strategies (ICSs) to reduce the discharge of toxic pollutants.

Port Gardner/Inner Everett Harbor was included on the Washington State Department of Ecology (Ecology) 304(l) short list. Science Applications International Corporation (SAIC) was engaged by the United States Environmental Protection Agency (EPA) to provide 304(l) technical assistance for an investigation of the Scott Paper Company (Scott) sulfite pulp and paper mill in Everett, Washington, which discharges into this water body. The purpose of SAIC's work assignment was to prepare a summary of existing information on the facility and receiving water and, on the basis of that information, determine the role of Scott discharges in relation to the impairment, evaluate whole effluent and sediment toxicity, and provide recommendations relative to the ICS.

Chronology of Events

The following significant events were presented in the document:

- o 1930: Scott sulfite pulp and paper mill began operations.
- o 1951: Outfall SW001 was constructed and began operations as a shared facility with the Weyerhaeuser Thermomechanical Plant.
- o 1980: Scott constructed a secondary wastewater treatment plant (WWTP).
- o 1980: Outfall S008 was constructed to discharge secondary effluent from the Scott wastewater treatment plant (WWTP).
- o 1980: Weyerhaeuser Thermomechanical Plant was closed.
- o 1981: Scott production rates - 518 tons/day bleached sulfite pulp, 32 tons/day groundwood pulp; 41 tons/day nonintegrated tissue paper.
- o 1989: (February) Port Gardner/Inner Everett Harbor was included on the Ecology 304(l)(1)(B) short list.

- Sampling dates for three existing, National Pollution Discharge Elimination System (NPDES) permitted Scott outfalls were:

  - 1980 data submitted with 1980 NPDES permit application;
  - 1982 to 1983;
  - June 1985; and
  - October 1986 Ecology Class II inspection.

2.0 LEGAL AND REGULATORY ISSUES

Legal and regulatory issues presented in the document are provided below.

- The inclusion of Inner Everett Harbor on the 304(l)(1)(B) short list was due to violation of Ecology narrative water quality criteria not specifically identified in the document.

- The June 24, 1985, Scott NPDES permit expired on June 24, 1990. The permit contained average daily effluent limits for biological oxygen demand (BOD), total suspended solids (TSS), and pH as follows:

  - BOD: 16,800 lb/day;
  - TSS: 25,300 lb/day; and
  - pH: 5.0 to 9.0 with some excursions permitted for outfalls S001 and S003.

  Priority pollutants were not regulated by this permit.

- The following measures were recommended for inclusion in the Scott 1990 NPDES permit in order to meet the intent and satisfy the ICS requirements of 304(l):

  - Determine the mixing zone for outfalls S003 and S008 using computer modeling. It was proposed that information be used in combination with future priority pollutant scans to evaluate chronic toxicity at the edge of the dilution zone.

  - Incorporate quarterly or semiannual chronic toxicity testing into the permit for two "appropriately" chosen species.

  - Require periodic or annual amphipod bioassays both underneath and outside the dilution zone.

  - Require annual effluent characterization (priority pollutants, resin acids, and chlorinated phenols/guaiacols.

  - Require periodic ambient water quality monitoring for selected contaminants for comparison with state criteria. Exceedances would be remedied with additional source controls.

These recommendations did not address specific control strategies as required by the amendments to the Clean Water Act. Rather, they provided for additional data gathering to amass information from which control strategies could be developed should they be deemed necessary. This does not entirely meet the intent of the ICS which is to reduce the discharge of 307(a) toxic pollutants from identified point sources.

- Scott currently has a chemical control management system which requires all proposed chemicals to be evaluated for rainbow trout toxicity.

- Scott outfalls S001 and S003 discharge to Class A and Class B waters of the state, respectively.

- EPA chronic toxicity criteria have been adopted by the state and are applicable outside the permitted Scott outfall dilution zones.

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

Identification and location of industries that were considered potential contaminant sources are provided in Attachment A. Discussions in the document of past and present industrial uses were limited primarily to Scott Industries and are presented throughout this review in appropriate sections.

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

Locations of point source discharges for Scott Industries and other industrial and municipal operations discharging into East Waterway and its immediate vicinity are provided in Attachment A. According to the report, Scott currently has three NPDES permitted outfalls. These include:

- SW001 - discharging 6 million gallons per day (MGD), 2,000 feet offshore into Port Gardner;

- S003 - discharging 7 MGD through a nearshore diffuser into the mouth of East Waterway adjacent to the paper mill; and

- S008 - discharging 13.5 MGD of secondary treated effluent near the head of East Waterway.

Average daily total combined discharge from these outfalls for the period of January 1985 through April 1988 was 28 MGD.

Wastewater discharged from both SW001 and S003 receive primary treatment in two sedimentation clarifiers. The wastewater treatment plant (WWTP) operates using an activated sludge treatment system. It was designed to receive wastestreams exhibiting high BOD including:

- o Spent sulfite liquor recovery system wastes;
- o Pulp mill wastewaters;
- o Bleach plant wastes;
- o Sludge dewatering filtrate; and
- o Wastewater from the pulp mill floor trenches.

It has been assumed by the authors of the document that the deep water diffuser of SW001 provides adequate dilution and flushing, but the magnitude of circulation in Everett Harbor is insufficient to provide effective mixing of S003 and S008. However, there is no available supporting information to substantiate these assumptions.

Outfalls S002 and S004, historically operated by Scott prior to the construction of the WWTP, discharged untreated pulp bleaching wastewater and water from the paper mill floor, respectively.

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

In general, stormwater flows were considered insignificant to the total Scott discharge by the authors of the document. No supporting documentation (i.e., flow data) for this conclusion was provided. Stormwater runoff for Scott facilities is handled as follows:

- o Runoff from the paper mill area is routed through the clarifiers and is discharged through SW001 and S003;
- o Runoff from the pulp mill is discharged directly through S003; and
- o Other property is served by four storm drains.

7.0 CHEMICAL DATA

No chemical data were generated as a result of this study; however, all existing information related to the Scott Everett facility was obtained and used. Chemical water quality data summaries and raw data used to evaluate the facility and formulate the study recommendations (see Section 2) are included in Attachments B and C, respectively. Data sources are identified in the data summary tables.

Water Quality Compliance Criteria

SW001 - It was estimated, based on the existing data, that wastewater discharged from outfall SW001 would require a dilution ratio of 10:1 (seawater to wastewater), or less, to comply with EPA water quality

criteria. As previously noted, it was assumed by the authors that the diffuser meets these dilution requirements. The following effluent conditions were noted:

- o EPA chronic criteria were exceeded for concentrations of zinc (Zn), copper (Cu), lead (Pb), and nickel (Ni);
- o Phthalate ester concentrations exceeded the federal LOEL;
- o Volatile compounds detected were chloroform, acetone, and ethyl benzene;
- o Semivolatile compounds detected were 4-methyl phenol, benzoic acid, phenols, and phthalate esters; and
- o The 1980 data set exhibited the greatest number of exceedances, whereas, more recent data suggest improvements in effluent conditions.

S003 - Estimates of dilution ratio requirements for outfall S003 were also 10:1. It is not known whether these requirements are met. The following effluent conditions were noted:

- o EPA chronic criteria for Cu, Pb, and mercury (Hg) were exceeded in 1980;
- o Volatile compounds detected were chloroform, acetone, ethyl benzene, and methylene chloride;
- o The only semivolatile compounds detected were phenols; and
- o Two resin acids, dehydroabietic acid (DHA) and abietic acid, were detected.

DHA is known to accumulate in major organs of salmon and is persistent in sediments with a half-life of 20 years.

S008 - Estimates of dilution ratio requirements for outfall S008 were 6:1. The authors assumed that initial dilution may be limited because of the location of the outfall in the upper reaches of the waterway. The following effluent conditions were noted:

- o EPA chronic criteria for Cu, Ni, Pb, and Zn were exceeded;
- o Volatile compounds detected were chloroform, acetone, and carbon tetrachloride;
- o Phenols were the only semivolatile compounds detected; and
- o DHA and rentene were detected.

The authors noted that the priority pollutant database for East Waterway is limited. It was noted by the reviewer that analyses for dioxins apparently have not been done or were not available at the time this work took place.

Data Quality

No information regarding data quality was included in the data packages. Neither method references nor quality control sample results were included in the report. Several pages of the raw data were unreadable.

Methylene chloride, a common laboratory contaminant, reported as a contaminant in S003 also was detected in the blank, indicating possible laboratory contamination. The reviewer was unable to assess the reliability of reported phthalate contamination; however, it is also a common laboratory contaminant and was found at relatively low concentrations.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

Whole Effluent Toxicity

Whole effluent toxicity was evaluated based on Scott effluent bioassay results (1982-1988) and Ecology narrative standards for effluent toxicity in surface waters ("i.e., no acute toxicity within a defined mixing zone, and no acute or chronic toxicity at the edge of the dilution zone"). Data summaries are presented in Attachment D. The following conditions were noted:

- Outfalls SW001 and S003 had the greatest number of bioassay failures;
- Outfall S008 had only two failures attributed to high ammonia levels;
- The majority of failures took place in 1984 and 1985;
- Reductions in bioassay failures were observed in 1986-1987 after Scott took action (presumably in 1985) to reduce effluent toxicity.

Sediment Toxicity

The sediment toxicity evaluation was based on data generated as a part of the Everett Harbor Action Program. Sampling stations and data are included in Appendix E. Sampling and analyses, conducted during August through October 1986, included sediment chemical analysis, amphipod bioassays, and benthic invertebrate community characterization.

Contamination was related to the pulp mill based on geochemical indicators including: chlorinated resin acids and chlorinated guaiacols; non-chlorinated resin acids; chlorinated phenols; rentenes; and diterpenoid hydrocarbons. General findings were:

- The eastern shore of East Waterway was the most contaminated area of Everett Harbor.
- Organic compounds were much more widely distributed at elevated levels than inorganic compounds;
- Stations sampled near SW001, S003, and S008 during the study exhibited maximum concentrations of various chemicals and "severe" effects for amphipod bioassays and indigenous invertebrate populations.
- Amphipod mortality was high when high concentrations of 4-methyl phenol, rentene, total organic carbon (TOC), chlorinated phenols, resin acids, and sulfides were present. Note that 4-methyl phenol, TOC, and sulfides were not identified by the authors as geochemical tracers for the pulp mill).
- S008 - High apparent effects thresholds (HAETs) for phenols and 4-methyl phenol were exceeded. There was 100 percent mortality for all bioassay replicates, and abundance of three of the four major taxonomic groups were "significantly" reduced (no statistics were included in the report).
- S003 - HAETs for 4-methyl phenol, phenol, 2-methyl phenol, 2-4-dimethyl phenol, benzyl alcohol, polychlorinated biphenyls (PCBs), 1-2-dichlorobenzene, and TOC were exceeded. There was 95 to 100 percent mortality for all bioassay replicates, and TOC, at 29 percent mortality, was the highest observed in the study.
- SW001 - HAETs were exceeded for 4-methyl phenol.
- Biological impacts at all stations outside East Waterway were less "significant" than those observed inside the waterway.

Data Quality

Aspects of data quality were not presented in the report. Data were presented as summary tables only.

9.0 DATA QUALITY

Data quality cannot be evaluated by the reviewer because sufficient information was not included in the report. It is unknown whether or not the authors had access to information sufficient to complete this task prior to using the data for their work.

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

N/A

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

Various chemical contaminants have been identified as being associated with the Scott pulp and paper mill discharge, whereas other contaminants, identified as contributing to the toxic effects on biological communities, have not been linked to a source. A source/ contaminant list should be compiled. Once all the documentation currently available for the East Waterway has been reviewed it may be possible to begin to compile such a list. All identified existing contaminants should be verified during any Remedial Investigation/ Feasibility Study or sediment cleanup study conducted for the waterway.

16.0 FINAL COMMENTS

The reviewer has no additional comments.

Attachment A

LOCATIONS OF SCOTT OUTFALLS AND OTHER
DISCHARGES TO EAST WATERWAY

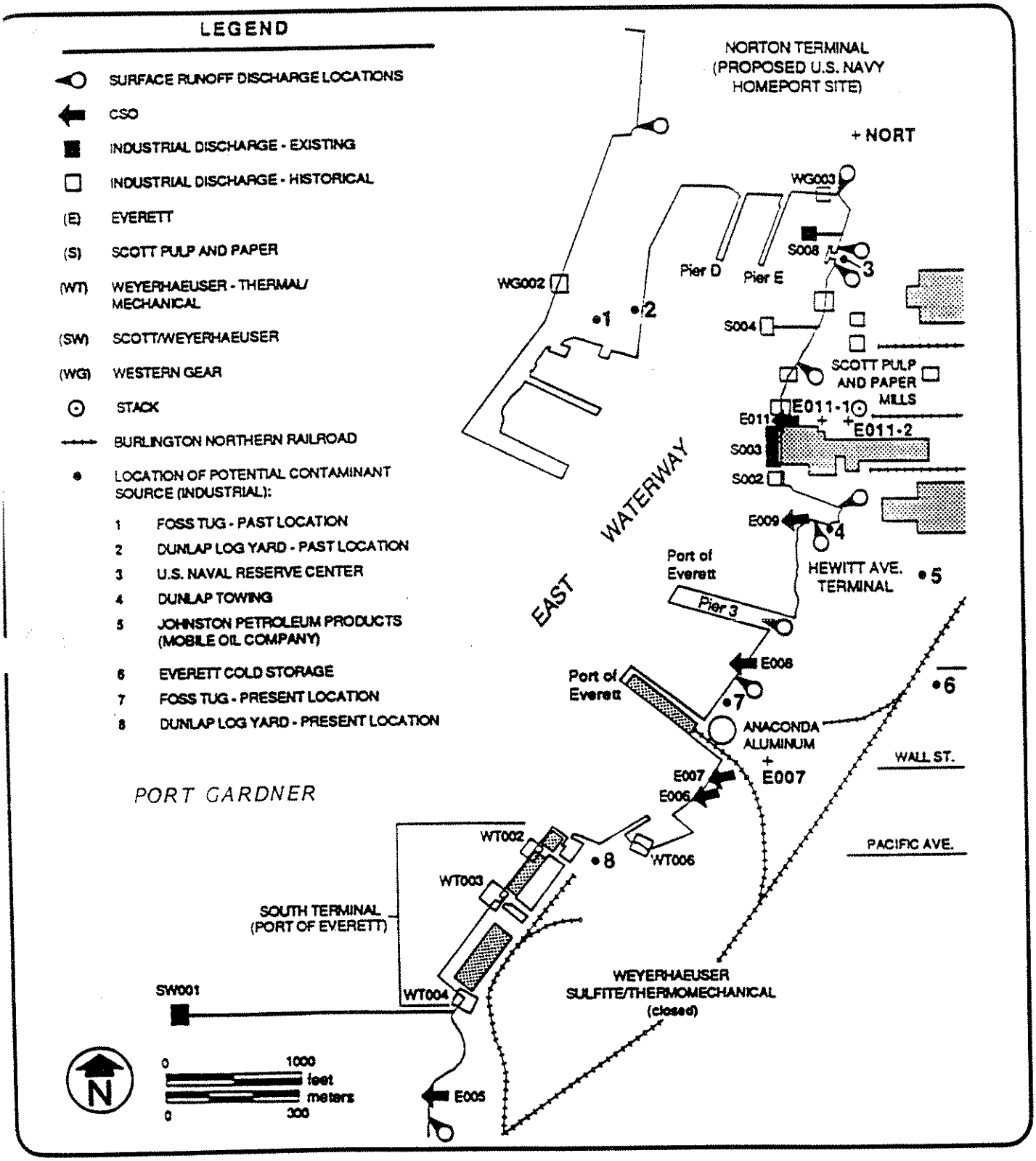

Figure 2

LOCATIONS OF SCOTT OUTFALLS AND OTHER DISCHARGES
TO THE EAST WATERWAY
Source: Adapted from Tetra Tech, 1988

Attachment B

DATA SUMMARY

Table 1

COMPOUNDS DETECTED IN SCOTT EVERETT OUTFALLS[a]

OUTFALL 001

Sample Date	Compound	Effluent Concentration (ug/L)	EPA Marine Criteria Acute	Chronic	Sample/ Critera Ratio Acute	Chronic
Oct 1986	METALS (Total)					
	Cadmium	1.6	43	9.3		
	Nickel	5.0	140	7.1		
	Zinc	82.0	170	58		1.41
	VOLATILES					
	Acetone	200	Unk	Unk		
	Chloroform	79	Unk	Unk		
	Total Xylenes	9	Unk	Unk		
	SEMIVOLATILES					
	Benzoic Acid	57	Unk	Unk		
	4-Methylphenol	9.4	Unk	Unk		
	Diethylphthalate	4.7	Unk	Unk		
	Bis (2-Ethylhexyl) Phthalate	1.9[b]	2,944[c]	3.4[c]		
June 1985	METALS (Total)					
	Cadmium	1.0	43	9.3		
	Chromium	5.0	1,100[d]	50		
	Copper	4.0	2.9	2.9	1.38	1.38
	Zinc	45.0	170	58		
1982-1983	VOLATILES					
	Chloroform	107	Unk	Unk		
	Ethyl Benzene	21	430[c]	Unk		
1980	METALS (Total)					
	Antimony	0.8	Unk	Unk		
	Arsenic	0.4	69[e]	36[e]		
	Chromium	9.0	1,100[d]	50		
	Copper	26.0	2.9	2.9	8.97	8.97
	Lead	62.0	140	5.6		11.07
	Nickel	9.0	140	7.1		1.27
	Selenium	1.5	410	54		
	Zinc	97.0	170	58		1.67
	VOLATILES					
	Chloroform	50	Unk	Unk		
	Ethyl Benzene	25	430[c]	Unk		

Table 1 (cont'd)

COMPOUNDS DETECTED IN SCOTT EVERETT OUTFALLS[a]

OUTFALL 001

Sample Date	Compound	Effluent Concentration (ug/L)	EPA Marine Criteria Acute	Chronic	Sample/ Critera Ratio Acute	Chronic
	SEMIVOLATILES					
	Bis (2-Ethylhexyl) Phthalate	11	2,944[c]	3.4[c]		3.23
	Butyl Benzyl Phthalate	12	2,944[c]	3.4[c]		3.53
	Phenols	58.6	5,800[c]	Unk		

Table 1 (cont'd)

COMPOUNDS DETECTED IN SCOTT EVERETT OUTFALLS[a]

OUTFALL 003

Sample Date	Compound	Effluent Concentration (ug/L)	EPA Marine Criteria Acute	Chronic	Sample/ Critera Ratio Acute	Chronic
Oct 1986	METALS (Total)					
	Cadmium	1.6	43	9.3		
	Nickel	5.0	140	7.1		
	Zinc	33	170	58		
	VOLATILES					
	Acetone	130	Unk	Unk		
	Chloroform	35	Unk	Unk		
	SEMIVOLATILES					
	Bis (2-Ethylhexyl) Phthalate	1.9[b]	2,944[c]	3.4[c]		
une 1985	METALS (Total)					
	Chromium	5.0	1,100[d]	50		
	Zinc	17.0	170	58		
1982-1983	VOLATILES					
	Chloroform	373	Unk	Unk		
	RESIN ACIDS					
	Dehydroabietic	35	Unk	Unk		
	Abietic	4	Unk	Unk		
1980	METALS (Total)					
	Antimony	0.5	Unk	Unk		
	Arsenic	0.2	69[e]	36[e]		
	Chromium	11	1,100[d]	50[d]		
	Copper	28	2.9	2.9	9.66	9.66
	Lead	60	140	5.6		10.71
	Mercury	0.26	2.1	0.025		10.40
	Nickel	9	140	7.1		1.27
	Zinc	9	170	58		
	VOLATILES					
	Chloroform	29	Unk	Unk		
	Ethyl Benzene	48	430[c]	Unk		
	Methylene Chloride	18	12,000[c]	6,400[c]		
	SEMIVOLATILES					
	Bis (2-Ethylhexyl) Phthalate	13	2,944[c]	3.4[c]		3.82
	Phenols	62.6	5,800[c]	Unk		

Table 1 (cont'd)

COMPOUNDS DETECTED IN SCOTT EVERETT OUTFALLS[a]

OUTFALL 008

Sample Date	Compound	Effluent Concentration (ug/L)	EPA Marine Criteria Acute	Chronic	Sample/ Critera Ratio Acute	Chronic
Oct 1986	METALS (Total)					
	Cadmium	1.7	43	9.3		
	Zinc	73	170	58		1.26
	VOLATILES					
	Acetone	15	Unk	Unk		
	Chloroform	66	Unk	Unk		
	SEMIVOLATILES					
	Bis (2-Ethylhexyl) Phthalate	1.4[b]	2,944[c]	3.4[c]		
June 1985	METALS (Total)					
	Cadmium	2.0	43	9.3		
	Chromium	10.0	1,100[d]	50[d]		
	Copper	2.0	2.9	2.9	1.45	1.45
	Nickel	7.0	140	7.1		
	Silver	1.8	2.3	Unk		
	Zinc	44.0	170	58		
1982-1983	VOLATILES					
	Chloroform	1130.0	Unk	Unk		
	Carbon Tetrachloride	10	50,000[c]	Unk		
	RESIN ACIDS					
	Dehydroabietic	18	Unk	Unk		
	Retene	45	Unk	Unk		
1980	METALS (Total)					
	Antimony	1.3	Unk	Unk		
	Arsenic	0.4	69[e]	36[e]		
	Cadmium	3.4	43	9.3		
	Chromium	18	1,100[d]	50[d]		
	Copper	17	2.9	2.9	5.86	5.96
	Lead	34	140	5.6		6.07
	Nickel	30	140	7.1		4.22
	Selenium	2	410	54		
	Thallium	55	2,130[c]	Unk		
	Zinc	78	170	58		1.34

Table 1 (cont'd)

COMPOUNDS DETECTED IN SCOTT EVERETT OUTFALLS[a]

OUTFALL 008

Sample Date	Compound	Effluent Concentration (ug/L)	EPA Marine Criteria Acute	Chronic	Sample/ Critera Ratio Acute	Chronic
	VOLATILES					
	Chloroform	138	Unk	Unk		
	SEMIVOLATILES					
	Phenols	111	5,800[c]	Unk		

---

[a] 1986 data from WDOE Class II inspection report.
1985 data from Scott; additional NPDES Permit Application Data.
1982-1983 data from various sources compiled by Tetra Tech, 1988.
1980 data from Scott NPDES Permit Application and EPA Storet; compiled by Tetra Tech, 1985.

[b] Estimated value.

[c] Insufficient data to develop criteria. Value presented in the Lowest Observed Effect Level (LOEL).

[d] Hexavalent state, Cr^{+6}

[e] Trivalent state, As^{+3}

Unk Unknown

Attachment C

RAW WATER QUALITY DATA

The material in this attachment was taken from the original document. Three Form I's are not legible.

1986 DATA

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Scott Paper
COI-Comp

ORGANICS ANALYSIS DATA SHEET
(Page 1)

boratory Name: ANALYTICAL RESOURCES, INC.
n Sample ID 273A
mple Matrix Waters

Client: Department of Ecology
QC Report No: 273
Project No: DOE 338A Account;429
Date Received: 10/6/86

ta Release Authorized:

VOLATILE COMPOUNDS

Date Prepared: 10/9/86
Date Analyzed: 10/9/86
Conc/Dil Factor: TO 1 pH: NA
Percent moisture: (Not decanted) NA

CAS Number		ug/L
4-87-3	Chloromethane	10 U
4-83-9	Bromomethane	10 U
5-01-4	Vinyl Chloride	10 U
5-00-3	Chloroethane	10 U
75-09-2	**Methylene Chloride**	**6 B**
67-64-1	**Acetone**	**200**
75-15-0	Carbon Disulfide	5 U
75-35-4	1,1-Dichloroethene	5 U
75-34-3	1,1-Dichloroethane	5 U
156-60-5	Trans-1,2-Dichloroethene	5 U
67-66-3	**Chloroform**	**79**
107-06-2	1,2-Dichloroethane	5 U
78-93-3	2-Butanone	10 U
71-55-6	1,1,1-Trichloroethane	5 U
56-23-5	Carbon Tetrachloride	5 U
108-05-4	Vinyl Acetate	10 U
75-27-4	Bromodichloromethane	5 U

CAS Number		ug/L
78-87-5	1,2-Dichloropropane	5 U
10061-02-6	Trans-1,3-Dichloropropene	5 U
79-01-6	Trichloroethene	5 U
124-48-1	Dibromochloromethane	5 U
79-00-5	1,1,2-Trichloroethane	5 U
71-43-2	Benzene	5 U
10061-01-5	cis-1,3-Dichloropropene	5 U
110-75-8	2-Chloroethylvinylether	10 U
75-25-2	Bromoform	5 U
108-10-1	4-Methyl-2-Pentanone	10 U
591-78-6	2-Hexanone	10 U
127-18-4	Tetrachloroethene	5 U
79-34-5	1,1,2,2-Tetrachloroethane	5 U
108-88-3	Toluene	5 U
108-90-7	Chlorobenzene	5 U
100-41-4	Ethylbenzene	5 U
100-42-5	Styrene	5 U
	Total Xylenes	**9**

Data Reporting Qualifiers

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with U based on necessary concentration/dilution action.
J	Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds or when result is less than specified DL.
T	This flag applies with a 'hit' is not acceptable by EPA protocol but is considered 'real' by the analyst
B	This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination.
K	This flag is used when the quantitated value falls above the limit of the calibration curve. Indicates a dilution should be run to determine exact concentration

1986 DATA

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Scott Paper
003-Grab

ORGANICS ANALYSIS DATA SHEET
(Page 1)

Laboratory Name: ANALYTICAL RESOURCES, INC.
Lab Sample ID 2738
Sample Matrix Waters

Data Release Authorized: Susan D Klein

Client: Department of Ecology
QC Report No: 273
Project No: 00E 338A Account:429
Date Received: 10/6/86

VOLATILE COMPOUNDS

Date Prepared: 10/10/86
Date Analyzed: 10/10/86
Conc/Dil Factor: / TO 1 pH: NA
Percent moisture: (Not decanted) NA

CAS Number		ug/L
74-87-3	Chloromethane	10 U
74-83-9	Bromomethane	10 U
75-01-4	Vinyl Chloride	10 U
75-00-3	Chloroethane	10 U
75-09-2	Methylene Chloride	5 U
67-64-1	**Acetone**	**130**
75-15-0	Carbon Disulfide	5 U
75-35-4	1,1-Dichloroethene	5 U
75-34-3	1,1-Dichloroethane	5 U
156-60-5	Trans-1,2-Dichloroethene	5 U
67-66-3	**Chloroform**	**35**
107-06-2	1,2-Dichloroethane	5 U
78-93-3	2-Butanone	10 U
71-55-6	1,1,1-Trichloroethane	5 U
56-23-5	Carbon Tetrachloride	5 U
108-05-4	Vinyl Acetate	10 U
75-27-4	Bromodichloromethane	5 U

CAS Number		ug/L
78-87-5	1,2-Dichloropropane	5 U
10061-02-6	Trans-1,3-Dichloropropene	5 U
79-01-6	Trichloroethene	5 U
124-48-1	Dibromochloromethane	5 U
79-00-5	1,1,2-Trichloroethane	5 U
71-43-2	Benzene	5 U
10061-01-5	cis-1,3-Dichloropropene	5 U
110-75-8	2-Chloroethylvinylether	10 U
75-25-2	Bromoform	5 U
108-10-1	4-Methyl-2-Pentanone	10 U
591-78-6	2-Hexanone	10 U
127-18-4	Tetrachloroethene	5 U
79-34-5	1,1,2,2-Tetrachloroethane	5 U
108-88-3	Toluene	5 U
108-90-7	Chlorobenzene	5 U
100-41-4	Ethylbenzene	5 U
100-42-5	Styrene	5 U
	Total Xylenes	5 U

Data Reporting Qualifiers

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with U based on necessary concentration/dilution action.
J	Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds or when result is less than specified DL.
T	This flag applies with a 'hit' is not acceptable by EPA protocol but is considered 'real' by the analyst
B	This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination.
K	This flag is used when the quantitated value falls above the limit of the calibration curve. Indicates a dilution should be run to determine exact concentration

1986 DATA

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ORGANICS ANALYSIS DATA SHEET
(Page 1)

oratory Name: ANALYTICAL RESOURCES, INC.
b Sample ID 273C
mple Matrix Waters

ata Release Authorized: Susan D Clam

Client: Department of Ecology
QC Report No: 273
Project No: DOE 338A Account;429
Date Received: 10/6/86

VOLATILE COMPOUNDS

Date Prepared: 10/10/86
Date Analyzed: 10/10/86
Conc/Dil Factor: 1 TO 1 pH: NA
Percent moisture: (Not decanted) NA

CAS Number		ug/L
74-87-3	Chloromethane	10 U
74-83-9	Bromomethane	10 U
75-01-4	Vinyl Chloride	10 U
75-00-3	Chloroethane	10 U
75[illegible]-2	Methylene Chloride	5 U
[illegible]4-1	**Acetone**	15
75-15-0	Carbon Disulfide	5 U
-35-4	1,1-Dichloroethene	5 U
75-34-3	1,1-Dichloroethane	5 U
156-60-5	Trans-1,2-Dichloroethene	5 U
67-66-3	**Chloroform**	66
107-06-2	1,2-Dichloroethane	5 U
78-93-3	2-Butanone	10 U
71-55-6	1,1,1-Trichloroethane	5 U
56-23-5	Carbon Tetrachloride	5 U
108-05-4	Vinyl Acetate	10 U
75-27-4	Bromodichloromethane	5 U

CAS Number		ug/L
78-87-5	1,2-Dichloropropane	5 U
10061-02-6	Trans-1,3-Dichloropropene	5 U
79-01-6	Trichloroethene	5 U
124-48-1	Dibromochloromethane	5 U
79-00-5	1,1,2-Trichloroethane	5 U
71-43-2	Benzene	5 U
10061-01-5	cis-1,3-Dichloropropene	5 U
110-75-8	2-Chloroethylvinylether	10 U
75-25-2	Bromoform	5 U
108-10-1	4-Methyl-2-Pentanone	10 U
591-78-6	2-Hexanone	10 U
127-18-4	Tetrachloroethene	5 U
79-34-5	1,1,2,2-Tetrachloroethane	5 U
108-88-3	Toluene	5 U
108-90-7	Chlorobenzene	5 U
100-41-4	Ethylbenzene	5 U
100-42-5	Styrene	5 U
	Total Xylenes	5 U

Data Reporting Qualifiers

Value	If the result is a value greater than or equal to the detection limit, report the value
U	Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with U based on necessary concentration/dilution action.
J	Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds or when result is less than specified DL.
T	This flag applies with a 'hit' is not acceptable by EPA protocol but is considered 'real' by the analyst
B	This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination.
K	This flag is used when the quantitated value falls above the limit of the calibration curve. Indicates a dilution should be run to determine exact concentration

1986 DATA

Scott Paper

\# [illegible] - GRAB

[illegible] Name: [illegible]

[illegible]: [illegible]

Scott Paper

ORGANICS ANALYSIS DATA SHEET

Page 2

SEMIVOLATILE COMPOUNDS

Concentration: [illegible]

Date Extracted/Prepared: [illegible]

Date Analyzed: [illegible]

[illegible] Factor: [illegible]

Percent Moisture: Decanted

[illegible]

CAS Number			CAS Number		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Dibenzofuran	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Diethylphthalate	4.7
[illegible]	[illegible]	[illegible]	[illegible]	4-Chlorophenyl-phenylether	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Fluorene	[illegible]
[illegible]	4-Methylphenol	9.4	[illegible]	4-Nitroaniline	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	N-Nitrosodiphenylamine (1)	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	4-Bromophenyl-phenylether	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Hexachlorobenzene	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Pentachlorophenol	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Phenanthrene	[illegible]
[illegible]	Benzoic Acid	57.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Di-n-Butylphthalate	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Pyrene	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Butylbenzylphthalate	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Benzo(a)Anthracene	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	bis(2-Ethylhexyl)Phthalate	1.9J
[illegible]	[illegible]	[illegible]	[illegible]	Chrysene	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Di-n-Octyl Phthalate	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Benzo(b)Fluoranthene	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Benzo(k)Fluoranthene	[illegible]
[illegible]	2-Chloronaphthalene	[illegible]	[illegible]	Benzo(a)Pyrene	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Indeno(1,2,3-cd)Pyrene	[illegible]
[illegible]	Dimethyl Phthalate	[illegible]	[illegible]	Dibenz(a,h)Anthracene	[illegible]
[illegible]	Acenaphthylene	[illegible]	[illegible]	Benzo(g,h,i)Perylene	[illegible]
[illegible]	3-Nitroaniline	[illegible]			

2-FLUOROPHENOL (SURR.STD.)	54
D5-PHENOL (SURR.STD.)	53
D5-NITROBENZENE (SURR.STD.)	72
2-FLUOROBIPHENYL (SURR. STD)	81
D10-PYRENE (SURR. STD.)	60
D14-TERPHENYL (SURR. STD.)	45

(1) - Cannot be separated from Diphenylamine

Form I

1986 DATA

SCOTT PAPER

Sample Number
407648

203 - GRAB

ORGANICS ANALYSIS DATA SHEET
(Page 2)

SEMIVOLATILE COMPOUNDS

entration: LOW
Extracted/Prepared: 10/07/86
Analyzed: 10/15/86
Factor: 1.00
ent Moisture: (Decanted)

GPC Cleanup ___ Yes X No
Separatory Funnel Extraction ___ Yes
Continuous Liquid-Liquid Extraction ___ Yes

Number		UG/L	CAS Number		UG/L
108-1	Phenol	2.9U	83-32-9	Acenaphthene	2.3U
----	bis(2-Chloroethyl)Ether .	2.9U	51-28-5	2,4-Dinitrophenol	15. U
7-1	2-Chlorophenol	2.9U	100-02-7	4-Nitrophenol	15. U
73-1	1,3-Dichlorobenzene . . .	2.9U	132-64-9	Dibenzofuran	2.3U
6-7	1,4-Dichlorobenzene . . .	2.9U	121-14-2	2,4-Dinitrotoluene	2.9U
51-1	Benzyl Alcohol	2.9U	606-20-2	2,6-Dinitrotoluene	2.3U
1-1	1,2-Dichlorobenzene . . .	2.9U	84-66-2	Diethylphthalate	2.3U
1-7	2-Methylphenol	2.9U	7005-72-3	4-Chlorophenyl-phenylether	2.9U
31-3	bis(2-Chloroisopropyl)Ether	2.9U	86-73-7	Fluorene	2.3U
---5	4-Methylphenol	2.9U	100-01-6	4-Nitroaniline	15. U
4--7	N-Nitroso-Di-n-Propylamine	2.9U	534-52-1	4,6-Dinitro-2-Methylphenol	15. U
	Hexachloroethane	2.9U	86-30-6	N-Nitrosodiphenylamine (1)	3.8 B
3-3	Nitrobenzene	2.3U	101-55-3	4-Bromophenyl-phenylether	2.3U
59-1	Isophorone	2.9U	118-74-1	Hexachlorobenzene	2.9U
75-5	2-Nitrophenol	2.9U	87-86-5	Pentachlorophenol	15. U
7-7-3	2,4-Dimethylphenol	2.9U	85-01-8	Phenanthrene	2.3U
33-1	Benzoic Acid	15. U	120-12-7	Anthracene	2.3U
-31-1	bis(2-Chloroethoxy)Methane	2.9U	84-74-2	Di-n-Butylphthalate . . .	2.3U
-31-1	2,4-Dichlorophenol	2.9U	206-44-0	Fluoranthene	2.3U
-33-1	1,2,4-Trichlorobenzene . .	2.3U	129-00-0	Pyrene	2.3U
-21-1	Naphthalene	2.9U	85-68-7	Butylbenzylphthalate . . .	2.3U
37-1	4-Chloroaniline	2.9U	91-94-1	3,3'-Dichlorobenzidine . .	5.8U
-33-3	Hexachlorobutadiene . . .	2.9U	56-55-3	Benzo(a)Anthracene	2.3U
-5.-7	4-Chloro-3-Methylphenol .	2.9U	117-81-7	bis(2-Ethylhexyl)Phthalate	2.3U
-37-3	2-Methylnaphthalene . . .	2.3U	218-01-9	Chrysene	2.3U
-7--	Hexachlorocyclopentadiene	2.9U	117-84-0	Di-n-Octyl Phthalate . . .	2.3U
-31-1	2,4,6-Trichlorophenol . .	2.9U	205-99-2	Benzo(b)Fluoranthene . . .	2.9U
-33--	2,4,5-Trichlorophenol . .	15. U	207-08-9	Benzo(k)Fluoranthene . . .	2.3U
-59-7	2-Chloronaphthalene . . .	2.9U	50-32-8	Benzo(a)Pyrene	2.3U
-74--	2-Nitroaniline	15. U	193-39-5	Indeno(1,2,3-cd)Pyrene . .	2.3U
1-11-3	Dimethyl Phthalate	2.9U	53-70-3	Dibenz(a,h)Anthracene . .	2.9U
3-96-8	Acenaphthylene	2.9U	191-24-2	Benzo(g,h,i)Perylene . . .	2.9U
3-09-2	3-Nitroaniline	15. U			

2-FLUOROPHENOL (SURR.STD.)	117
D5-PHENOL (SURR.STD.) . .	49
D5-NITROBENZENE (SURR.STD.)	89
2-FLUOROBIPHENYL (SURR. STD	83
D10-PYRENE (SURR. STD.) .	79
D14-TERPHENYL (SURR. STD.)	98

(1) - Cannot be separated from Diphenylamine

1986 DATA

SCOTT PAPER

#008 - GRAB

Laboratory Name: MANCHESTER LAB

Lab Sample ID No: [illegible]

Sample Number

[illegible]

ORGANICS ANALYSIS DATA SHEET

(Page 2)

SEMIVOLATILE COMPOUNDS

Concentration: LOW

Date Extracted/Prepared: 10/07/86

Date Analyzed: 12/16/86

Conc Factor: 1.481290

Percent Moisture: (Decanted) ______

GPC Cleanup ___ Yes X No

Separatory Funnel Extraction ___ Yes

Continuous Liquid-Liquid Extraction ___ Yes

CAS Number		UG/L	CAS Number		UG/L
108-95-2	Phenol	4.0U	83-32-9	Acenaphthene	4.0U
111-44-4	bis(2-Chloroethyl)Ether	4.0U	51-28-5	2,4-Dinitrophenol	20.U
95-57-8	2-Chlorophenol	4.0U	100-02-7	4-Nitrophenol	20.U
541-73-1	1,3-Dichlorobenzene	4.0U	132-64-9	Dibenzofuran	4.0U
106-46-7	1,4-Dichlorobenzene	4.0U	121-14-2	2,4-Dinitrotoluene	4.0U
100-51-6	Benzyl Alcohol	4.0U	606-20-2	2,6-Dinitrotoluene	4.0U
95-50-1	1,2-Dichlorobenzene	4.0U	84-66-2	Diethylphthalate	4.0U
95-48-7	2-Methylphenol	4.0U	7005-72-3	4-Chlorophenyl-phenylether	4.0U
39638-32-9	bis(2-Chloroisopropyl)Ether	4.0U	86-73-7	Fluorene	4.0U
106-44-5	4-Methylphenol	4.0U	100-01-6	4-Nitroaniline	20.U
621-64-7	N-Nitroso-Di-n-Propylamine	4.0U	534-52-1	4,6-Dinitro-2-Methylphenol	20.U
[illegible]	Hexachloroethane	4.0U	86-30-6	N-Nitrosodiphenylamine (1)	4.0U
98-95-3	Nitrobenzene	4.0U	101-55-3	4-Bromophenyl-phenylether	4.0U
78-59-1	Isophorone	4.0U	118-74-1	Hexachlorobenzene	4.0U
88-75-5	2-Nitrophenol	4.0U	87-86-5	Pentachlorophenol	20.U
105-67-9	2,4-Dimethylphenol	4.0U	85-01-8	Phenanthrene	4.0U
65-85-0	Benzoic Acid	20.U	120-12-7	Anthracene	4.0U
111-91-1	bis(2-Chloroethoxy)Methane	4.0U	84-74-2	Di-n-Butylphthalate	4.0U
120-83-2	2,4-Dichlorophenol	4.0U	206-44-0	Fluoranthene	[illegible]
120-82-1	1,2,4-Trichlorobenzene	4.0U	129-00-0	Pyrene	4.0U
91-20-3	Naphthalene	4.0U	85-68-7	Butylbenzylphthalate	4.0U
106-47-8	4-Chloroaniline	4.0U	91-94-1	3,3'-Dichlorobenzidine	8.0U
87-68-3	Hexachlorobutadiene	4.0U	56-55-3	Benzo(a)Anthracene	4.0U
59-50-7	4-Chloro-3-Methylphenol	4.0U	117-81-7	bis(2-Ethylhexyl)Phthalate	[illegible]
91-57-6	2-Methylnaphthalene	4.0U	218-01-9	Chrysene	4.0U
77-47-4	Hexachlorocyclopentadiene	4.0U	117-84-0	Di-n-Octyl Phthalate	4.0U
88-06-2	2,4,6-Trichlorophenol	4.0U	205-99-2	Benzo(b)Fluoranthene	4.0U
95-95-4	2,4,5-Trichlorophenol	20.U	207-08-9	Benzo(k)Fluoranthene	4.0U
91-58-7	2-Chloronaphthalene	4.0U	50-32-8	Benzo(a)Pyrene	4.0U
88-74-4	2-Nitroaniline	20.U	193-39-5	Indeno(1,2,3-cd)Pyrene	4.0U
131-11-3	Dimethyl Phthalate	4.0U	53-70-3	Dibenz(a,h)Anthracene	4.0U
208-96-8	Acenaphthylene	4.0U	191-24-2	Benzo(g,h,i)Perylene	4.0U
99-09-2	3-Nitroaniline	20.U		2-FLUOROPHENOL (SURR.STD.)	69
				D5-PHENOL (SURR.STD.)	58
				D5-NITROBENZENE (SURR.STD.)	63
				2-FLUOROBIPHENYL (SURR. STD)	64
				D10-PYRENE (SURR. STD.)	85
				D14-TERPHENYL (SURR. STD.)	89

H_2O

(1) - Cannot be separated from diphenylamine

Form I

1986 DATA

PESTICIDES

ECT: Scott Paper COMPILED BY: Bob Carvell DATE: 12-31-86

RATORY: ______ REVIEWED BY: ______ DATE: ______

			#001	#003	#008							
SAMPLE #:	BNK[illegible]		407646	407648	407650		407646					
UNITS :	ug/L		ug/L	ug/L	ug/L							
LOO :												
aldrin	0.025u		0.25u	0.05u	0.25u							
chlordane							TOO					
dieldrin							MUCH					
4,4'-DDT							INTERFERENCE					
4,4'-DDE												
4,4'-DDD												
-endosulfan I												
-endosulfan II												
9. endosulfan sulfate												
10. endrin												
11. endrin aldehyde												
12. heptachlor												
13. heptachlor epoxide												
14. -BHC A												
15. -BHC B												
16. Lindane												
17. -BHC D												
18 Toxaphene	1.5u		15u	3.0u	15u							

1986 DATA

PESTICIDES (continued)

PROJECT: Scott Paper COMPILED BY: Bob Carell DATE: 12-31-86

LABORATORY: REVIEWED BY: DATE:

		#001	#003	#008	
SAMPLE #:	ZW2880,11F	407646	407649	407650	407646D
UNITS :	ug/L	→			
LOQ :					
19. PCB 1016	0.5u	5.0u	1.0u	5u	
20. PCB 1221					
21. PCB 1232					
PCB-1242					
23. PCB-1248					
24. PCB-1254					
25. PCB-1260					
26. Methoxycnlor	0.025u	0.25u 0.0	0.05u	0.25u	
% D, P DDE, I. S.	70.4	→ diluted out ~~in~~			

BC/cm

5-29-86

1985 DATA

SCOTT

July 19, 1985

Mr. Bruce Johnson
Industrial Section
Mail Stop PV-11
Department of Ecology
Olympia, WA 98504

Dear Mr. Johnson:

You had requested that we analyze our effluents for priority pollutant metals to update data submitted previously in our NPDES permit application. Samples from our 24-hour composite samplers were collected June 5, 1985 and submitted to Laucks Testing Laboratories in Seattle.

The results of the analyses are as follows:

	PARTS PER BILLION (ug/L)		
	Outfall 001	Outfall 003	Outfall 008
Antimony	<5.0	<5.0	<5.0
Arsenic	<5.0	<5.0	<5.0
Beryllium	<0.5	<0.5	<0.5
Cadmium	1.0	<1.0	2.0
Chromium	5.0	5.0	10.0
Copper	4.0	<2.0	2.0
Lead	<5.0	<5.0	<5.0
Mercury	<0.5	<0.5	<0.5
Nickel	<5.0	<5.0	7.0
Selenium	<5.0	<5.0	<5.0
Silver	<0.5	<0.5	1.8
Thallium	<0.5	<0.5	<0.5
Zinc ✓	45.0	17.0	44.0

(< indicates "less than")

Please call if you have any questions or wish to discuss these data.

Sincerely,

Timothy J. Bechtel

Timothy J. Bechtel
Environmental Resource Manager

TJB:cjk

1982-1983 DATA

ORGANIC CHEMICALS AND METALS FOUND
IN SCOTT PULP AND PAPER MILL OUTFALLS (mg/L)

Contaminant	Date of Sample	Outfall SW001	Outfall S003	Outfall S008 Influent	Outfall S008 Effluent
Metals					
Cadmium	6/5/85[a]	0.0010	0.0010	NA	0.0020
	10/1/86[b]	0.0016	0.0007	NA	0.0017[c]
Chromium	6/5/85[a]	0.0050	0.0050	NA	0.0100
	10/1/86[b]	ND	ND	NA	ND
Copper	6/5/85[a]	0.0040	ND	NA	0.0020
	10/1/86[b]	ND	ND	NA	ND
Nickel	6/5/85[a]	ND	ND	NA	0.0070
	10/1/86[b]	0.005	0.008	NA	ND
Silver	6/5/85[a]	ND	ND	NA	0.0018
	10/1/86[b]	ND	ND	NA	ND
Zinc	6/5/85[a]	0.0450	0.0170	NA	0.440
	10/1/86[b]	0.082	0.033	NA	0.073[c]
Volatile Organics					
Acetone	10/1/86[b]	0.200	0.130	NA	0.015
Chloroform	7/9/85[d]	NA	NA	NA	0.049
	11/24/82[d]	0.107	NA	NA	
	9/22/82[d]	NA	0.373	NA	1.130
	10/1/86[b]	0.079	0.035	NA	0.066
Ethyl benzene	11/24/82[d]	0.021	NA	NA	
Carbon Tetrachloride	9/22/82[d]	NA	NA	NA	0.010
Semivolatile Organics					
Benzoic acid	10/1/86[b]	0.057	ND	NA	ND
Resin Acids					
Isopimaric[e]	NA	NA	NA	0.140	ND
Isopimaric[f]	3/2/83	NA	NA	0.285	ND
Dehydroabietic[e]	NA	NA	0.035	0.852	0.002
Dehydroabietic[f]	3/2/83	NA	NA	1.463	0.018
Abietic[e]	NA	NA	0.004	0.010	ND
Retene[f]	3/2/83	NA	NA	0.0009	0.045

[a] Bechtel, T. (19 July 1985, personal communication).

[b] Kjosness, D. (1 August 1988, personal communication).

[c] This value is the average result from two duplicate analyses.

[d] Bailey, A. (7 November 1985, personal communication).

[e] Archer, S. (9 September 1983, personal communication).

[f] Johnson, B. (9 August 1983, personal communication).

ND = Not detected.

NA = Information not available.

Source: Tetra Tech (1988)

1980 DATA

SCOTT PAPER AVERAGE POLLUTANT DATA
AND ESTIMATED LOADING

Outfall	001 Conc.	001 Load	003 Conc.	003 Load	004 Conc.	004 Load	008 Conc.	008 Load
Q(MGD)	7.7		8.1		5		12	
COD	244	15,700	296	20,000	286	11,900	869	86,900
TOC	70	4,500	70	4,700	77	3,210	283	28,300
NH_3 (mg/L)	1.1	71	2.3	155	0.32	13	11.6	1,160
Oil and grease	3.0	193	4.5	304	6	250	3.5	350
Fecal (No./100 mL)	575	1.7×10^{11}	19,000	5.8×10^{12}	<10	1.9×10^{9}	40,000	1.8×10^{13}
Sb ug/l	0.8	0.05	0.5	0.03	0.5	0.02	1.3	0.1
As	0.4	0.03	0.2	0.01	0.2	0.01	0.4	0.04
Be	<2	<0.1	<2	<0.1	<2	<0.1	<2	<0.2
Cd	<2	<0.1	<2	<0.1	1.0	0.04	3.4	0.34
Cr	9	0.6	11	0.7	5	0.2	18	1.8
Cu	26	2	28	2	28	1.2	17	1.7
Pb	62	4	60	4	32	1.3	34	3.4
Hg	<0.2	<0.01	0.26	0.02	<0.2	<0.01	<0.2	<0.02
Ni	9	0.6	9	0.6	12	0.5	30	3
Se	1.5	0.1	<0.5	<0.03	0.5	0.02	2	0.2
Ag	<2	<0.1	<2	<0.1	<2	<0.1	<2	<0.2
Tl	<11	<0.7	<11	0.7	20	0.8	55	5.5
Zn	97	6	9	0.6	33	1.4	78	7.8
Cn	<20	<1	<20	<1	<20	0.8	<20	<2
Phenols (ug/L)	58.6	4	62.6	4	5.3	0.2	111	11
Chloroform	50	3	29	2	157	7	138	14
Ethyl Benzene	25	2	48	3	84	4	<10	<1
2 Ethyl Hexyl Phthalate	11	0.7	13	0.9	<10	<0.4	<10	<1
Butyl Benzyl Phthalate	12	0.8	<10	<0.7	13	0.5	<10	<1
Pentachlorophenol	<10	0.6	<10	<0.7	<10	<0.4	<10	<1
4,6 Dinitro-o-Cresol	<100	<6	<100	<7	<100	<4	<100	<10
2,4 Dinitro Phenol	<100	<6	<100	<7	<100	<4	<100	<10
Methylene Chloride[b]	<10	<0.6	18	1	<10	<0.4	<10	<1

[a] Outfall no longer used.

[b] All other priority pollutants <10 ug/L. Loads calculated using average 1983-1984 flow and NPDES application and STORET pollutant data (average). Conventional concentrations in mg/L. Metals and organics in ug/L. Loads in lb/day.

Reference: Scott Paper Company (1980).

Attachment D

WHOLE EFFLUENT TOXICITY SUMMARY DATA

Table 2

SCOTT EFFLUENT BIOASSAY RESULTS*

Outfall	Year	No.Bioassays	No.Failures	Reasons for Failure
001	1982	1	0	0
001	1983	11	3	1.unidentified 2.bleach plant upset
001	1984	12	6	1.unidentified 2.absorbancy chemical
001	1985	11	6	1.unidentified 2.use of surfactants 3.sludge blanket carryover 4.test fish too small 5.pulp operation
001	1986	11	3	1.high fiber discharge 2.high fines/surfactants
001	1987	6	0	0
001	1988	3	1	1.bleach plant overflow
001	TOT.	55	19	35% Failure Rate
003	1982	1	0	0
003	1983	11	1	1.bleach plant upset
003	1984	12	3	1.unidentified 2.absorbancy chemical
003	1985	11	4	1.unidentified 2.surfactants 3.sludge blanket carryover 4.pulp operation
003	1986	11	0	0
003	1987	6	0	0
003	1988	3	2	1.high zinc levels 2.bleach plant overflow
003	TOT.	55	10	18% Failure Rate

Table 2 - Continued

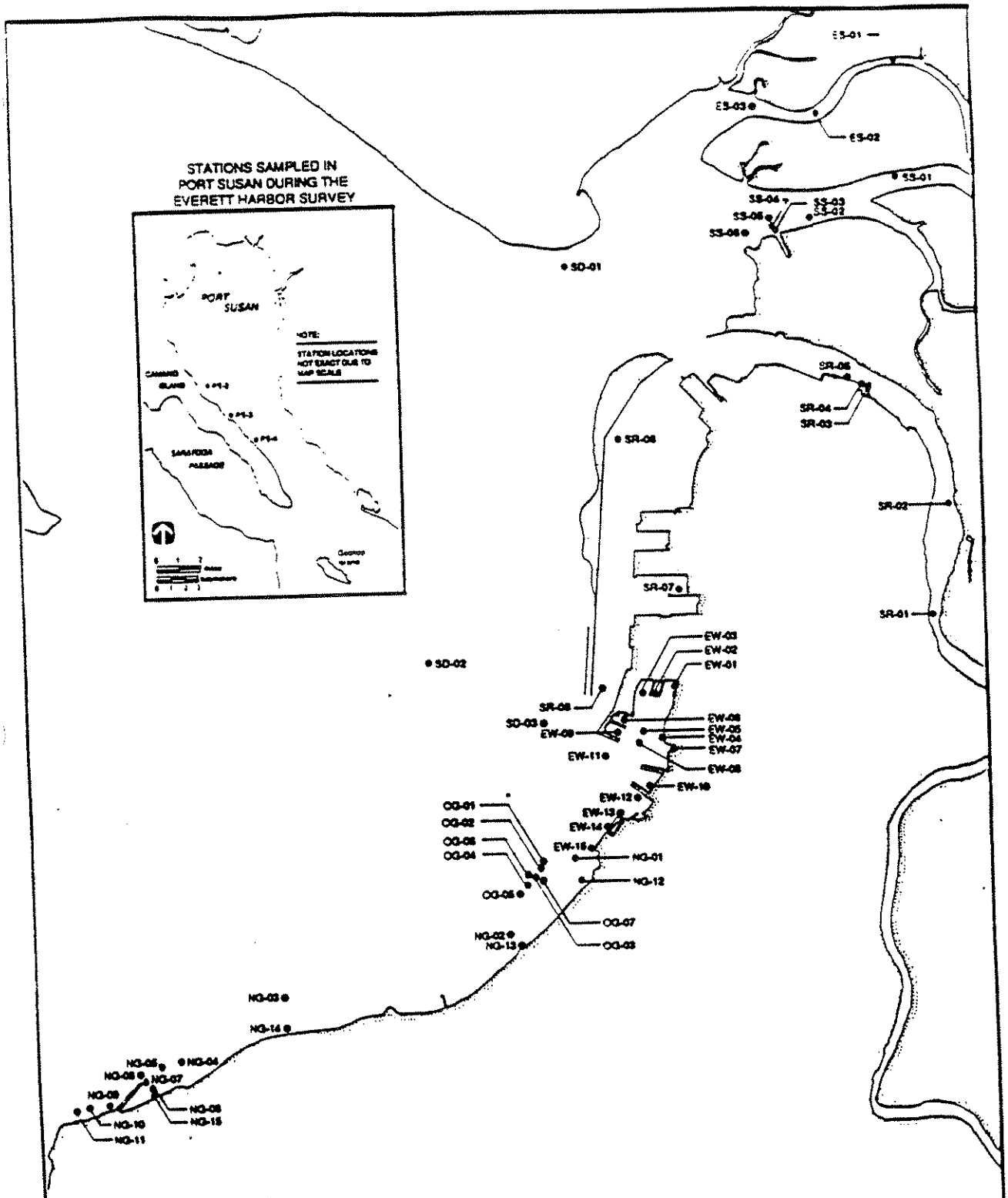
SCOTT EFFLUENT BIOASSAY RESULTS*

Outfall	Year	No.Bioassays	No.Failures	Reasons for Failure
008	1982	1	0	0
008	1983	11	0	0
008	1984	12	0	0
008	1985	11	1	1.high ammonia levels
008	1986	11	1	1.high ammonia levels
008	1987	6	0	0
008	1988	3	0	0
008	TOT.	55	2	4% Failure Rate

* 96-hour acute bioassay with rainbow trout, with a failure defined as less than 80% survival in a 65% effluent concentration.

Attachment E

SEDIMENT TOXICITY DATA



Source: PTI and Tetra Tech (1988)

FIG C-1 Locations of sampling stations for sediment chemistry, amphipod bioassay, and benthic macroinvertebrates.

Table C-1

CONCENTRATIONS OF DETECTED SEMIVOLATILE AND VOLATILE ORGANIC COMPOUNDS IN SURFACE SEDIMENTS OF EVERETT HARBOR AND PORT SUSAN[a]

Chemical	Range (ug/kg dry wt)[b]	Detection Frequency	Location of Maximum
LPAH	L36 - 28,000	54/54	EW-14
naphthalene	B3 - X17,000	46/54	EW-07
acenaphthylene	1 - 800	41/54	EW-14
acenaphthene	2 - 5,200	45/54	EW-14
fluorene	6 - 4,300	24/54	EW-14
phenanthrene	3 - 8,100	50/54	EW-04
anthracene	1 - 6,100	51/54	EW-14
HPAH	L36 - 23,000	54/54	EW-14
fluoranthene	3 - 3,700	53/54	EW-13
pyrene	3 - 5,500	49/54	EW-14
benz(a)anthracene	1 - 3,200	54/54	EW-14
chrysene	1 - 3,200	54/54	EW-14
benzofluoranthenes	5 - 4,100	48/54	EW-14
benzo(a)pyrene	1 - 1,700	50/54	EW-14
indeno(1,2,3-c,d)pyrene	1 - 730	42/54	EW-14
dibenzo(a,h)anthracene	2 - 270	29/54	EW-14
benzo(g,h,i)perylene	3 - 550	46/54	EW-14
Total PCBs	U1 - E9,600	7/54	EW-04
Resin Acids			
abietic acid	U130 - 98,000	21/31	EW-13
dehydroabietic acid	E20 - 83,000	29/31	EW-04
12-chlorodehydroabietic acid	E61 - 11,000	19/31	EW-04
14-chlorodehydroabietic acid	E46 - 3,400	10/31	EW-04
dichlorodehydroabietic acid	U130 - E710	5/31	EW-04
isopimaric acid	E85 - E11,000	20/31	EW-13
neoabietic acid	E79 - E14,000	8/31	EW-13
sandaracopimaric acid	E17 - 14,000	21/31	EW-01
Phenols and Guaiacols			
phenol	11 - 2,900	49/54	EW-10
2-methylphenol	6 - 1,200	3/54	EW-04
4-methylphenol	3 - X98,000	50/54	EW-07
2,4-dimethylphenol	U10 - 520	2/54	EW-04
2-chlorophenol	E1 - 160	11/60	EW-04
2,4-dichlorophenol	2 - 320	21/60	EW-01
2,4,6-trichlorophenol	U2 - 290	22/60	EW-01
2,4,5-trichlorophenol	E1 - 120	18/60	EW-02
2,3,4,6-tetrachlorophenol	U2 - 120	6/31	EW-01
pentachlorophenol	U2 - E460	22/60	EW-04
3,4,5-trichloroguaiacol	E1 - 110	11/31	EW-01
4,5,6-trichloroguaiacol	U2 - 48	6/31	EW-01
tetrachloroguaiacol	U2 - 50	4/31	EW-01
Chlorinated Benzenes			
1,2-dichlorobenzene	7 - 96	4/54	EW-04
1,4-dichlorobenzene	2 - 25[c]	14/54	OG-02
Phthalates			
dimethyl phthalate	8 - 26[c]	2/54	NG-02
diethyl phthalate	3 - 11[c]	5/54	NG-02, SD-03
di-n-butyl phthalate	B10 - 260[c]	20/54	EW-13
butyl benzyl phthalate	U10 - 70	6/54	EW-01
bis(2-ethylhexyl)phthalate	B10 - 930	39/54	EW-14
di-n-octyl phthalate	B3 - 4[c]	3/54	SR-02, SR-03

EW-01 NEAR OUTFALL 008
EW-04 NEAR OUTFALL 003
06- NEAR OUTFALL 001

Source: PTI and Tetra Tech (1988)

Table C-1 (Continued)

Chemical	Range (ug/kg dry wt)[b]	Detection Frequency	Location of Maximum
Pesticides			
lindane (gamma-HCH)	U0.5 - 1[c]	1/54	NG-04
p,p'-DDT	U1 - 23	1/54	SD-03
Nitrogen-Containing Compounds			
N-nitrosodiphenylamine	8 - 57	13/54	EW-01
Miscellaneous Extractables and Tentatively Identified Compounds			
benzyl alcohol	U10 - 810	6/54	EW-04
benzoic acid	E10 - 5,900	25/54	EW-14
dibenzofuran	3 - 5,000	44/54	EW-14
2-methylnapnthalene	2 - 7,400	38/54	EW-07
1-methylpyrene[d]	U - E240	25/54	NG-11
retene[d]	U - E3,100	44/54	EW-04
cymene (unspecified isomer)[d]	U - E2,900	41/54	EW-04
dibenzothiophene[d]	U - E280	19/54	EW-14
1,2,4-trithiolane[d]	U - E5,800	31/54	EW-04
diterpenoid hydrocarbon[d] (base peak 255)	U - E23,000	41/54	EW-04
diterpenoid alcohol[d] (base peak 271)	U - E8,600	42/54	EW-11
hexadecanoic acid[d]	U - E2,300	27/54	EW-10
hexadecanoic acid methyl ester[d]	U - E4,300	53/54	EW-04
hexadecenoic acid methyl ester[d]	U - E3,200	53/54	EW-04
cholesterol[d]	U - E630	51/54	EW-04
campesterol[d]	U - E1,100	20/54	EW-04
alkanol (unidentified)[d]	U - E2,200	43/54	EW-04
base peak 181, isomer #1[d]	U - E12,000	44/54	EW-04
base peak 181, isomer #2[d]	U - E6,500	45/54	EW-04
Volatile Organic Compounds			
acetone	U6 - 230	4/19	EW-05
ethylbenzene	U3 - E5[c]	2/19	EW-09
total xylenes	U3 - 39	4/19	EW-08

[a] Qualifiers:

U = Substance undetected at the detection limit shown.
B = Blank corrected down to the detection limit shown.
X = The surrogate recovery for this compound was low (<10 percent). Hence, the recovery correction was at least a factor of 10.
L = "Less than" - the reported concentration is the mean of a detected value and a detection limit or, for PAH sums, the sum includes detection limits.
E = Estimated value.

[b] Maximum is the highest detected value even if maximum detection limits were higher.

[c] Maximum concentration does not exceed Puget Sound reference area concentrations.

[d] Tentatively identified organic (TIO) compound - detection limits for TIO compounds were not assigned.

Source: PTI and Tetra Tech (1988)

Table C-2 SUMMARY OF AMPHIPOD BIOASSAY RESULTS

Station	Range of Mortality (percent)	Mean Mortality[a] (percent)
ES-01	0-20	10(4.2)
ES-02	5-25	12(3.7)
ES-03	0-25	15(4.2)
EW-01	100[b]	100(0)*
EW-04	95-100	99(1.0)*
EW-07	60-100	75(8.4)*
EW-10	10-100	55(19)
EW-12	10-20	13(2.0)
EW-14	15-55	37(7.2)
NG-01	0-10	5(1.6)
NG-02	0-15	6(2.4)
NG-03	5-15	13(2.0)
NG-04	100[b]	100(0)*
NG-06	25-55	43(5.6)
NG-10	0-10	5(1.6)
NG-12	0-10	2(2.0)
NG-13	0-10	6(1.9)
NG-14	0-10	5(2.2)
NG-15	0-5	1(1.0)
OG-03	15-90	58(12)
PS-02	20-40	29(4.0)
PS-03	15-40	24(4.6)
PS-04	5-35	20(6.3)
SD-01	5-20	15(3.2)
SD-02	15-50	29(7.0)
SR-01	0-35	12(6.0)
SR-02	0-10	4(1.9)
SR-04	15-30	21(2.9)
SR-07	0-80	33(13)
SR-08	0-30	15(5.7)
SS-01	0-10	5(2.2)
SS-03	0-10	6(2.4)
Control[c] A	0-10	5(2.2)
Control B	0-25	10(4.2)
Control C	5-15	9(1.9)
Control D	0-10	4(1.9)

[a] Mean mortality is based on five replicate samples per station. Standard error of each mean is given in parentheses.

[b] A mortality level of 100 percent was observed for each of the five replicates.

[c] Clean control sediments from the amphipod collection site at West Beach, Whidbey Island.

* Asterisk denotes that mean mortality differed significantly ($P<0.001$) from the mean mortality of pooled replicates from two Port Susan stations (PS-03 and PS-04).

Source: PTI and Tetra Tech (1988)

Table C-3

PUGET SOUND AET (DRY WEIGHT)[a,b]

(ug/kg dry weight for organic compounds; mg/kg dry weight for metals)

Chemical	Amphipod AET[c]	Oyster AET[d]	Benthic AET[e]	Microtox AET[f]	LAET	HAET
Low molecular weight PAH	5,500[g,h,i]	5,200	6,100[i]	5,200	5,200	6,100
naphthalene	2,400[h,i]	2,100	2,100	2,100	2,100	2,400
acenaphthylene	560	>560	640[i]	>560	560	640
acenaphthene	980[h,i]	500	500	500	500	980
fluorene	1,800[h,i]	540	640[i]	540	540	1,800
phenanthrene	5,400[h,i]	1,500	3,200[i]	1,500	1,500	5,400
anthracene	1,900[g,h,i]	960	1,300[i]	960	960	1,900
High molecular weight PAH	38,000[h,i]	17,000	>51,000[i]	12,000	12,000	38,000
fluoranthene	9,800[h,i]	2,500	6,300[i]	1,700	1,700	9,800
pyrene	11,000[h,i]	3,300	>7,300[i]	2,600	2,600	11,000
benz(a)anthracene	3,000[h,i]	1,600	4,500[i]	1,300	1,300	4,500
chrysene	5,000[h,i]	2,800	6,700[i]	1,400	1,400	6,700
benzofluoranthenes	3,700	3,600	8,000[i]	3,200	3,200	8,000
benzo(a)pyrene	2,400	1,600	6,800[i]	1,600	1,600	6,800
indeno(1,2,3-c,d)pyrene	880[h,i]	690	>5,200[i]	600	600	880
dibenzo(a,h)anthracene	510[h,i]	230	1,200[i]	230	230	1,200
benzo(g,h,i)perylene	860[h,i]	720	5,400[i]	670	670	5,400
Total PCBs	2,500[i]	1,100	1,100	130	130	2,500
Total chlorinated benzenes	680[i]	400	400	170	170	680
1,3-dichlorobenzene	>170	>170	>170	>170		
1,4-dichlorobenzene	260	120	120	110	110	260
1,2-dichlorobenzene	>350	50	50	35	35	50
1,2,4-trichlorobenzene	51	64	64	31	31	64
hexachlorobenzene (HCB)	130	230	230	70	70	230
Total phthalates	>5,200[i]	3,400	>70,000[i]	3,300	3,300	3,400
dimethyl phthalate	>700[h,i]	160	160	71	71	160
diethyl phthalate	>1,200[h,i]	>73	200[h,i]	>48	200	200
di-n-butyl phthalate	>5,100	1,400	>5,100	1,400	1,400	1,400
butyl benzyl phthalate	>470	>470	470	63	63	470
bis(2-ethylhexyl)phthalate	>3,100	1,900	1,900	1,900	1,900	1,900
di-n-octyl phthalate	>590[i]	>420	>68,000[i]	--		
Pesticides						
p,p'-DDE	15	--	9	--	9	15
p,p'-DDD	43	--	2	--	2	43
p,p'-DDT	3.9	>6	11[i]	--	3.9	11
Phenols						
phenol	670[h,i]	420	1,200	1,200	420	1,200
2-methylphenol	63	63	>72	>72	63	63
4-methylphenol	1,200	670	670	670	670	1,200
2,4-dimethylphenol	>72[h,i]	29	29	29	29	29
pentachlorophenol	>140	>140	>140	>140		
2-methoxyphenol	930	930	930	930	930	930
Miscellaneous extractables						
hexachlorobutadiene	290	270	270	120	120	290
1-methylphenanthrene	310	370	370	370	310	370
2-methylnaphthalene	670	670	670	670	670	670
biphenyl	260	260	270	270	260	270
dibenzothiophene	240	240	250	250	240	250
dibenzofuran	540	540	540	540	540	540
benzyl alcohol	73	73	73	57	57	73
benzoic acid	>690	650	650	650	650	650
N-nitrosodiphenylamine	220	130	75	40	40	220

Source: PTI and Tetra Tech (1988)

Table C-3[(Continued)]

Chemical	Amphipod AET[c]	Oyster AET[d]	Benthic AET[e]	Microtox AET[f]	LAET	HAET
Volatile organics						
tetrachloroethene	>210	140	140	140	140	140
ethylbenzene	>50	37	37	33	33	37
total xylenes	>160	120	120	100	100	120
Metals						
antimony	5.3	26	3.2	26	3.2	26
arsenic	93	700	85	700	85	700
cadmium	6.7	9.6	5.8	9.6	5.8	9.6
chromium	>130	>37	59	27	27	59
copper	800[i]	390	310	390	310	800
lead	700[i]	660	300	530	300	700
mercury	2.1[i]	0.59	0.88	0.41	0.41	2.1
nickel	>120[i]	39	49	28	28	49
silver	>3.7[i]	>0.56	5.2	>0.56	5.2	5.2
zinc	870[i]	1,600	260	1,600	260	1,600

[a] ">" indicates that a definite AET could not be established because the highest concentration occurred at a station without biological effects (hence, it is not clear from available data if biological effects always occur above this concentration, as specified in the definition of AET). For the purposes of problem identification in Elliott Bay, these values were excluded when LAET (low AET) and HAET (high AET) were generated.

[b] The following data sets were used to generate the AET in this table:

1. Battelle (1986)
2. Chan et al. (1985 , unpublished)
3. Comiskey et al. (1984)
4. Osborn et al. (1985)
5. Romberg et al. (1984)
6. Tetra Tech (1985a)
7. Tetra Tech (1986d)
8. Trial and Michaud (1985)
9. U.S. Department of the Navy (1985).

[c] Based on 160 stations.

[d] Based on 56 stations (all from Commencement Bay Remedial Investigation).

[e] Based on 104 stations.

[f] Based on 50 stations (all from Commencement Bay Remedial Investigation).

[g] A higher AET (24,000 ug/kg for low molecular weight PAH and 13,000 ug/kg for anthracene) could be established based on data from an Eagle Harbor station. However, the low molecular weight PAH composition at this station is considered atypical of Puget Sound sediments because of the unusually high relative proportion of anthracene. Thus, the low molecular weight PAH and anthracene AET shown are based on the next highest station in the data set.

[h] The value shown exceeds the Puget Sound AET established in Tetra Tech (1986c) and results from the addition of Eagle Harbor Preliminary Investigation data (Tetra Tech 1986d).

Source: PTI and Tetra Tech (1988)

Appendix L

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

Storer, R.S. and P.M. Arsenault, August 1987, Combined Sewer Overflow Receiving Water Sediments Sampling and Analysis Program, Ott Water Engineers, Seattle, Washington, 18 pp and appendices.

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January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.
101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537
International Specialists in the Environment

EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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X	Section 7.0	CHEMICAL DATA
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X	Section 16.0	FINAL COMMENTS

ATTACHMENTS

Attachment A - Sediment Sampling and Observation Locations
Attachment B - Data Summary Tables

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

The combined sewer overflow (CSO) program for the City of Everett was undertaken to comply with regulations (WAC 173-245) promulgated by the State of Washington. These regulations require municipalities to monitor and sample CSOs if "a consistent hydraulic and pollutant correlation between/among the group of CSO sites" can be established. This report summarizes data collected during a single sampling event at two CSOs that discharge into Port Gardner within Puget Sound.

Ott Water Engineers were contracted by the City of Everett to assist in the development and implementation of a program for sampling CSOs within the city. A chronological listing of events prior to and during the CSO sampling and analysis program follows:

- o March 30, 1987. Preparation of a plan for sampling and analyzing CSO and outfall sediment deposits. The plan included preliminary estimates for CSO volumes, frequency, and the 1-year CSO storm event volume for Everett's North End Sewer Service Area.
- o April 27, 1987. Completion of a reconnaissance site visit with City of Everett personnel.
- o July 6-8, 1987. Diver (SCUBA) assessment of the extent of sediment accumulation at Puget Sound outfalls (PSO) 1 through 4, 7 and 8, and Snohomish River outfalls (SRO) 1 through 8. No discernable deposits were found at the mouths of these outfalls.
- o July 10, 1987. Collection of sediment deposited at PSO 5 and 6.
- o Chemical analyses were performed by AM Test Laboratory in Redmond.

2.0 LEGAL AND REGULATORY ISSUES

This investigation was initiated in response to CSO regulations identified in WAC 173-245 which require municipalities to monitor and sample "one or more CSO sites in a group" if "a consistent hydraulic and pollutant correlation between/among the group of CSO sites" can be established. The information gathered was intended for use in developing and implementing a CSO reduction plan for the City of Everett. The outfalls surveyed represent mixtures of residential and commercial land uses. (Some of the outfalls investigated represent discharge pipes from various industries but, because no visible outfall-related deposits were observed, samples of sediment were not collected.)

3.0 DEMOGRAPHICS AND LAND USE

N/A

4.0 POTENTIALLY LIABLE PERSONS

N/A

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

N/A

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

Pollution non-point sources are discussed in appropriate sections throughout the review.

7.0 CHEMICAL DATA

Data Collection

Nine CSO outfall groups (two that discharged to Port Gardner within Puget Sound and seven that discharged to the Snohomish River) were surveyed during the study using SCUBA divers. Hydrologic movement inhibits the settlement of fine sediment in rivers; therefore, no sediment samples were collected from the Snohomish River outfalls. The Port Gardner outfalls were composed of eight separate pipes. Only two of the outfalls, PSO 5 and 6, had a sufficient amount of sediment for analysis and these two were sampled as part of this study.

Procedures used in collecting and analyzing sediment samples were identical to those outlined in the guidelines for WAC 173-245. Outfalls were accessed on sunny days and during low tides using SCUBA gear so their exact locations could be ascertained. Samples were collected by scooping the top 2 cm of the "darker" sludge deposits into two 15-ounce wide-mouth glass jars and two 40-mL vials, each with TFE cap liners. Samples were iced immediately in a cooler and transported via chain-of-custody documentation to AM Test Laboratory in Redmond for analysis.

Analytical Testing

The sediment samples were analyzed for 10 metals using the Total Heavy Metals Method cited in the Puget Sound Estuary Program's Protocols Manual (Tetra Tech 1986a), instead of the Extraction Procedure Toxicity Test. In addition, sample analysis included 29 organochlorine and organophosphorus pesticides, 33 volatile organic compounds, 45 base-neutral compounds, 11 acid compounds, hydrocarbons, and total solids.

Results

The Washington State Department of Ecology (Ecology) requested that all results be compared with the lowest Apparent Effects Threshold (AET) values because no single set of standards specific to CSO control plans had been established. For those analytes that exceeded the lowest AETs, comparisons were then made to the following additional sources:

- o Ecology Dangerous Waste Regulations (WAC 173-303).
- o 1986 United States Environmental Protection Agency (EPA) Gold Book Quality Criteria for Water.
- o Water Quality Standards for Waters of the State of Washington (WAC 183-201).
- o Puget Sound Estuary Program Protocols Manual (Tetra Tech 1986a).
- o Toxicant Pretreatment Planning Study Technical Report (Galvin et al. 1984).

Therefore, Ott's discussion of analytical results was primarily a comparison of their results with the lowest AETs (see summary table in Attachment B).

CSO Sediments - Metals. The analytical results for three metals (chromium, nickel, and zinc) exceeded the lowest AET values at both sampling stations. Generally, PSO 5 revealed higher concentrations of all metals, except cadmium, when compared with PSO 6. Lead present in sediments at PSO 5 exhibited concentrations that were up to 10 times higher than mean values obtained from the Puget Sound reference areas.

CSO Sediments - Hydrocarbons. Analysis of hydrocarbons (polycyclic aromatic hydrocarbons [PAHs] plus halogenated hydrocarbons [HH]) revealed percent residues of 0.22 and 0.08 percent for PSO 5 and PSO 6, respectively. The WAC 173-303 Dangerous Waste Regulations designate a compound as a dangerous waste when the total concentration (percent) of HHs (only) present is between 0.01 and 1.0 percent.

The WAC 173-303-040 defines PAHs as those hydrocarbon molecules composed of two or more benzene rings. Therefore, only those PAHs with more than three rings and less than seven rings were considered to be of concern. At PSO 5, the sum total concentration of individual pollutants from this PAH class was significantly higher than the sum total of Puget Sound Dredged Disposal Analysis (PSDDA) AET sediment values (235 versus 12.4 ppb, respectively).

CSO Sediments - Base-Neutral Compounds. Thirteen base-neutral compounds were detected that exceeded AET sediment values. These compounds are listed below:

- o Acenaphthene,
- o Anthracene,
- o Bis-(2-Ethylhexyl) Phthalate,
- o Benzo(a) Anthracene,
- o Benzo(a) Pyrene,
- o Benzo(b + k) Fluoranthene,
- o Chrysene,
- o Fluoranthene,
- o Fluorene,
- o Ideno (1,2,3-cd) Pyrene,

- o Naphthalene,
- o Phenanthrene, and
- o Pyrene.

In general, PSO 5 exhibited higher concentrations of base-neutral compounds than PSO 6 (see Attachment B). Pyrene was 22 times higher at PSO 5 (89.1 µg/g) compared to PSO 6 (4.1 µg/g).

CSO Sediments - Acid Compounds. Only phenol, which was detected at 0.66 µg/g at PSO 5, exceeded the AET sediment values. No acid compounds were detected at PSO 6.

CSO Sediments - Volatile Compounds. Five volatile compounds were detected at both sampling stations: acetone, methylene chloride, 1,2-dichlorobenzene, trichloroethylene, and xylenes.

The concentration of acetone at PSO 5 (2.76 µg/g) was three times higher than the concentration at PSO 6 (0.91 µg/g). However, concentrations of methylene chloride and trichloroethylene were five to seven times higher at PSO 6 (0.38 and 0.4 µg/g) than at PSO 5 (0.08 and 0.06 µg/g). Of all the compounds analyzed, only these two compounds had higher concentrations at PSO 6 than at PSO 5. No AET values exist for acetone, methylene chloride, and trichloroethylene.

Additionally, at PSO 5 the concentration of 1,2-dichlorobenzene and xylene exceeded AET sediment values.

CSO Sediments - Organochlorine and Organophosphorus Pesticides. The analysis of these two separate pesticide screens revealed no pesticide compounds in sediments at either location.

8.0 BIOLOGICAL DATA (FLORA/FAUNA)

N/A

9.0 DATA QUALITY

N/A

10.0 HYDROLOGIC AND HYDRODYNAMIC INFORMATION

Field Methods

The discussion of field sampling methods is inadequate for the following reasons:

- o Exact sampling locations are difficult to discern from the map provided in the report.

- o Decontamination procedures are not discussed for sampling equipment.

- o No field quality assurance (QA) was performed; therefore, data comparability is limited.

Analytical Methods

In the absence of any QA/quality control (QC) data, such as duplicate samples, trip blanks, replicate analyses, and interlaboratory comparisons, data quality is uncertain. However, surrogate recoveries were performed for four acid compounds and three volatile organic compounds. With the exception of phenol (36%), percent recoveries were good. Surrogate recoveries provide a measure of the bias in a system, but without field duplicates, matrix spikes, and other measures of precision and accuracy, usability of the data is limited.

Supporting Documentation

The authors cite the following sediment studies for comparison of CSO results:

- o Puget Sound Estuary Program Protocol Manual (Tetra Tech 1986a).

- o Puget Sound Dredged Disposal Analysis, no date, Sediment Quality Values for Puget Sound, PSDDA, Olympia, Washington (no reference provided).

- o Puget Sound Estuary Program, Sediment Concentrations in Puget Sound Reference Areas (no reference provided).

- o Toxicant Pretreatment Planning Study Technical Report (Galvin et al. 1984).

Organics

Data accuracy cannot be determined because of the absence of a QA/QC component to the study. Instead, all values must be considered estimates.

This report can be considered a preliminary assessment of sediment quality for two CSOs in Port Gardner. However, because of QA limitations noted above, data should be considered as estimates only. The applicability of comparing these CSO sediment data to EPA 1986 Quality Criteria, Galvin et al. 1984, and Ecology Dangerous Waste Regulations (WAC 173-303) is questionable. For example, the zinc concentration in the summary table (Attachment B) is compared to a liquid CSO sample in the Galvin et al. 1984 study.

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

N/A

12.0 ENVIRONMENTAL IMPACTS

N/A

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

N/A

14.0 COMMUNITY RELATIONS INFORMATION

N/A

15.0 RECOMMENDATIONS

N/A

16.0 FINAL COMMENTS

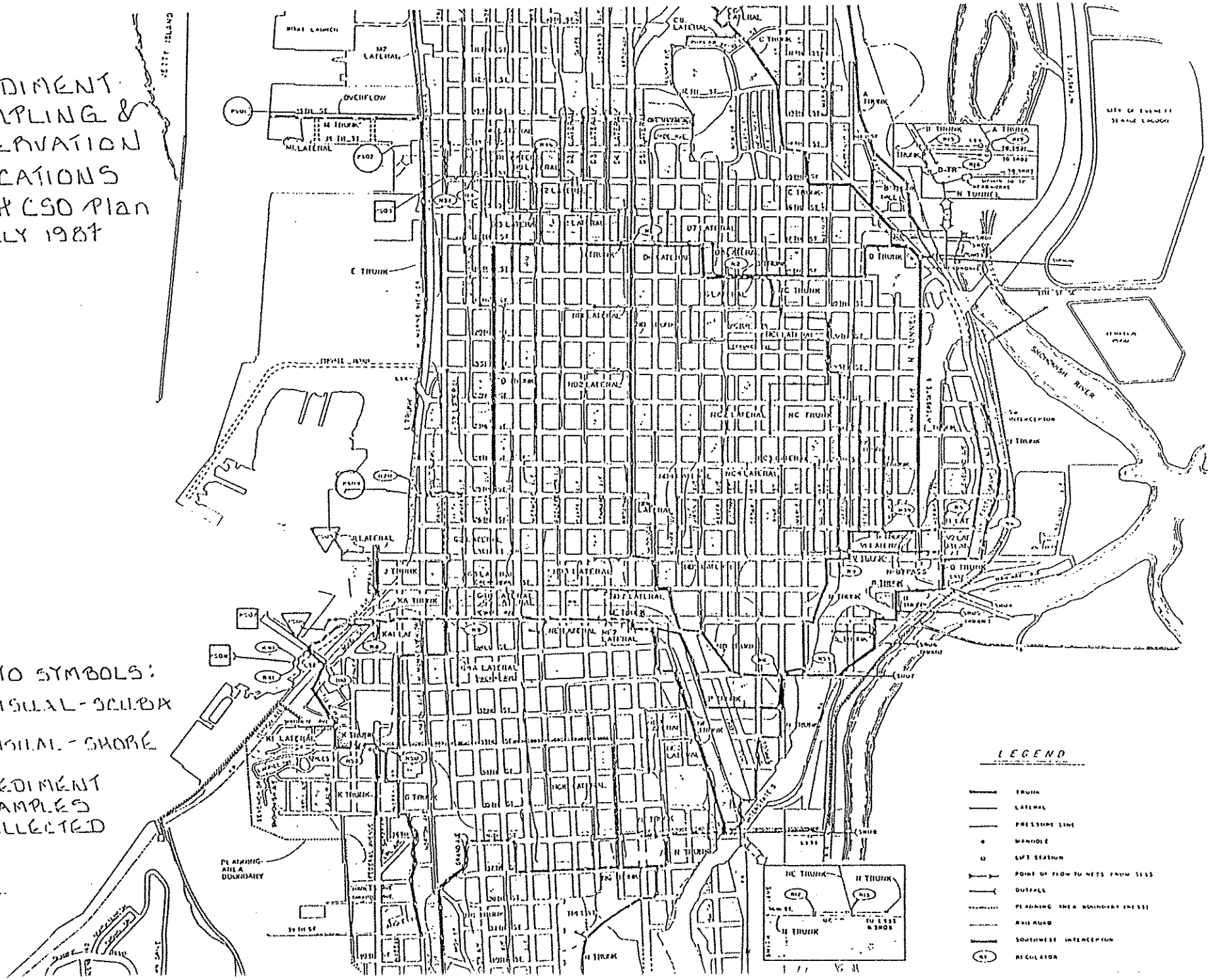
The usefulness of the data in this report to assess CSO sediment quality in Port Gardner is limited. The accuracy of the sediment data is questionable because of the absence of a QA/QC component to the study.

Because "visible accumulation" was not observed at the mouths of most of the outfalls surveyed, no samples were collected. Accumulation and impacts at these outfalls need to be characterized.

Attachment A

SEDIMENT SAMPLING AND OBSERVATION LOCATIONS

SEDIMENT SAMPLING & OBSERVATION LOCATIONS
Everett CSO Plan
JULY 1987



Attachment B

DATA SUMMARY TABLES

SUMMARY TABLE

PARAMETER	PSO 5	PSO 6	LOWEST APPARENT EFFECTS THRESHOLD (AET)	PSEP *[1]	EPA 1986 QUALITY CRITERIA (GOLD BOOK)	TPPS*[2] (CSO CONC.)	DOE DANGEROUS WASTE (EP TOXICITY)
METALS:							
Total Solids	52.0%	75.8%	22.0%				
Chromium	59.0 ug/g	54.0 ug/g	27.0 mg/kg		50.0 ug/L	0.048 mg/L	5-500 mg/L
Nickel	105.0 ug/g	100.0 ug/g	28.0 mg/kg	28	7.1 ug/L	0.042 mg/L	
Zinc	300.0 ug/g		260.0 mg/kg	62	58.0 ug/L	0.224 mg/L	
BASE-NEUTRAL COMPOUNDS							
Acenaphthene	5.22 ug/g		0.5 ug/g		710-970 ug/L		
Anthracene	14.4 ug/g	1.24 ug/g	0.96 ug/g				
Bis-(2-Ethylhexyl) Phthalate	9.97 ug/g		1.9 ug/g				
Benzo (a) Anthracene	27.2 ug/g		1.3 ug/g				
Benzo (a) Pyrene	10.2 ug/g		1.6 ug/g				
Benzo (b+k) Fluoranthene	20.5 ug/g		3.2 ug/g				
Chrysene	15.3 ug/g		1.4 ug/g				
Fluoranthene	70.1 ug/g	5.92 ug/g	1.7 ug/g		16-40 ug/L		
Fluorene	6.10 ug/g	0.76 ug/g	0.54 ug/g				
Ideno (1,2,3-cd) Pyrene	2.89 ug/g		0.60 ug/g				
Naphthalene	2.74 ug/g		---		2350 ug/L	0.33-9.54 ug/L	
Phenanthrene	71.9 ug/g	5.83 ug/g	1.5 ug/g			0.12-0.86 ug/L	
Pyrene	89.1 ug/g	4.1 ug/g	2.6 ug/g				

SUMMARY TABLE (cont.)

PARAMETER	PSO 5	PSO 6	LOWEST APPARENT EFFECTS THRESHOLD (AET)	PSEP *1	EPA 1986 QUALITY CRITERIA (GOLD BOOK)	TPPS*2
ACID COMPOUNDS						
Phenol	0.66 ug/g		0.42 ug/g		5,800 ug/L	
VOLATILE COMPOUNDS						
Acetone	2.76 ug/g	0.91 ug/g	---			
Methylene Chloride	0.08 ug/g	0.38 ug/g	---			25.4-121 ug/L
1,2-Dichlorobenzene	0.16 ug/g		0.035 ug/g			
Trichloroethylene	0.06 ug/g	0.40 ug/g	---		2,000 ug/L	1.0-98.7 ug/L
Xylenes	0.14 ug/g		0.10 ug/g			

HALOGENATED HYDROCARBONS (HH) AND POLYCYCLIC AROMATIC HYDROCARBONS (PAH)

DOE Hazardous Waste — WAC 173-303-9907 Persistent Dangerous Waste Mixtures

Extract for HH + PAH — 0.22 % | 0.08 % | 0.01 to 1.00 % = Designated Dangerous Waste (DW) for HH only

High Molecular Weight PAH (>3 and <7 rings):	PSO 5 ug/g	PSO 6 ug/g	AET (ug/kg)	AET (ug/g)
Fluoranthene	70.1	5.92	1700	1.7
Pyrene	89.1	4.1	2600	2.6
Benzo (a) Anthracene	27.2	1.07	1300	1.3
Chrysene	15.3	0.81	1400	1.4
Benzofluoranthenes	20.5	0.99	3200	3.2
Benzo (a) Pyrene	10.2	ND	1600	1.6
Indeno (1,2,3-c,d) Pyrene	2.89	ND	600	0.67
	235.3	12.8	12,400	12.4

*1 Puget Sound Estuary Program Protocol Manual

*2 Toxicant Pretreatment Planning Study Technical Report

ND = Not Detected

Appendix M

EAST WATERWAY, EVERETT, WASHINGTON
TECHNICAL DOCUMENT REVIEW

Review of:

Tetra Tech, Inc., September 1988, Puget Sound Estuary Program Everett Harbor Action Program: Evaluation of Potential Contaminant Sources, Final Report, prepared for U.S. Environmental Protection Agency, Region 10.

Contract No. C0089007

Document Control No. WD4030.1.0-M

January 1991

Prepared For:

WASHINGTON STATE DEPARTMENT OF ECOLOGY
Toxics Cleanup Program

ecology and environment, inc.

101 YESLER WAY, SEATTLE, WASHINGTON, 98104, TEL. 206/624-9537

International Specialists in the Environment

EAST WATERWAY TECHNICAL DOCUMENT REVIEW

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ATTACHMENTS

Attachment A - Maps
Attachment B - Scott Paper Plant Discharge Data Tables
Attachment C - City of Everett CSO Study Subbasin and Chemical Data
Attachment D - Stream Drainage Basin and Pollutant Loading Tables
Attachment E - Tetra Tech Outfall Sediment Study Contaminant List Tables
Attachment F - Puget Sound AET Values Table
Attachment G - Tetra Tech Outfall Sediment Study Relative Percent Distribution Figures

1.0 INTRODUCTION AND CHRONOLOGY OF EVENTS

Introduction

Under the guidance of the Everett Harbor Action Program, Tetra Tech, Inc. prepared a report in 1988, for the United States Environmental Protection Agency (EPA) evaluating selected potential contaminant sources in the Everett Harbor study area (see Figure 1 in Attachment A). Included in the study area was East Waterway. This review focused on subject matter directly applicable to the East Waterway.

The Tetra Tech source sampling program was designed as an initial screening survey to identify problem chemicals in a limited number of drains discharging into Port Gardner. Sediment samples were collected from two combined sewer outfalls (CSOs) and one storm drain in the East Waterway portion of their study area. The sediment samples were collected from deposits found in manholes near the mouth of each drain. The problem chemicals identified in the drains were compared to offshore sediment sample data in an attempt to isolate the potential contribution of the CSO and storm drain outfalls to existing East Waterway contamination.

The report also presented summary information on major industrial discharges, City of Everett outfalls, watershed, and atmosphere source areas.

Chronology of Events

Critical or relevant historic events influencing industrial conditions and scientific study conducted to characterize the East Waterway are listed below chronologically:

1930	Scott Paper Mill began operations;
1936	Weyerhaeuser began operations of the calcium-based, sulfite process paper mill near the present-day South Terminal.
pre-1951	Weyerhaeuser - Outfalls WT002 and WT003 were in operation and included the discharge of untreated waste waters from washing, bleaching and drying. Outfall WT004 was operable and discharged storm water runoff and waste water from limestone cleaning. Outfall WT006 was operable and discharged other storm water runoff from the facility.
1951	Scott - Outfall SW001 (Deep Water Diffuser) was constructed.
post-1951	Weyerhaeuser - Discharge of untreated sulfite waste liquor and effluent from a secondary treatment plant was directed through the Scott deep water diffuser (Outfall SW001).
pre-1960	City of Everett - City raw sewage was discharged into Port Gardner and Snohomish River via 14 outfalls.

1975 Weyerhaeuser - Plant performed conversion to thermo-mechanical process. New secondary treatment plant was activated to process waste waters, and discharged through the deep water diffuser (Outfall SW001). Outfalls WT002 and WT003 were sealed and abandoned.

post-1975 Weyerhaeuser - Outfalls WT004 and WT006 were dedicated to drain storm water discharge only.

1978 U.S. Corps of Engineers (COE) - Appendix F of the reviewed document reported 131,919 cubic yards of sediment dredged from the East Waterway.

1980 Weyerhaeuser - Pulp plant ceased operations.

1980 Scott - Outfall S008 was constructed for discharge of effluent from secondary treatment plant.

1986 Tetra Tech - October 15 through 29, sediment samples were collected from two CSOs (E011 and E007) and one storm drain (Norton Terminal). Analysis included priority pollutants, resin acids, and guaiacols.

1987-1988 City of Everett - Storm waters collected from four CSOs were analyzed.

2.0 LEGAL AND REGULATORY ISSUES

Regulatory issues generally were not addressed in the reviewed document. East Waterway National Pollutant Discharge Elimination System (NPDES) permits presented briefly included:

Scott Paper Company 26th Street and Federal Avenue Everett, Washington	Permit I.D. WA-000062-1
Western Gear (closed 1988) 2100 Norton Avenue Everett, Washington	Permit I.D. WA-000341-7

The list of dischargers was presented in the reviewed document.

The City of Everett Waste Water Treatment Plant (WWTP) located on Smith Island, built in 1960, also was identified as NPDES permitted (Permit I.D. WA 002449-0), and included several pretreatment program participants which were summarized in Table 2 of the reviewed document. The Everett system reportedly discharges into the Snohomish River, not into East Waterway.

No specific references were made to past NPDES permitting regarding the Weyerhaeuser (South Terminal area) pulp plant.

3.0 DEMOGRAPHICS AND LAND USE

Several of the active and historic industrial operations along the East Waterway shoreline were identified in the document. The list included:

- Scott Paper Company - Company operations began in 1930. The facility extends from 22nd Street to Everett Avenue. The mill produces ammonia-based sulfite pulp and towel/tissue paper. Auxiliary plants include a steam plant and waste water treatment plant.

- Port of Everett - The port operates three active terminals: Hewitt (Piers 1 and 3), Pacific (Piers B, D, and E), and South (historic Weyerhaeuser) Terminal. The disposition of the Norton Terminal was not specified.

- Anaconda Aluminum - Located at Hewitt Terminal.

- Everett Cold Storage (American Ice and Cold Storage) - Hewitt Terminal.

- Johnston Petroleum Products (Mobil Oil Company) - Hewitt Terminal.

- Foss Tug - Pacific Terminal.

- Dunlap Towing - Pacific Terminal.

- Western Gear Company (historic) - Company operations formerly were conducted along the north end of Pacific Terminal, south of the Norton Terminal.

- Weyerhaeuser paper facility (historic) - South Terminal.

4.0 POTENTIALLY LIABLE PERSONS

Potentially liable persons (PLPs) identified along the waterway are listed below, and their locations are plotted on Figure 4 (see Attachment A).

- City of Everett,
- Dunlap log yard (historic),
- Dunlap log yard (current),
- Dunlap Towing,
- Foss Tug (historic),
- Foss Tug (current),
- Johnston Petroleum Products,
- Port of Everett,
- Scott Paper Company,
- U.S. Naval Reserve Center, and
- Weyerhaeuser pulp facility (historic).

5.0 IDENTIFICATION OF POLLUTION POINT SOURCES

Several water discharge point sources were identified and discussed. Each of those sources is listed by discharger below.

Scott Paper Company

Outfalls Identified.

- Outfall SW001: Scott deep water diffuser, constructed in 1951. The diffuser is located 2,000 to 3,000 feet offshore at a depth of approximately 300 feet. SW001 discharges waste water from the plant's primary clarifiers. The outfall also was used by Weyerhaeuser for both treated and untreated wastes prior to 1980.

- Outfall S002 (historic ?): Located south of Outfall S003 (see Attachment A). The outfall discharged untreated pulp bleaching waste water effluent.

- Outfall S003: Scott nearshore diffuser. Discharges effluent released by the plant's two primary clarifiers.

- Outfall S004 (abandoned): Abandoned in approximately 1980. Formerly discharged "floor trench" waters.

- Outfall S008: Outfall for the plant's secondary treatment plant.

Scott operates several discharges under NPDES permit requirements. Effluent and discharge rates for outfalls SW001, S003, and S008, during 1985, 1986, and 1987 were summarized in Tables 4, 5, and 6 (see Attachment B). For the 3-year period, the averaged annual volume discharges for those outfall were: SW001 - 2,890 million gallons (MG), S003 - 2,197 MG, and S008 - 5,013 MG.

Weyerhaeuser (South Terminal Plant)

Outfalls Identified.

- Outfall SW001: Deep water discharge shared with Scott between 1951 and 1980. Discharges included untreated sulfite waste liquor, and secondary treatment plant effluent.

- Outfall WT002: Sealed and abandoned in 1975. Discharges included untreated waste waters from bleaching, washing, and drying processes. Utilization apparently was modified after activation of SW001 in 1951.

- Outfall WT003: Sealed and abandoned in 1975. Discharges included untreated waste waters from bleaching, washing, and drying processes. Application apparently was modified after activation of SW001 in 1951.

- Outfall WT004: Discharges included storm water runoff and waste water from limestone cleaning operations. After 1975, the outfall was dedicated to storm water discharge.

- Outfall WT006: Discharged storm water runoff after 1951. Previous history not mentioned.

When the calcium-based sulfite process paper and pulp plant converted to a thermomechanical process plant in 1975, several waste water modifications occurred. In 1975 a secondary treatment plant was constructed and all waste waters were treated.

The following reference was provided for a more complete discussion of the facility:

Tetra Tech, 1985a, Everett Harbor Action Program: Initial Data Summaries and Problem Identification, draft report, prepared for United States Environmental Protection Agency (USEPA), Region 10, Office of Puget Sound.

City of Everett (WWTP)

The City of Everett Waste Water Treatment Plant (WWTP) North End Sewer System (NESS) reportedly contains 16 outfalls, 8 of which discharge into Port Gardner. Two others are deactivated. Industrial dischargers using the system are permitted through the city's Everett Industrial Pretreatment Program (EIPP). EIPP participants were listed in Table 2 (page 15) of the reviewed document.

Combined Sewer Outfalls (CSOs) and storm drains are discussed in Section 6.0 as non-point sources.

Western Gear Company

Operations of the former Western Gear operation were discussed only briefly in the document. Apparently, the company's Norton Avenue facility which closed in 1980, was a NPDES permitted discharger of noncontact cooling water. Discharge occurred through Outfall WG003, located at the north end of the East Waterway.

6.0 IDENTIFICATION OF POLLUTION NON-POINT SOURCES

Everett CSOs

The Everett waste water treatment program NESS, as regulated under WAC 173-245, was identified as having 16 outfalls, 37 regulators, and 10 lift stations. Eight of the CSOs (PS01 through PS08) discharge into Port Gardner. In 1987, the city commissioned CWC-HDR and OTT Water

Engineers to study and model the CSO system. From that work, the eight outfalls directly impacting the East Waterway (PS1-PS8) area were divided into two groups (Group 1 and Group 2) (refer to Figure 9 and Table 23 in Attachment C).

"Outfall sites PSO1, PSO2, PSO3 (outfall Group 1) represent the overflows from the northwest part of Everett, between 9th and 21st streets, and west of Wetmore Avenue. PSO3 rarely overflows due to the overflow weir, which has a high elevation relative to the normal flow of the corresponding pipeline".

"Outfall PSO4 is located near 25th Street on property owned by Scott Paper Company. The overflow from Lift Stations 3 and 4 is discharged at Outfall PSO5. This CSO collects the majority of flow west of Colby Avenue between 26th and 60th Streets. Outfall PSO6 has a large contributing area which encompassed southwest Everett outfall. PSO7 is located off of Bond Street between Wall Street and Pacific Avenue. Regulation of flow upstream of Lift Station 2, combined with the new interceptor, allows infrequent overflows at Outfall PSO8".

Within the system, the overflow weirs are not similar. As a result, the proportion of diverted flow during overflows varies at each weir. The systems also are influenced by back-water surcharging. The conclusion was reached that it was nearly impossible to define the contribution from each contributing basin at each outfall, particularly in Group 2. Volume and capacity outfall information are summarized in Table 23, Table 24, and Figure 9 (see Attachment C).

Chemical analytical results from the Everett CSO stormwater outfall sampling study are discussed in Section 7.0 of this review.

Storm Drains

The numbers, serviced areas, and locations of surface storm drains along the East Waterway were discussed briefly in the document. Details were not provided, but Figure 4 (see Attachment B) identified nine locations. The Scott facility may have up to six drains. The Port of Everett reportedly has drains serving Hewitt and Norton Terminals. City of Everett storm drains reportedly serve only Norton Avenue and adjacent areas. Mention also was made of Scott using a north end Port of Everett drain.

Landfills

The Everett and Tulalip landfills were identified as landfills that impact the Everett Harbor study area. These sites potentially are impacting the Snohomish River and Delta, but do not threaten the East Waterway directly.

Rivers and Creeks

Excluding the Snohomish River, in the scope of the East Waterway document review project, only one creek, Pigeon Creek #1, located at the far southern end of the East Waterway was identified. Table 33 and

Table 34 of the document presented baseline data on the creek (see Attachment D). The tables indicated that the creek has a drainage area of 973 acres, and an average flow of 6.4 MG per day. Loading estimates included 1,470 pounds biological oxygen demand (BOD); and 6 pounds of lead, copper, and zinc for a 1-year (24-hour) storm event.

Groundwater

Information on upland groundwater immediately surrounding the East Waterway was not included in the document.

Atmospheric

According to a conversation with J. Anderson, June 13, 1988, of the Puget Sound Air Pollution Control Agency (PSPCA), the total suspended particulate emissions from 13 sources in the project area were calculated at 1,615 ton/year (Table 36 [page 91]) in the reviewed document. A list of common toxic air emissions in the project area were summarized in Table 37 (page 92) of the reviewed document.

7.0 CHEMICAL DATA

Data and interpretations summarized in this section principally present results from sampling work completed on four East Waterway related environments:

- The City of Everett CSO storm water study;
- The Tetra Tech (Everett Harbor Action Program) CSO sediment sampling;
- The Tetra Tech (Everett Harbor Action Program) offshore sediment sampling of selected outfalls; and
- The analytical summaries of analyses performed on the Scott outfalls.

Several of the tables and figures presented in the document have been included as attachments to this report to assist in presenting these data.

City of Everett CSO Study

Sampling stations and results of the storm water organic and inorganic contaminant study performed by City of Everett in 1987 and 1988 are presented in Tables 25, 26, 27, and 28 (see Attachment C). For the East Waterway Group 1 and 2 outfalls, several metals exceeded either chronic or acute EPA freshwater quality criteria.

CSO Sediment Analysis

The sampling performed by Tetra Tech involved the analysis of sediments collected from within two CSOs and one storm drain (SD). The samples were numbered:

Number	Location
Sample E007:	CSO E007
Sample E011-1:	CSO E011
Sample E011-2:	CSO E011 (approx. 200 ft. from sample E011-1)
Sample NORT:	Norton Terminal Storm Drain

The sampling was performed in October 1986. Rainfall for the month at the time of sampling was 2.93 inches, 0.26 inches below normal. Samples were analyzed for metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, iron and manganese), extractable organics, total solids, and grain-size analysis. Chemical analytical summary sheet results were presented in Appendix A of the reviewed document. Samples were handled according to Puget Sound Estuary Program (PSEP) protocols as described in:

> Tetra Tech, 1986a, Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, final report, prepared for EPA and COE.

Grain-Size Results. A detailed graphic presentation of the grain-size characteristics of the four samples was presented in Appendix D of the reviewed document. The analyses were performed according to PSEP protocols. In general, the samples were dominantly sand, except for the NORT sample which was a sandy silty clay.

Metals Results. The samples were analyzed using both Atomic Adsorption (AA) and X-Ray Fluoresence (XRF) analytical techniques. Results were presented as dry weights. The parallel analyses were performed because of concerns surrounding inappropriate comparisons of the reported concentrations generated by differing methodologies to Puget Sound reference data stations. This Quality Assurance (QA) issue is further discussed in Section 10.0 of this document review.

Extractables and Volatile Organic Compounds. The base/neutral acid extractable organic compounds (BNAs) reportedly were analyzed by gas chromatography/mass spectrometry (GC/MS) following the PSEP protocol procedures. Thirty-four volatile organic compounds (VOCs) were analyzed by purge and trap GC/MS according to EPA Contract Laboratory Program (CLP) protocols. The analyses also included miscellaneous extractables and 15 tentatively identified compounds (TICs). Table 42 (see Attachment E) lists the parameters measured.

The results were identified as acceptable as qualified, and were reported as dry weights.

Pesticides/Polychlorinated Biphenyls. Nineteen pesticides were evaluated by GC/electron capture detector (ECD) following PSEP protocol methods. Quantitation and confirmation were performed using packed columns and EPA CLP protocols.

The polychlorinated biphenyl (PCB) analysis was conducted for total PCBs reportedly using both GC/ECD and GC/MS. The instrument and quantification methods for the GC/ECD required several modifications of the PSEP protocol methodology. The analytical PCB data were considered acceptable when qualified as estimates.

Resin Acids and Chlorinated Phenols/Guaiacols. Non-standard analytical methods were required to analyze for selected pulp mill-related compounds. A list of those chemicals can be found in Table 42 under Chlorinated Phenols/Guaiacols and Resin Acids (see Attachment E). The methodologies reportedly are described in the following reference:

Tetra Tech, 1988, Everett Harbor Action Program: Data Quality Assurance Assessment, final report, prepared for USEPA, Region 10.

The resin acids were analyzed by full-scan GC/MS. Chlorinated phenols were analyzed by GC/MS - SIM (selected ion monitoring). The data were considered acceptable, except as qualified. Palustric acid data were rejected.

Results Discussion. Problem chemicals were identified by comparing the CSO data to Puget Sound Apparent Effects Threshold (AET) concentrations as listed in Table 38 (see Attachment F). AETs are expressed as chemical concentrations in sediments above which a particular adverse biological effect is expected to be statistically significant ($P < 0.05$) relative to appropriate reference conditions. For each of the 64 chemicals listed in Table 38, a separate AET was developed for four biologic indicators. From the resulting data, a list of the highest (HAET) and lowest (LAET) for each chemical was established.

Chromium was identified above the AET in all four samples. The nickel AET was exceeded in three of the drain samples. Antimony was not compared to an AET due to uncertainties surrounding analytical method comparability (see QA discussion in Section 10). Organic compounds detected included DDT, acenaphthene, naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene, 4-methylphenol, dibenzofuran, dimethyl phthalate, and benzoic acid. Table 43 (see Attachment E) listed a summary of the problem chemicals identified. Table 44 (see Attachment E) listed chemicals which were undetected, but which had analytical detection limits above HAET concentrations.

Offshore Sediment Sampling

Chemical concentrations of sediment samples collected at several stations in the East Waterway directly offshore of the sampled outfalls were discussed briefly, however, detailed discussion and listing of these analytical results were not presented in the document. Reference was made to the following report as the likely source of such data:

PTI Environmental Services and Tetra Tech, 1988, Everett Harbor Action Program: Analysis of Toxic Problem Areas, draft report, prepared for USEPA, Region 10.

At least 15 sediment samples (EW-1 through EW-15) positioned along the East Waterway (see Figure 11 in Attachment A) were referenced. The organic chemicals that most frequently exceeded the listed AET concentrations were 4-methylphenol and LPAH (defined as naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene). Station sample EW-07, located in the slip between the Scott facility and Hewitt Terminal, showed the highest 4-methylphenol concentration. Stations EW-04, EW-07, EW-13, and EW-14 showed the highest LPAH concentrations. Naphthalene was the predominant polycyclic aromatic hydrocarbon (PAH) detected.

The most prevalent resin acids noted were dehydroabietic acid (DHA) and abietic acid, and their concentrations were highest at EW-04 and EW-13, respectively. EW-04, located offshore of the Scott facility, exhibited more prevalent chlorinated resin acids and chlorinated phenols than EW-14, located offshore of the South Terminal (historic Weyerhaeuser facility site). Pronounced concentrations of chlorinated phenols and chlorinated guaiacols were reported for samples EW-1 and EW-2, located approximately 100 feet offshore of the Norton Terminal Storm Drain.

Problem metals exceeding the stated HAETs were copper and zinc. EW-14 (South Terminal) exceeded those HAETs as well as the LAETs for arsenic, cadmium, lead, and mercury.

Evaluation of Outfall versus Offshore Sediment Samples

The Tetra Tech team compared the analytical results from the CSO sediments to waterway sediments sampled offshore of the outfalls, in an effort to identify potential contaminant sources impacting the East Waterway. To assist in evaluating the data, relative percent distributions of chemicals were calculated and graphed. Percent distributions were established for related chemical groups (i.e., LPAH, HPAH, chlorinated phenols, resin acids and metals) and calculated by taking the percentage contribution (by concentration) of the related chemicals and plotting them for comparison. Figures 17 through 21 graphically display the percent distributions and are provided in Attachment G. Brief summaries of those comparisons and analytical results follow.

Norton Terminal Storm Drain. Sediments from the Norton SD showed similar percent distributions, but concentrations were dissimilar. While the SD contained metals (chromium 133 mg/kg and nickel 67.2 mg/kg) exceeding HAET concentrations and antimony (6.0 mg/kg) exceeding the LAET, the sediment from offshore sample EW-01 showed concentrations below AET problem levels.

In contrast, the problem chemicals (chlorinated phenols, chlorinated guaiacols, and the resin acid sandaracopimaric acid found in the offshore sediment samples) were not detected in the SD sample.

The resin acid dehydroabietic acid (DHA) was found at 4.8 mg/kg in the Norton SD versus 10.0 mg/kg in the offshore sediment.

CSO E011. Offshore sediment sample station EW-04 was positioned approximately 250 feet offshore of outfall CSO-E011. The resulting samples E011-1 (manhole 1) and E011-2 (manhole 2) comprised the CSO samples collected.

Eight organic HAET concentrations were exceeded for EW-04, including four phenols, LPAH, and PCBs. Ninetieth percentile concentrations were exceeded for nine phenolic, chlorophenolic, and resin acid compounds. DHA exceeded an Elevation Above Reference (EAR) of 1,000.

Four HAET (LPAH, acenaphthene, 4-methylphenol and benzoic acid) were exceeded in drain sample E011-1. HAET concentrations for naphthalene, acenaphthylene, and dimethyl phthalate were exceeded in sample E011-2. The compound 4-methylphenol was noted as a widespread contaminant in the East Waterway, but no sources have been identified. This compound has been detected at several areas impacted by pulp industry processes in the Everett Harbor study area, including sediment at station NG-01 at Scott outfall SW001.

For pulp industry compounds the relative percent distribution differed between the CSO and offshore sediments, except for DHA. PAH compound distribution in the CSO and offshore sediments were similar. PAH distributions, in part, matched relative abundances observed in a limited sampling of street dusts collected in Bellevue and Seattle.

Relative abundances of metals concentrations were not similar. A zinc concentration (9,890 mg/kg) from sample E011-1 exceeded the listed HAET.

CSO E007. The comparative offshore sample station EW-12, located approximately 550 feet offshore of the outfall E007, did not exceed HAET or LAET, except for 4-methylphenol. Pulp industry-related compounds were not analyzed at station EW-12.

Relative percent distributions between the outfall and offshore sediment samples for PAH compounds compared more closely for HPAH than LPAH. Relative abundances of metals were similar. Pulp compounds could not be compared.

8.0 HYDROLOGIC AND HYDRODYNAMIC DATA

One drainage system, Pigeon Creek #1, which directly empties into the East Waterway study area was identified. The creek opens to Port Gardner immediately south of the South Terminal (see Figure 2 in Attachment A). Brief drainage and loading summaries for the creek are presented in Table 33 and Table 34 found in Attachment D.

No hydrogeologic data were presented directly relevant to the East Waterway.

9.0 BIOLOGICAL DATA (FLORA/FAUNA)

A listing of AET concentrations used for comparative purposes in the document were listed in Table 38 (see Attachment F). A detailed explanation of the origin of these criteria was not presented.

Though not biologically based, problem chemical assessments also were made using a criteria based on exceeding of an Elevation Above Reference (EAR) value of 1,000. The Puget Sound locations from which these background reference chemical concentrations were derived was not explained. Reference was made to the application of these criteria in another Action Program reference which may elaborate on the derivation of the AET and EAR:

PTI Environmental Services and Tetra Tech, 1988, Everett Harbor Action Program: Analysis of Toxic Problem Areas, draft report, prepared for USEPA, Region 10.

10.0 DATA QUALITY

The document stated that the quality of the Tetra Tech CSO sediments analyses and offshore sediment sampling results were assessed by applying procedures specified in accordance with PSEP guidelines. The data summary sheets presented in Appendix A of the reviewed document included data qualifiers. Data requiring qualifiers included selected metals, BNAs, resin acids, chlorinated phenols and guaiacols, PCBs, and TICs.

The validation procedures reported included assessments of accuracy (using Standard Reference Materials [SRM]), matrix spike and/or surrogate recovery, and precision. Also included was the evaluation of initial and ongoing calibrations, tuning, blank results and holding times.

Metals Analytical Issue

A potential analytical comparability problem concerning an observed variance of reported total metals concentrations created by non-equivalent analytical methods was discussed. Specifically, they noted the questionable comparability of XRF methodology, as provided under the PSEP protocols, and "strong acid" digestion methods typical of EPA CLP analytical procedures (i.e., AA analysis). During the studies, a limited number of comparative analyses were conducted using samples from Everett Harbor, Elliott Bay, Port Susan, and Carr Inlet reference sites. From these comparisons, it was determined that "sufficient uncertainty" existed. In particular, it was not appropriate to use the metal, antimony, to identify problem areas for the current study.

11.0 DREDGING AND DISPOSAL ISSUES AND DATA

A brief summary of the dredging history of the Everett Harbor study area was presented in Appendix F of the reviewed document. The COE dredged 131,919 cubic yards of sediment from the East Waterway in 1978. Details were not presented. The data were obtained by personal communication in 1988 with H. Arden of the Seattle Office COE.

12.0 ENVIRONMENTAL IMPACTS

In reference to air pollution impacts, a listing of registered dischargers with the Puget Sound Air Pollution Control Agency (PSAPCA) was presented in Appendix G of the reviewed document.

13.0 INTERIM MEASURES/SPILL AND POLLUTION PREVENTION MEASURES

Scott Paper Company reportedly unloads liquid chlorine (pressurized chlorine gas) for pulp bleaching near historic Outfall S002. No mention was made of spill prevention or contingency plan protocols.

Section 2.8 of the reviewed document indicated that insufficient information was available to determine loading caused by past chemical or petroleum spills in the waterway.

14.0 COMMUNITY RELATIONS INFORMATION

The project was funded through the National Estuary Program under the authorities of the Clean Water Act. Several groups and personnel who contributed and/or benefited from the study were noted in the introduction. A summary list is provided below.

Technical guidance credits were given to:

City of Everett

Dan Mathias
Carl Baird
Ron Thomas
Jeff Kerwin

EPA

Claire Ryan
Lawrence McCrone

Ecology

Dave Wright

Port of Everett

Dennis Gregoire

Snohomish County Health Department

David Peterson

Scott Paper

Tim Bechtet

Tetra Tech

Raymond Luce II
Robert Storer
Sharon Steele
Lynne Kilpatrick-Howard

Participation credits were given to groups referred to as the Citizens Advisory Committee (CAC) and the Interagency Work Group (IAWG). The CAC was chaired by Gary Wold and Dave Murdock, and the IAWG was chaired by Joan Thomas.

15.0 RECOMMENDATIONS

The recommendations presented below are based on reviewing the report as a stand-alone document, and do not attempt to account for additional information potentially available. The additional information needed based on the review of the Everett Harbor Action Program document is listed below:

- A comprehensive listing of chemicals known to be associated with the Scott and historic Weyerhaeuser pulp plants would establish the connection of these operations to offshore problem chemicals more completely, and potentially would identify additional problem chemicals. Such a listing should include definition of the chemical composition of the sulfite waste liquor historically discharged by Weyerhaeuser.

- More detailed operational and wastestream specific records on industries listed in Section 4.0. On-site inspections may be appropriate.

- Exact location descriptions, location coordinates, and inventory of the numerous outfalls reportedly existing along the East Waterway. An inventory should include the City of Everett CSOs and storm drains, Port of Everett storm drains, and miscellaneous current or historic industrial outfalls.

- A resolution of the metals analytical methodology issue to establish accepted PSEP protocols.

- An evaluation of the outfall and waterway sediment chemistry results relative to the most recent Ecology sediment standards (WAC 173-204).

An additional recommendation is to obtain and formally review the appropriate Tetra Tech document on the analytical validity of the outfall sediment samples.

Additional References

After document review, several pertinent documents were referenced to support the content. To support comprehensive site planning, these documents should be acquired by the Ecology Toxics Cleanup Program site library, and evaluated. Those references include:

PTI Environmental Services, 1988, Everett Harbor Action Program: 1988 Action Plan, draft report, prepared for Tetra Tech, Inc. and United States Environmental Protection Agency Region 10, PTI Environmental Services, Bellevue, Washington.

Tetra, Tech, Inc., 1985a, Everett Harbor Action Program: Initial Data Summaries and Problem Identification, draft report, prepared for United Environmental Protection Agency Region 10, Office of Puget Sound, Tetra Tech, Inc., Bellevue, Washington.

_____, 1986b, Quality Assurance Project Plan for Field Investigations to Support Development of the Everett Harbor Action Plan, prepared for U.S. Environmental Protection Agency Region 10.

_____, 1986c, Sampling and Analysis Design for Development of Everett Harbor Action Program, draft report, prepared for U.S. Environmental Protection Agency Region 10, Tetra Tech, Inc., Bellevue, Washington.

_____, 1986d, User's Manual for the Pollutant of Concern Matrix, final report, prepared for U.S. Environmental Protection Agency Region 10, Tetra Tech, Inc., Bellevue, Washington, 64 pp.

_____, 1988, Everett Harbor Action Program: Data Quality Assurance Assessment, final report, prepared for U.S. Environmental Protection Agency Region 10, Office of Puget Sound, Tetra Tech, Inc., Bellevue, Washington.

16.0 FINAL COMMENTS

Drain Sediment Study

The recognition of certain East Waterway problem chemicals existing in the sampled Everett CSO and SD sediments should only be interpreted as a screening approach. Problems arise in attempting to quantify and verify the current or historic release of contaminants from these sources based on the data presented. The application of the approach presented in the document would be maximized by promoting a comprehensive, monitoring program with the goal of isolating ongoing problem chemical outfall sources impacting the East Waterway and developing

appropriate controls and corrective actions. Such an investigation would benefit from storm water sampling techniques used during the City of Everett CSO study.

Conclusions presented on the outfall/offshore sediment chemical relationships did not include historic considerations. The storm water and sediment train chemical compositions carried by the outfalls are dynamic. Historic parameters cannot be confidently assumed. For example, the conclusion that the Norton SD was probably not a major contributor to the problem chemicals measured in the associated offshore sample station lacks adequate supportive documentation.

Attachment A

MAPS

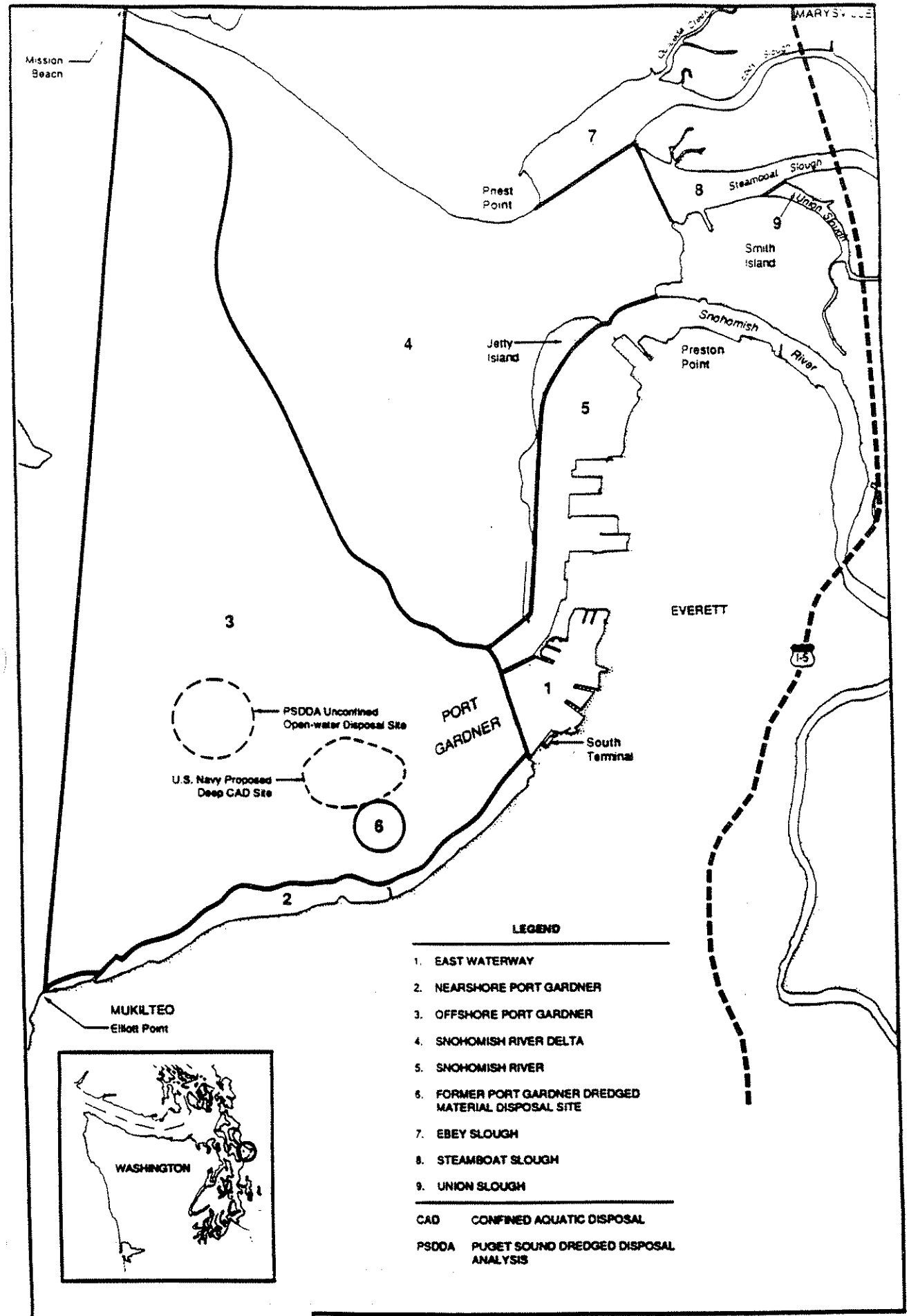

Figure ES-1. Project location and study areas within Everett Harbor and the lower Snohomish River.

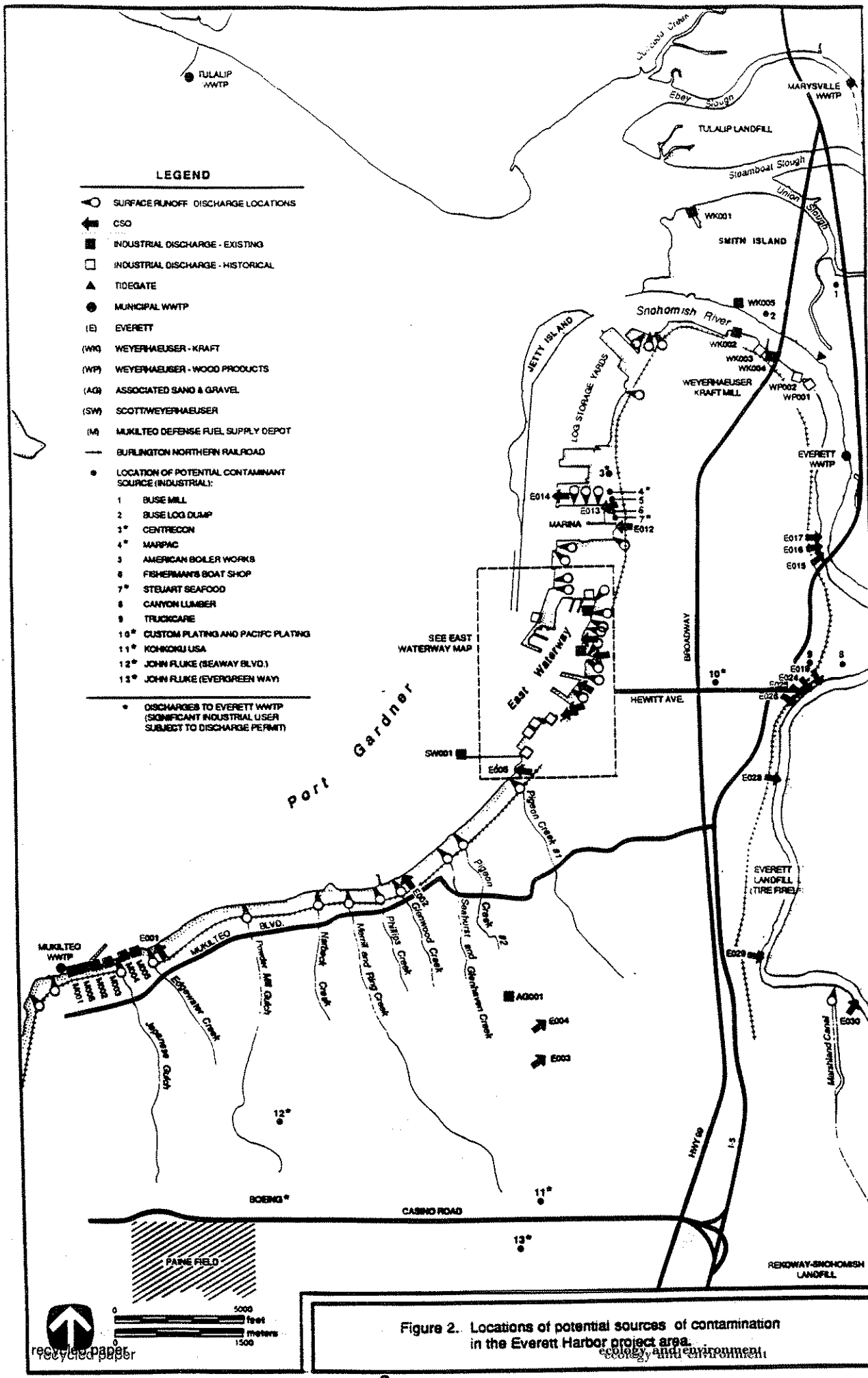

Figure 2. Locations of potential sources of contamination in the Everett Harbor project area.

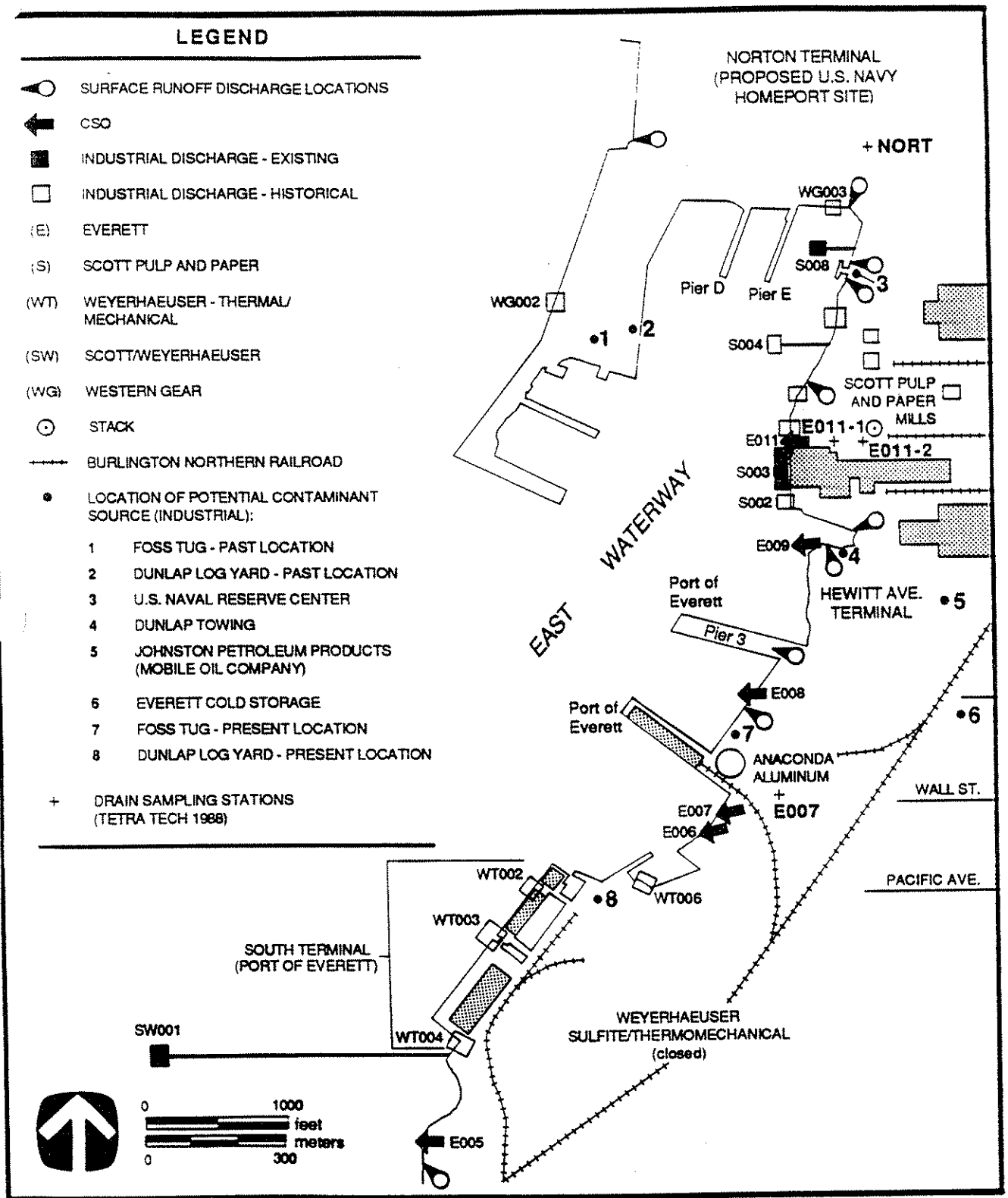

Figure 4. Locations of drain sampling stations, industrial discharge outfalls, CSOs, and storm drains in the East Waterway study area.

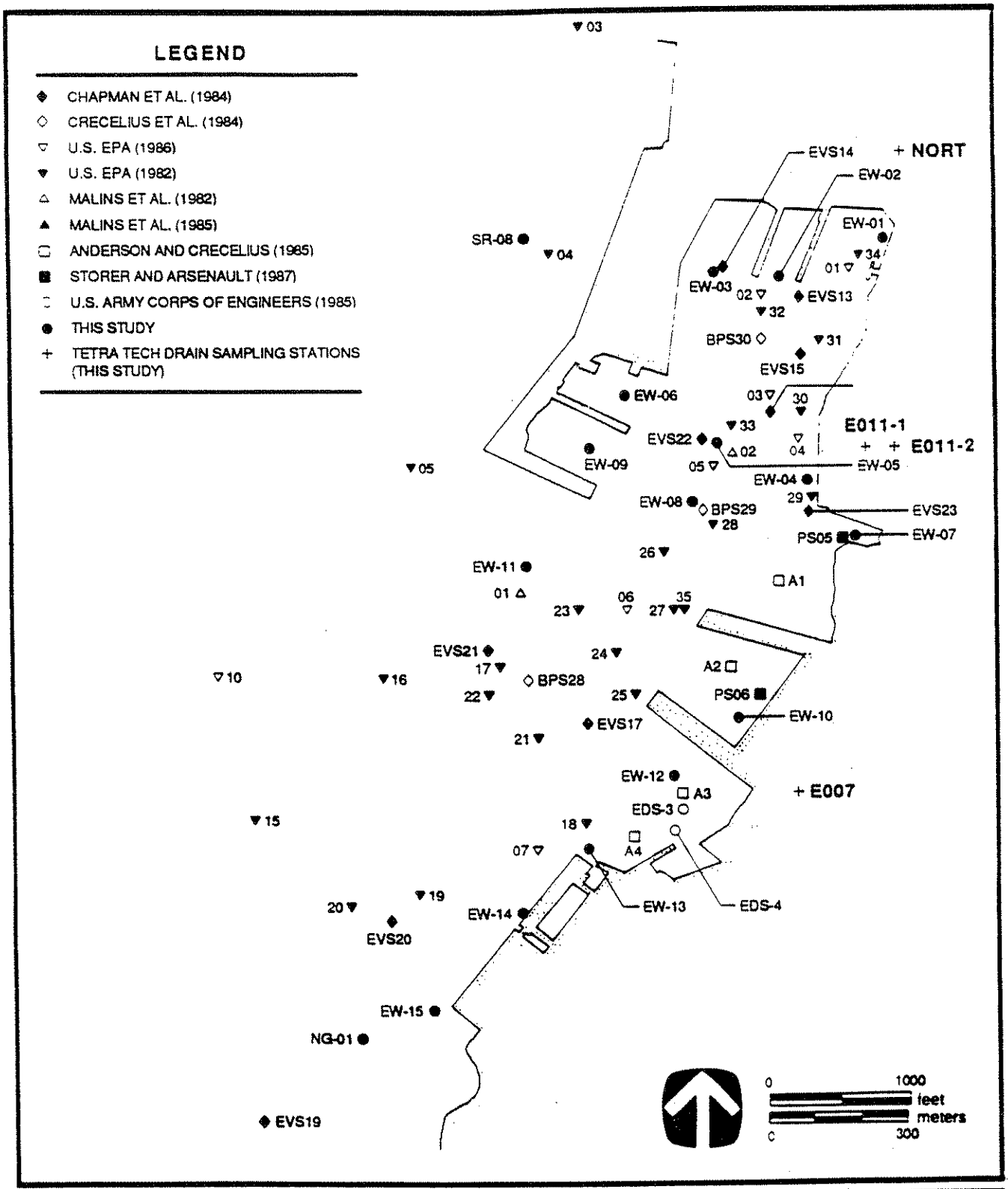

Figure 11. Locations of offshore and drain sampling stations in the East Waterway study area.

Attachment B

SCOTT PAPER PLANT DISCHARGE DATA TABLES

TABLE 4. SCOTT MILL EFFLUENT DISCHARGE
MONITORING REPORTS (1985-APRIL 1988)
OUTFALL SW001

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1985					
J	7.3	77	4,668	51	3,114
F	8.0	62	4,088	56	3,764
M	7.9	65	4,235	48	3,146
A	6.9	54	3,136	58	3,356
M	8.1	57	3,824	58	3,878
J	9.4	54	4,243	67	5,205
J	9.5	64	4,712	63	4,668
A	10.4	97	8,607	76	6,483
S	10.9	98	9,192	105	9,790
O	8.5	64	4,495	66	4,668
N	8.8	94	6,870	92	6,697
D	8.8	96	7,064	97	7,148
Total	3,155 MG		987 ton		942 ton
1986					
J	8.8	78	5,698	80	5,876
F	8.4	84	5,838	99	6,897
M	8.1	92	6,135	104	6,793
A	7.7	81	5,230	84	5,390
M	7.8	96	6,276	75	4,877
J	8.3	77	5,288	74	5,123
J	8.1	75	5,088	85	5,774
A	7.7	69	4,374	62	3,913
S	7.8	65	4,217	73	4,745
O	7.5	67	4,193	76	4,734
N	6.5	85	4,673	104	5,667
D	6.9	70	3,956	78	4,511
Total	2,789 MG		908 ton		954 ton

TABLE 4. (Continued)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1987					
J	8.2	62	4,257	70	4,816
F	8.0	79	5,293	89	5,991
M	7.9	76	5,016	77	5,093
A	8.0	63	4,199	70	4,662
M	7.7	59	3,777	65	4,128
J	7.7	49	3,182	52	3,333
J	6.9	46	2,660	51	2,911
A	6.3	45	2,361	49	2,580
S	6.4	50	2,698	53	2,821
O	8.1	57	3,828	63	4,225
N	7.7	61	3,901	58	3,732
D	8.2	65	4,492	65	4,505
Total	2,727 MG		684 ton		730 ton
1988					
J	8.0	69	4,631	70	4,723
F	5.8	65	3,142	54	2,583
M	5.7	70	3,379	57	2,660
A	6.5	65	3,527	69	3,707
Total	752		212		198
3-1/3 Yr Average	7.9 $\pm$1.1[a]	70 $\pm$15	4,661 $\pm$1,460	71 $\pm$16	4,717 $\pm$1,500

[a] Average = $\bar{x} \pm$ SD (SD = standard deviation).

Reference: Scott Paper Company (1988).

TABLE 5. SCOTT MILL EFFLLUENT DISCHARGE
MONITORING REPORTS (1985-APRIL 1988)
OUTFALL S003

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1985					
J	7.6	69	4,460	48	3,001
F	4.5	55	2,075	44	1,667
M	3.9	54	1,744	44	1,425
A	4.2	45	1,581	49	1,770
M	6.0	46	2,224	45	2,218
J	7.5	35	2,298	49	3,170
J	8.6	30	1,988	34	2,221
A	5.9	44	2,167	43	2,166
S	3.8	71	2,194	67	1,994
O	5.1	41	1,864	47	2,185
N	6.7	72	3,922	65	3,525
D	4.7	76	2,974	58	2,310
Total	2,057 MG		448 ton		421 ton
1986					
J	5.4	50	2,364	60	2,978
F	3.5	67	1,872	65	1,800
M	5.0	102	3,898	74	3,419
A	4.2	91	3,154	43	1,552
M	4.1	116	3,875	48	1,615
J	5.5	67	2,926	34	1,485
J	7.1	44	2,515	30	1,672
A	8.6	30	2,157	18	1,330
S	6.9	23	1,329	20	1,134
O	9.2	39	2,949	35	2,727
N	7.5	95	5,614	76	5,118
D	5.8	99	4,686	50	2,454
Total	2,204 MG		567 ton		414 ton

TABLE 5. (Continued)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1987					
J	5.0	84	3,416	52	2,214
F	7.6	71	4,596	61	4,040
M	5.0	78	3,070	55	2,358
A	7.0	56	3,214	43	2,584
M	7.2	48	2,931	33	2,004
J	7.1	44	2,602	34	2,004
J	6.1	69	3,328	49	2,343
A	6.7	41	2,285	27	1,489
S	7.8	42	2,816	41	2,787
O	8.0	57	3,719	46	3,105
N	4.7	63	2,366	39	1,611
D	5.1	77	3,158	47	2,040
Total	2,330 MG		566 ton		430 ton
1988					
J	6.8	88	5,414	61	3,630
F	4.4	89	3,271	46	1,688
M	7.0	132	6,970	53	3,165
A	5.0	162	6,382	60	2,563
Total	706 MG		335 ton		168 ton
3-1/3 yr Average	6.0 $\pm$1.5[a]	67 $\pm$29	3,159 $\pm$1,296	47 $\pm$13	2,364 $\pm$832

[a] Average = $\bar{x} \pm$ SD (SD = standard deviation).

Reference: Scott Paper Company (1988).

TABLE 6. SCOTT MILL EFFLUENT DISCHARGE
MONITORING REPORTS (1985-APRIL 1988)
OUTFALL S008

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1985					
J	10.8	22	1,972	67	6,057
F	11.1	29	2,623	61	5,550
M	11.5	35	3,356	76	7,238
A	12.9	25	2,670	61	6,640
M	13.5	20	2,274	53	5,919
J	15.1	22	2,767	68	8,489
J	15.3	24	2,769	49	5,857
A	16.4	28	3,794	62	8,569
S	12.7	22	2,291	52	5,437
O	13.4	24	2,699	61	6,819
N	11.9	39	3,922	89	8,923
D	10.2	24	2,065	56	4,911
Total	4,654 MG		501 ton		1,218 ton
1986					
J	12.3	24	2,449	60	6,116
F	11.4	26	2,528	52	5,047
M	10.3	41	3,486	93	8,118
A	10.9	27	2,417	64	5,810
M	11.0	24	2,192	51	4,763
J	11.8	34	3,324	76	7,468
J	12.6	33	3,501	97	10,269
A	17.2	26	3,631	58	8,126
S	16.3	21	2,837	44	6,066
O	15.3	24	3,059	58	7,328
N	12.8	23	2,661	66	7,566
D	15.8	26	3,487	69	8,962
Total	4,776 MG		546 ton		1,289 ton

TABLE 6. (Continued)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1987					
J	14.4	18	2,174	54	6,433
F	13.1	15	1,665	38	4,186
M	15.3	14	1,775	44	5,698
A	14.2	18	2,169	42	4,906
M	13.9	16	1,846	37	4,387
J	14.2	21	2,389.	51	5,939
J	15.6	23	2,526	50	5,793
A	19.1	28	4,387	53	8,297
S	15.8	32	4,430	58	7,748
O	15.9	28	3,794	63	8,354
N	17.1	23	3,264	57	8,103
D	16.5	19	2,608	39	5,419
Total	5,610 MG		501 ton		1,141 ton
1988					
J	15.2	21	2,675	55	6,582
F	19.6	16	2,708	48	7,905
M	13.9	22	2,791	63	7,826
A	17.9	17	2,524	43	6,248
Total	1,985 MG		162 ton		432 ton
3-1/3 yr Average	14.1 $\pm$2.4[a]	24 $\pm$6	2,812 $\pm$686	58 $\pm$14	6,747 $\pm$1,447

[a] Average = $\bar{x} \pm$ SD (SD = standard deviation).

Reference: Scott Paper Company (1988).

TABLE 7. ORGANIC CHEMICALS AND METALS FOUND IN SCOTT PULP AND PAPER MILL OUTFALLS (mg/L)

Contaminant	Date of Sample	Outfall SW001	Outfall S003	Outfall S008 Influent	Outfall S008 Effluent
Metals					
Cadmium	6/5/85[a]	0.0010	0.0010	NA	0.0020
	10/1/86[b]	0.0016	0.0007	NA	0.0017[c]
Chromium	6/5/85[a]	0.0050	0.0050	NA	0.0100
	10/1/86[b]	ND	ND	NA	ND
Copper	6/5/85[a]	0.0040	ND	NA	0.0020
	10/1/86[b]	ND	ND	NA	ND
Nickel	6/5/85[a]	ND	ND	NA	0.0070
	10/1/86[b]	0.005	0.008	NA	ND
Silver	6/5/85[a]	ND	ND	NA	0.0018
	10/1/86[b]	ND	ND	NA	ND
Zinc	6/5/85[a]	0.0450	0.0170	NA	0.440
	10/1/86[b]	0.082	0.033	NA	0.073[c]
Volatile Organics					
Acetone	10/1/86[b]	0.200	0.130	NA	0.015
Chloroform	7/9/85[d]	NA	NA	NA	0.049
	11/24/82[d]	0.107	NA	NA	
	9/22/82[d]	NA	0.373	NA	1.130
	10/1/86[b]	0.079	0.035	NA	0.066
Ethyl benzene	11/24/82[d]	0.021	NA	NA	
Carbon Tetrachloride	9/22/82[d]	NA	NA	NA	0.010
Semivolatile Organics					
Benzoic acid	10/1/86[b]	0.057	ND	NA	ND
Resin Acids					
Isopimaric[e]	NA	NA	NA	0.140	ND
Isopimaric[f]	3/2/83	NA	NA	0.285	ND
Dehydroabietic[e]	NA	NA	0.035	0.852	0.002
Dehydroabietic[f]	3/2/83	NA	NA	1.463	0.018
Abietic[e]	NA	NA	0.004	0.010	ND
Retene[f]	3/2/83	NA	NA	0.0009	0.045

[a] Bechtel, T. (19 July 1985, personal communication).

[b] Kjosness, D. (1 August 1988, personal communication).

[c] This value is the average result from two duplicate analyses.

[d] Bailey, A. (7 November 1985, personal communication).

[e] Archer, S. (9 September 1983, personal communication).

[f] Johnson, B. (9 August 1983, personal communication).

ND = Not detected.

NA = Information not available.

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Attachment C

CITY OF EVERETT CSO STUDY SUBBASIN AND CHEMICAL DATA

TABLE 21. OUTFALLS AND THEIR ASSOCIATED GROUPS IN THE EVERETT HARBOR PROJECT AREA

Outfall Group Number	Combined Sewer Overflows
Port Gardner	
1	PS01, 2, 3
2	PS04, 5, 6, 7, 8
Snohomish River	
3	SR01
4	SR02
5	SR03 (siphon to treatment plant)
6	SR04
7	SR05, 6 (deactivated)
8	SR07
9	SR08

Reference: CWC-HDR and Ott Water Engineers (1987).

TABLE 23. OUTFALL GROUP OVERFLOW SUMMARY

Outfall Group No.	Outfalls	Approximate CSO Discharge Points	Service Area (ac)	Stormwater Capacity (MGD)	Average Annual Volume of Overflow (MG)	Annual Number of Events	Estimated 1-yr Return CSO Event Volume (MG)
1	PS01, 2, 3	PS01 13th Street PS02 14th Street PS03 16th Street	183	4.8	4.4	25	0.8
2	PS04, 5, 6 7, 8	PS04 25th Street PS05 Everett Avenue PS06 Hewitt Avenue PS07 Bond Street (between Wall Street and Pacific Avenue) PS08 Bond Street (between Wall Street and Pacific Avenue)	397	4.8	48.9	69	4.5
3	SR01	17th Street and Marine View Drive	61	0.4	5.4	79	0.5
4	SR02	17th Street and Marine View Drive	563	0.1	84.8	111	5.8
5	SR03	17th Street and Marine View Drive	Siphon Headworks - All basins contribute - Overflows are negligible	-----Negligible-----			
6	SR04	California Street and Railway Avenue	518	7.0	35.3	58	4.1
7	SR05, 6	SR05 Railway Avenue between Hewitt Avenue and California Street SR06 Railroad crossing between Hewitt Avenue and Pacific Avenue	Deactivated with the construction of the riverside interceptor	--------None--------			
8	SR07	Pacific Avenue and Railroad	488	6.0	36.3	58	3.7
9	SR08	36th Street and Railroad	890	5.0	269.9	101	18.9
		NESS COMBINED:	3,100	28.1	485.0	72[a]	38.3
ALL SYSTEM-WIDE		**NESS TOTAL:**	3,287	**28.0**	**442**	**79**	**38**

[a] Average.

Reference: Numbers taken from CWC-HDR and Ott Water Engineers (1987).

TABLE 24. APPROXIMATE DRAINAGE AREAS FOR THE SEVEN SUBBASINS SHOWN IN FIGURE 9

Subbasins	Area (ac)
A1	590
A2	560
A3	490
A4	340
A5	15
A6	640[a]
A7	320[a]

[a] Includes area south of 52nd Street.

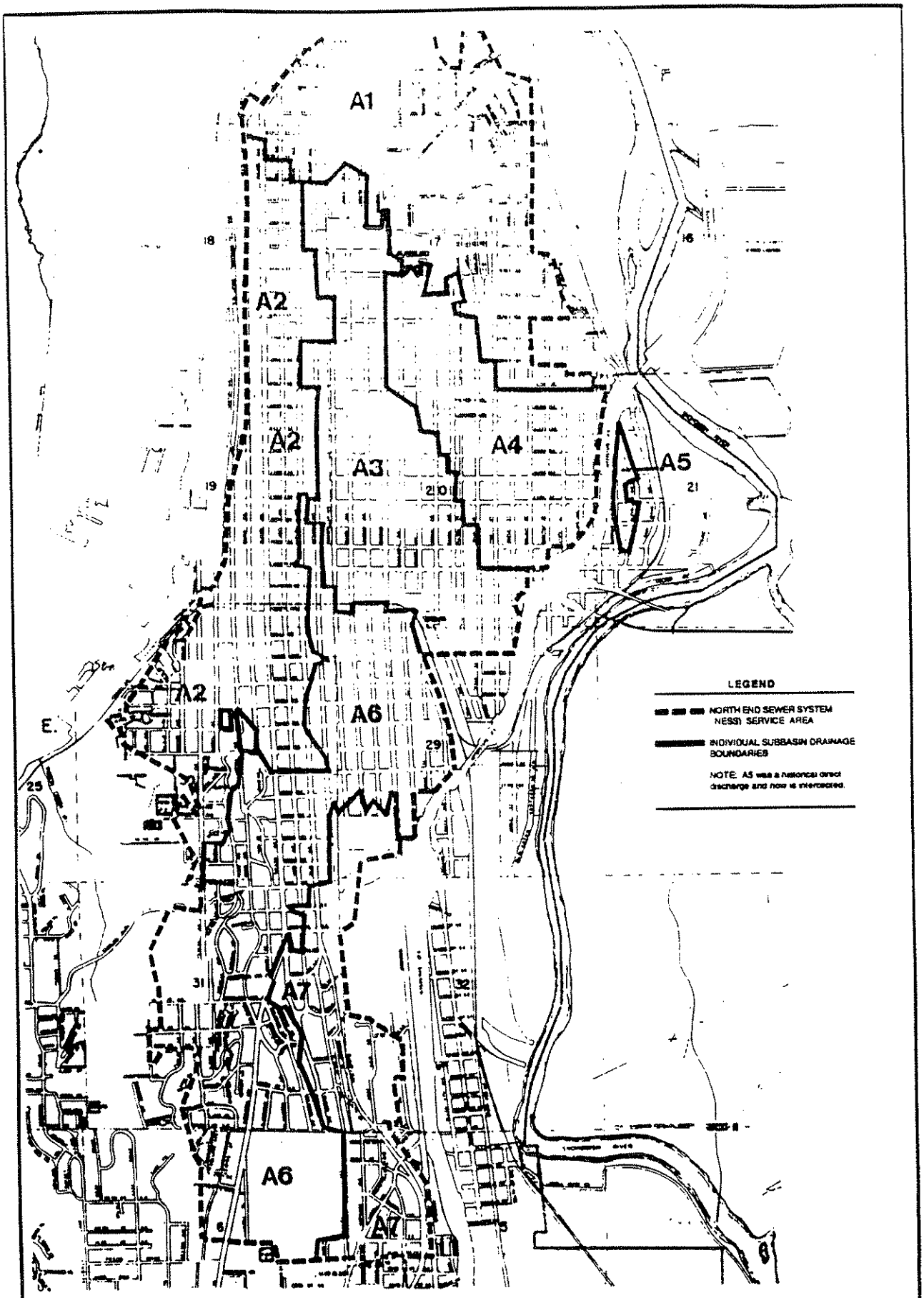

Figure 9. Individual drainage subbasin boundaries for City of Everett North End CSOs.

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TABLE 25. SUMMARY OF STORMWATER SAMPLES COLLECTED (1987-1988) BY THE CITY OF EVERETT[a]

Date	CSO			
	PS05[b]	PS06[c]	SR07[d]	SR08[e]
09/25/87				X
10/31/87	X[f]			
11/13/87		X	X	
01/20/88			X	
03/02/88				X
03/24/88		X		
03/26/88	X			

[a] For geographical reference, see Figure 3.

[b] PS05 = Lift Station #3 (Railroad) (E009).

[c] PS06 = Hewitt and Bond (E008).

[d] SR07 = Pacific and Chestnut (E026).

[e] SR08 = 36th Street (Upstream of LS33) (E028).

[f] Represents a sample collected.

TABLE 26. SUMMARY OF EVERETT CSO STORMWATER CONTAMINANT DATA

Detected Analytes	Mean Concentration (ug/L) PS05 (E009)	PS06 (E008)	SR07 (E026)	SR08 (E028)	U.S. EPA (1986) Freshwater Quality Criteria (Aquatic Life) (ug/L) Acute	Chronic
Arsenic	5.0	3.5	5.5	4.0	360	190
Antimony	5.0	5.0	5.0	5.0	9,000[d]	1,600[d]
Beryllium	5.5	3.0	5.0	5.0	130[d]	5.3[d]
Cadmium	5.0[a]	1.0	2.0[b]	1.75[b]	3.9[f]	1.1[f]
Chromium	10.9	10.0	15.5[b]	12.5[b]	1700[f]/16[e]	210[f]/11[e]
Copper	51.0[a]	36.0[a]	78.0[a]	121.5[a]	18[f]	12[f]
Lead	32.0[b]	35.5[b]	55.0[b]	125.0[a]	82[f]	3.2[f]
Mercury	0.9[b]	0.2[b]	0.2[b]	0.7[b]	2.4	0.012
Nickel	28.0	5.0	11.5	21.0	1,400[f]	160[f]
Selenium	2.5	1.5	1.5	2.5	260	35
Silver	35.5[a]	1.0[b]	1.0[b]	9.0[a]	4.1[f]	0.12
Thallium	1.0	2.0	1.0	1.5	1,400[d]	40[d]
Zinc	230.0[a]	1,115.0[a]	290.0[a]	365.0[a]	120[f]	110[f]
Phenol				53.6[c]	10,200[d]	2,560[d]
4-Methylphenol		6.0[c]			g	g
gamma-BHC				0.17[c]	2.0	0.014
Diethyl phthalate	1.8[c]	2.8[c]		7.7[c]	g	g
Di-n-butyl phthalate		2.0[c]		26.7[c]	g	g
Benzyl butyl phthalate		2.4[c]			g	g
Bis(2-ethylhexyl) phthalate	228.0	9.8[c]	5.2	37.8	g	g
Methylene chloride		1.8[c]	17.0[c]	8.35	g	g
Chloroform		2.9[c]		7.0[c]	28,900[d]	1,240[d]
Tetrachloroethane				8.4[c]	9,320[d]	g
Trichlorofluoromethane				3.2[c]	g	g
Trichloroethylene				59.0[c]	45,000[d]	21,900[d]
Trans-1,2-dichloroethylene				55.6[c]	g	g
Toluene	63.2[c]			34.8[c]	17,500[d]	g
Xylene		5.0[c]			g	g
Acetone		95.0[c]			g	g
Benzoic acid	17.0[c]				g	g

[a] Concentration exceeds U.S. EPA acute criteria.

[b] Concentration exceeds U.S. EPA chronic criteria.

[c] Single concentration obtained from one sample. All other values represent means obtained from two samples collected from each CSO, each during different storm events (see Table 25, Section 2.3).

[d] Insufficient data to develop criteria. Value presented is the U.S. EPA lowest observed effect level (LOEL).

[e] The first value is for trivalent chromium (III) and the second value is for hexavalent chromium (VI).

[f] Hardness dependent criteria (100 mg/L used).

[g] No criteria or toxicity thresholds are presented in the water quality criteria documents.

Note: Other analytes were undetected at reasonable detection limits (see Table 42).

Reference: Data compiled from Mathias, D. (23 May 1988, personal communciation).

TABLE 27. OUTFALL SPECIFIC POLLUTANT CONCENTRATIONS FOR NESS

Outfall Group	Final Weighted Concentration (mg/L) BOD	TSS	Lead	Cadmium	Zinc
* 1	29.1	66.1	0.23	0.002	0.23
* 2	59.5	79.7	0.26	0.003	0.25
3	31.8	69.9	0.21	0.003	0.26
4	31.5	70.8	0.21	0.001	0.22
6	30.5	65.5	0.23	0.003	0.26
8	27.5	55.5	0.28	0.001	0.26
9	50.0	77.6	0.24	0.002	0.25

Reference: Data from CWC-HDR and Ott Water Engineers (1987).

* East Waterway

TABLE 28. ESTIMATED POLLUTANT LOADINGS FOR NESS

Outfall Group	Average Annual Volume MG	Mass Loading (lbs/yr) BOD	TSS	Lead	Cadmium	Zinc
1	4.4	1,066	2,422	8.4	0.10	8.4
2	48.9	24,225	32,449	105.9	1.20	101.8
3	5.4	1,430	3,143	9.4	0.10	11.7
4	84.4	22,240	49,988	148.3	0.70	155.3
6	35.3	8,964	19,251	67.6	0.90	76.4
8	36.3	8,311	16,774	84.6	0.30	78.6
9	267.9	111,527	173,090	535.3	4.50	557.6

Reference: Data from CWC-HDR and Ott Water Engineers (1987).

Attachment D

STREAM DRAINAGE BASIN AND POLLUTANT LOADING TABLES

TABLE 33. DRAINAGE BASIN AREAS AND FLOW ESTIMATES FOR SURFACE RUNOFF DISCHARGES IN SOUTH PORT GARDNER

	Area (ac)	Flow (MGD)
Powder Mill Gulch	1,280	9.4
* Pigeon Creek #1	973	6.4
Japanese Gulch	935	5.6
Pigeon Creek #2	900	4.2
Merrill and Ring Creek	800	2.4
Narbeck Creek	450	1.9
Glenwood Creek	400	0.6
Mukilteo Storm Drain #2	326	0.9
Edgewater Creek	200	0.3
Seahurst-Glenhaven Creek	185	1.3
Phillips Creek	105	0.003
Mukilteo Storm Drain #1	47	0.3

Reference: Tetra Tech (1985b).

* East Waterway Related

TABLE 34. LOADING ESTIMATES FOR CONVENTIONAL POLLUTANTS AND SELECTED METALS FROM SURFACE RUNOFF DISCHARGES BASED ON A 1-YR STORM[a]

Source	TSS (lb)	BOD (lb)	Lead+Copper+Zinc (lb)
South Port Gardner			
Powder Mill Gulch	15,000	940	31
Pigeon Creek #1	--	1,470	6
Japanese Gulch	8,400	560	20
Pigeon Creek #2	6,300	420	15
Merrill and Ring Creek	3,600	240	8
Narbeck Creek	2,850	190	7
Glenwood Creek	2,800	60	2
Mukilteo Storm Drain #2	1,350	90	2
Edgewater Creek	450	30	1
Seahurst-Glenhaven Creek	1,950	130	5
Phillips Creek	5	3	<1
Mukilteo Storm Drain #1	450	3	1
Ebey Slough			
Quilceda Creek	--	2,460	--
Allen Creek	--	820	--
Ebey Slough Storm Drain	5,700	380	14
Snohomish River			
Marshland Canal	--	3,520	--
Tidegates	--	3,570	--
Snohomish River near Monroe	--	--	1,100

[a] 1-yr storm is defined as a 24-h storm event with a 1-yr recurrence interval.

Attachment E

TETRA TECH OUTFALL SEDIMENT STUDY CONTAMINANT LIST TABLES

TABLE 42. LIST OF CONTAMINANTS AND CONVENTIONAL VARIABLES MEASURED DURING THE EVERETT HARBOR STUDY

Low Molecular Weight PAH
- naphthalene[a]
- acenaphthylene[a]
- acenaphthene[a]
- fluorene[a]
- phenanthrene[a]
- anthracene[a]

High Molecular Weight PAH
- fluoranthene[a]
- pyrene[a]
- benzo(a)anthracene[a]
- chrysene[a]
- benzofluoranthenes (b and k)[a]
- benzo(a)pyrene[a]
- indeno(1,2,3-c,d)pyrene[a]
- dibenzo(a,h)anthracene[a]
- benzo(g,h,i)perylene[a]

Total PCBs[a]

Neutral Halogenated Compounds
- 1,2-dichlorobenzene[a]
- 1,3-dichlorobenzene[a]
- 1,4-dichlorobenzene[a]
- 1,2,4-trichlorobenzene[a]
- hexachlorobenzene (HCB)[a]
- 2-chloronaphthalene[a]
- hexachlorobutadiene[a]
- hexachloroethane[a]

Phthalate Esters
- dimethyl phthalate[a]
- diethyl phthalate[a]
- di-n-butyl phthalate[a]
- butyl benzyl phthalate[a]
- bis(2-ethylhexyl)phthalate[a]
- di-n-octyl phthalate[a]

Pesticides
- p,p'-DDE[a]
- p,p'-DDD[a]
- p,p'-DDT[a]
- aldrin[a]
- chlordane[a]
- dieldrin[a]
- endrin[a]
- endosulfan I[a]
- endosulfan II[a]
- endosulfan sulfate[a]
- endrin ketone
- heptachlor[a]
- hepachlor epoxide[a]
- alpha-HCH[a]
- beta-HCH[a]
- delta-HCH[a]
- gamma-HCH[a] (lindane)
- methoxychlor[b]
- toxaphene[a]

Phenol and Alkyl-Substituted Phenols
- phenol[a]
- 2-methylphenol
- 4-methylphenol
- 2,4-dimethylphenol[a]
- 4-chloro-3-methylphenol

Chlorinated Phenols/Guaiacols
- 2-chlorophenol[a]
- 2,4-dichlorophenol[a]
- 2,4,6-trichlorophenol[a]
- 2,4,5-trichlorophenol[b]
- 2,3,4,6-tetrachlorophenol[b]
- pentachlorophenol[a]
- 3,4,5-trichloroguaiacol
- 4,5,6-trichloroguaiacol
- tetrachloroguaiacol

Resin Acids
- abietic acid
- dehydroabietic acid
- 12-chlorodehydroabietic acid
- 14-chlorodehydroabietic acid
- dichlorodehydroabietic acid
- isopimaric acid
- neoabietic acid
- sandaracopimaric acid

Nitrogen-Containing Compounds
- N-nitrosodi-n-propylamine[a]
- N-nitrosodiphenylamine[a]
- nitrobenzene[a]
- 2-nitrophenol[a]
- 4-nitrophenol[a]

TABLE 42. (Continued)

2,4-dinitrophenol[a]
4,6-dinitro-2-methylphenol
4-chloroaniline[b]
2-nitroaniline
3-nitroaniline
4-nitroaniline
2,4-dinitrotoluene[a]
2,6-dinitrotoluene[a]
3,3'-dichlorobenzidine[a]

Halogenated Ethers
bis(2-chloroethyl)ether[a]
bis(2-chloroisopropyl)ether[a]
bis(2-chloroethoxy)methane[a]
4-chlorophenyl phenyl ether[a]
4-bromophenyl phenyl ether[a]

Miscellaneous Extractables and Tentatively Identified Organic Compounds
benzyl alcohol
benzoic acid[b]
dibenzofuran
2-methylnaphthalene
isophorone[a]
hexachlorocyclopentadiene[a]
1-methylpyrene[c]
retene[c]
cymene (unspecified isomer)[c]
dibenzothiophene[c]
1,2,4-trithiolane[c]
diterpenoid hydrocarbon[c] (base peak 255)
diterpenoid alcohol[c] (base peak 271)
hexadecanoic acid[c]
hexadecanoic acid methyl ester[c]
hexadecenoic acid methyl ester[c]
cholesterol[c]
campesterol[c]
alkanol (unidentified)[c]
base peak 181, isomer #1[c]
base peak 181, isomer #2[c]

Volatile Organic Compounds
acetone
benzene
bromodichloromethane
bromoform
bromomethane
2-butanone
carbon disulfidecarbon tetrachloride
chlorobenzene
chloroethane
2-chloroethylvinyl ether
chloroform
chloromethane
dibromochloromethane
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethene
trans-1,2-dichloroethene
1,2-dichloropropane
cis-1,3-dichloropropene
trans-1,3-dichloropropene
ethylbenzene
4-methyl-2-pentanone
2-hexanone
styrene
1,1,2,2-tetrachloroethane
tetrachloroethene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethene
toluene
total xylenes
vinyl acetate
vinyl chloride

Metals
antimony[a]
arsenic[a]
cadmium[a]
chromium[a]
copper[a]
iron
lead[a]
manganese
mercury[a]
nickel[a]
selenium[a]
silver[a]
zinc[a]

Conventional Variables
total solids
percent fine-grained material

[a] U.S. EPA priority pollutant.
[b] U.S. EPA hazardous substance list compound.
[c] Tentatively identified organic compound.

TABLE 43. PROBLEM CHEMICALS IDENTIFIED IN EVERETT HARBOR PROJECT AREA DRAIN SEDIMENTS[a]

Drain Sediment	Number of Problem Chemicals	Problem Chemicals Identified
E007	3	Chromium[b], nickel[c], DDT[d]
E011-1	6	Chromium[b], acenaphthene[d], LPAH[d,e], 4-methylphenol[d], benzoic acid[d], dibenzofuran[d]
E011-2	8	Chromium[b], nickel[c], cadmium[d], zinc[d], naphthalene[d], dibenzofuran, dimethyl phthalate[d], acenaphthylene[d],
NORT	2	Chromium[b], nickel[c]

[a] Defined by exceedance of HAET concentration.

[b] Concentrations of chromium may be overestimated by a factor of 2 to 4. See Section 4.1.2 and Section 3.2.4.

[c] The HAET for nickel has been established using a relatively limited range of concentrations. See Section 4.1.2.

[d] The concentration of this chemical was the highest measured in the four drain sediments.

[e] LPAH is defined as the sum of naphthalene, acenaphthylene, acenaphthene, flourene, phenanthrene, and anthracene.

TABLE 44. CHEMICALS UNDETECTED IN THE EVERETT HARBOR PROJECT AREA DRAIN SEDIMENTS WITH DETECTION LIMITS ≥ HAET CONCENTRATIONS

Drain Sediment	Undetected Chemicals With Detection Limits ≥ HAET
E007	None
E011-1	2-Methylphenol; 2,4-dimethylphenol; 1,2-dichlorobenzene; 1,2,4-trichlorobenzene; benzyl alcohol
E011-2	2-Methylphenol; 2,4-dimethylphenol; 1,2-dichlorobenzene; benzoic acid; benzyl alcohol
NORT	2-Methylphenol; 2,4-dimethylphenol; 1,2,4-trichlorobenzene; benzyl alcohol

Attachment F

PUGET SOUND AET VALUES TABLE

TABLE 38. PUGET SOUND AET VALUES
(ug/kg dry weight = ppb for organic compounds;
mg/kg dry weight = ppm for metals)

	Lowest AET	Highest AET
LPAH[a]	5,200	6,100
Naphthalene	2,100	2,400
Acenaphthylene	560	640
Acenaphthene	500	980
Fluorene	540	1,800
Phenanthrene	1,500	5,400
Anthracene	960	1,900
HPAH[b]	12,000	38,000
Fluoranthene	1,700	9,800
Pyrene	2,600	11,000
Benzo(a)anthracene	1,300	4,500
Chrysene	1,400	6,700
Benzofluoranthenes	3,200	8,000
Benzo(a)pyrene	1,600	6,800
Indeno(1,2,3-c,d)pyrene	600	880
Dibenzo(a,h)anthracene	230	1,200
Benzo(g,h,i)perylene	670	5,400
Total PCBs	130	2,500
Total Chlorinated Benzenes	170	680
1,3-Dichlorobenzene	--	--
1,4-Dichlorobenzene	110	260
1,2-Dichlorobenzene	35	50
1,2,4-Trichlorobenzene	31	64
Hexachlorobenzene	70	230
Total Phthalates	3,300	3,400
Dimethyl phthalate	71	160
Diethyl phthalate	--	200
Di-n-butyl phthalate	1,400	1,400
Butyl benzyl phthalate	63	470
Bis(2-ethylhexyl) phthalate	1,900	1,900
Pesticides		
p,p'-DDE	9	15
p,p'-DDD	2	43
p,p'-DDT	3.9	11

TABLE 38. (Continued)

	Lowest AET	Highest AET
Phenols		
Phenol	420	1,200
2-Methylphenol	63	63
4-Methylphenol	670	1,200
2,4-Dimethyl phenol	29	29
Pentachlorophenol	--	--
2-Methoxyphenol	930	930
Miscellaneous Extractables		
Hexachlorobutadiene	120	290
1-Methylphenanthrene	310	370
2-Methylnaphthalene	670	670
Biphenyl	260	270
Dibenzothiophene	240	250
Dibenzofuran	540	540
Benzyl alcohol	57	73
Benzoic acid	650	650
n-Nitrosodiphenylamine	40	220
Volatile Organic Compounds		
Tetrachloroethene	140	140
Ethyl benzene	33	37
Total xylenes	100	120
Metals		
Antimony	3.2	26
Arsenic	85	700
Cadmium	5.8	9.6
Copper	310	800
Lead	300	700
Mercury	0.41	2.1
Nickel	28	49
Silver	5.2	5.2
Zinc	260	1,600

[a] LPAH = Low molecular weight polynuclear aromatic hydrocarbons.

[b] HPAH = High molecular weight polynuclear aromatic hydrocarbons.

Reference: Tetra Tech (1987).

Attachment G

TETRA TECH OUTFALL SEDIMENT STUDY
RELATIVE PERCENT DISTRIBUTION FIGURES

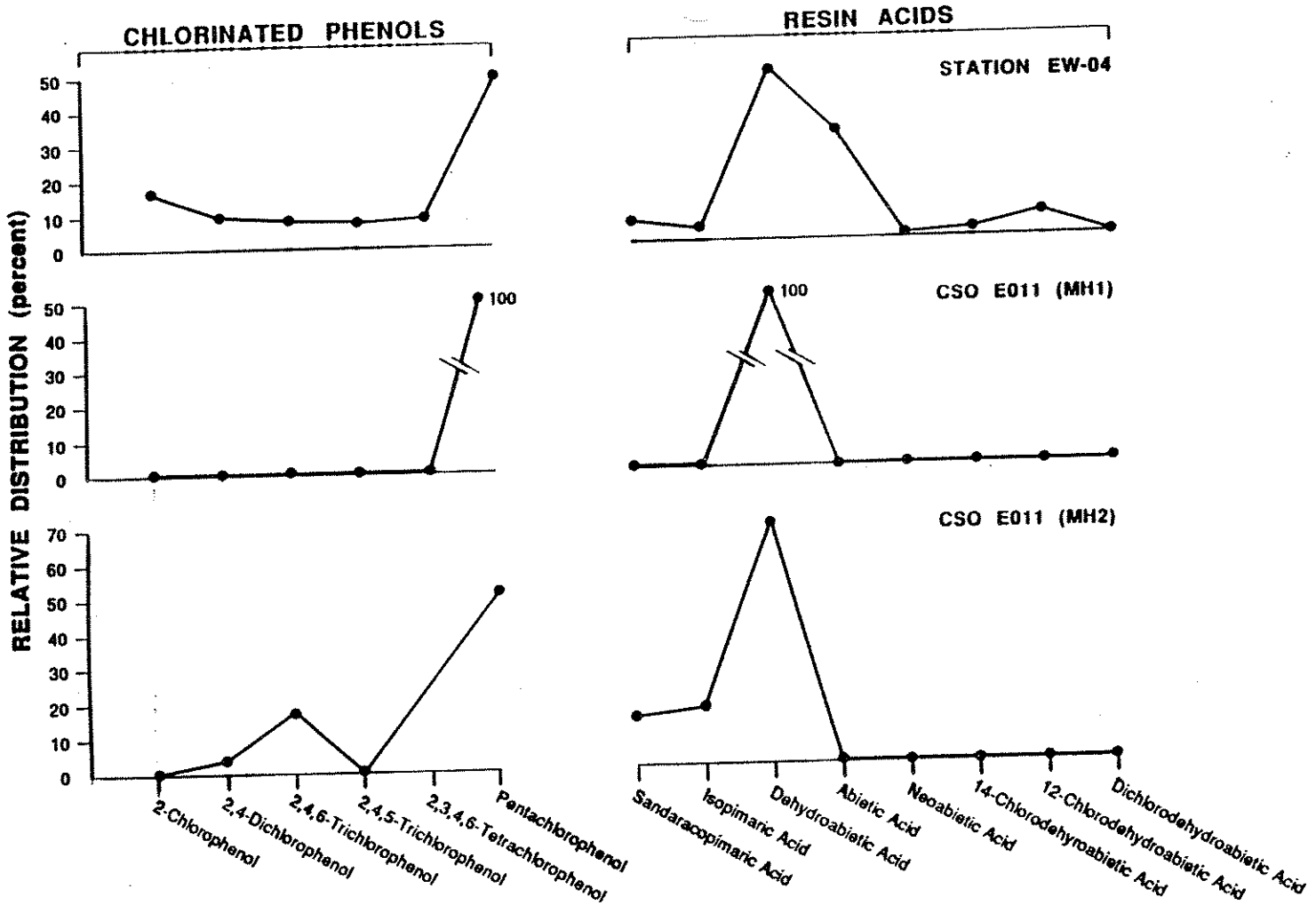

Figure 17. Comparison of relative percent distribution of pulp industry compounds in sediment from Station EW-04 and sediment from two locations along CSO E011.

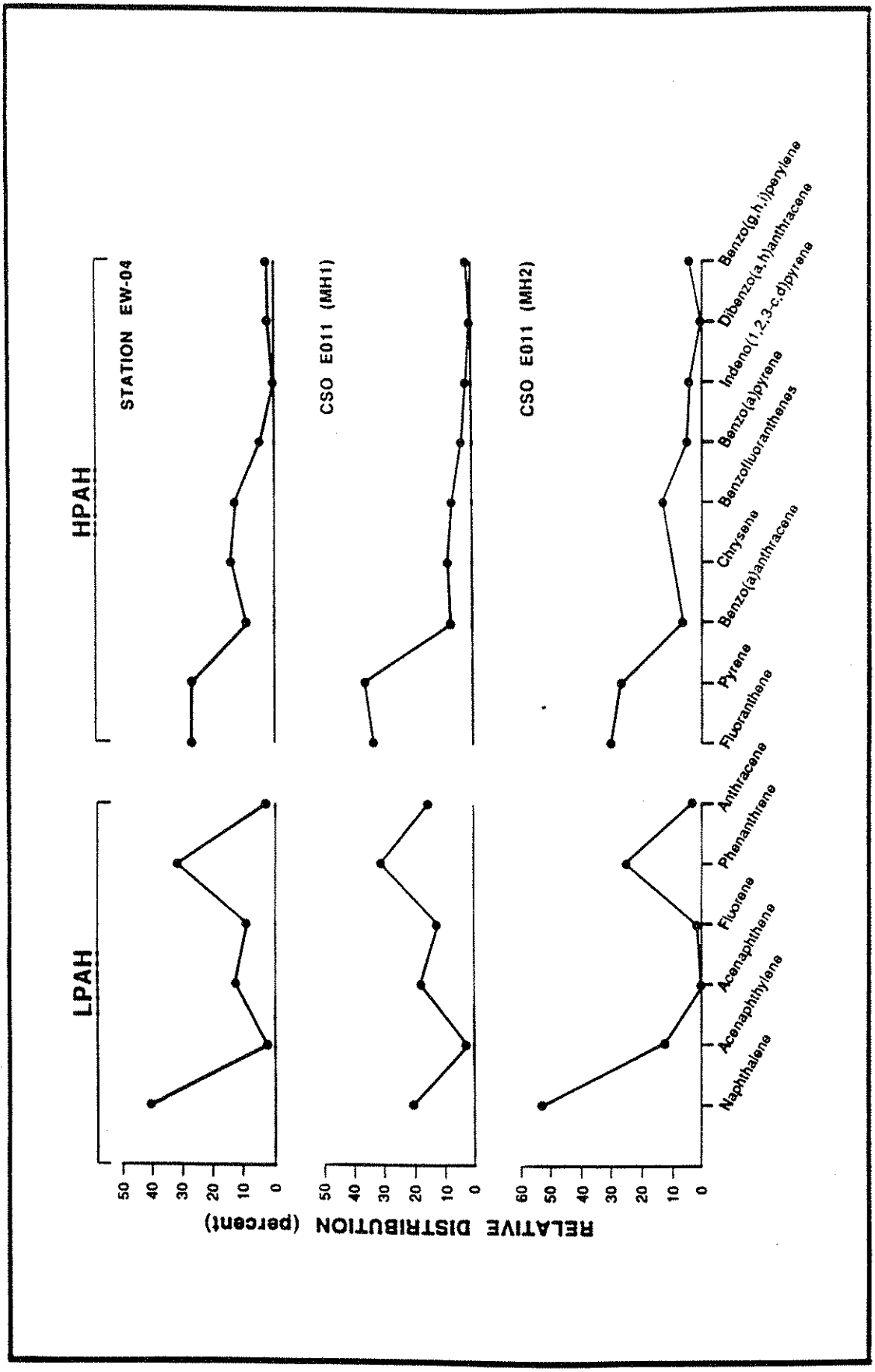

Figure 18. Comparison of relative percent distribution of PAH compounds in sediments from Station EW-04 and sediment from two locations along CSO E011.

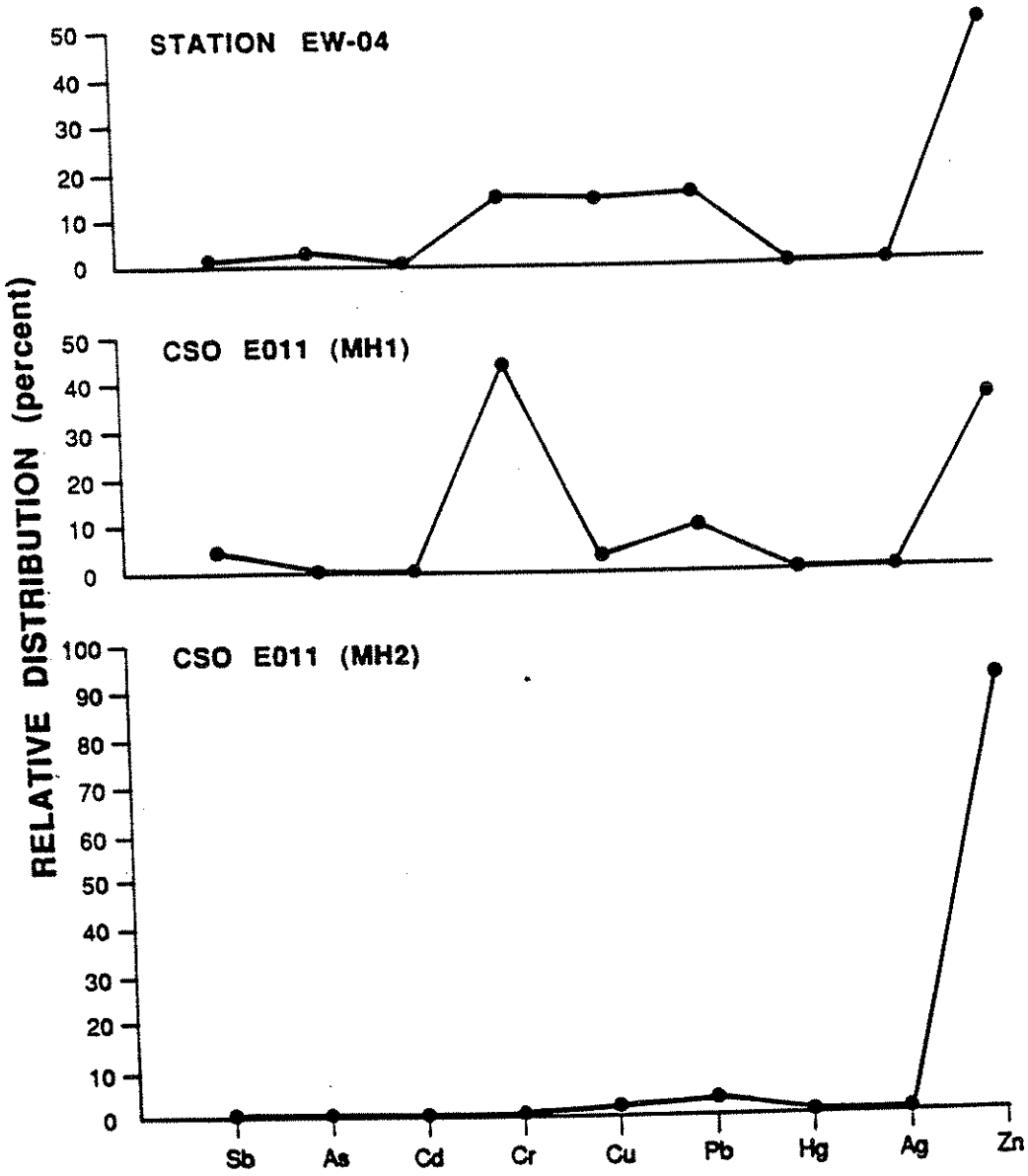

Figure 19. Comparison of relative percent distribution of metals in sediment from Station EW-04 and sediment from two locations along CSO E011.

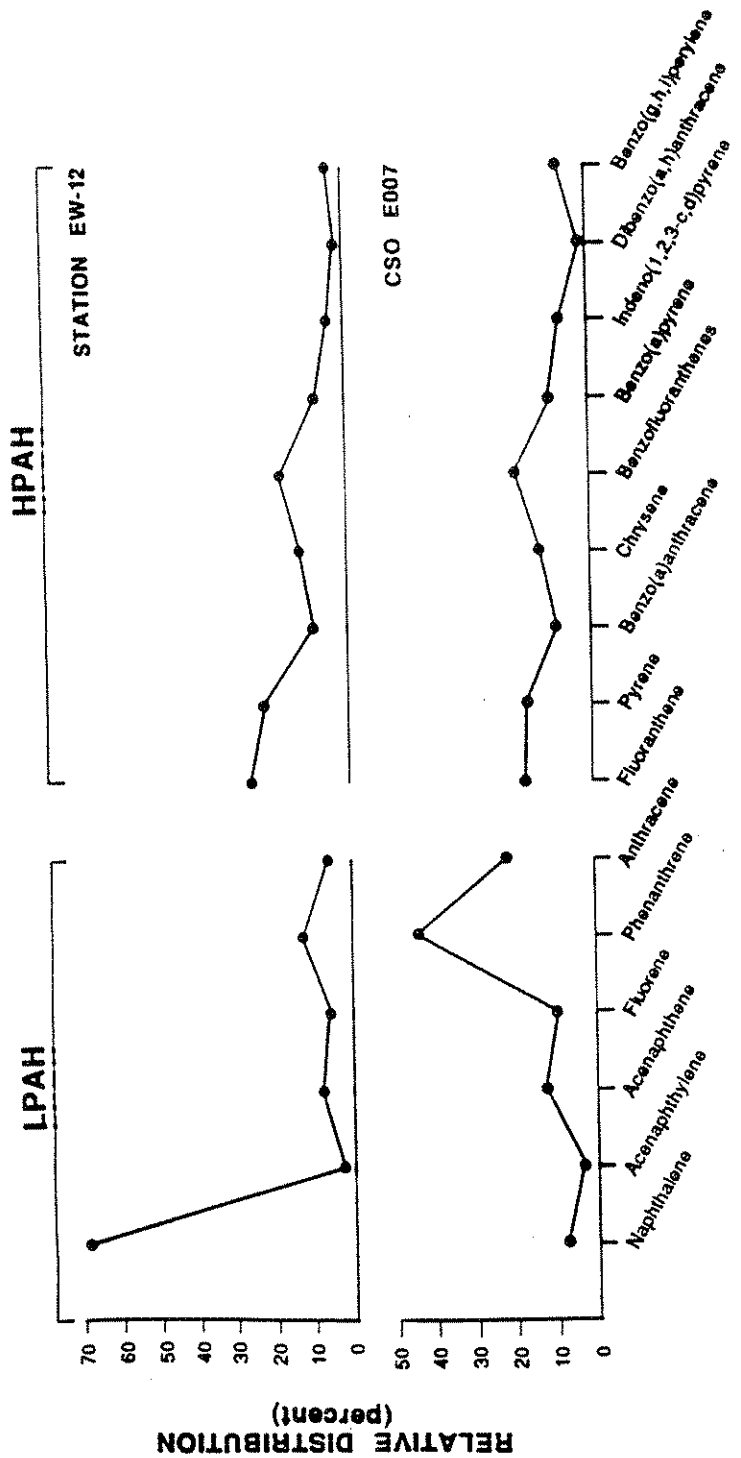

Figure 20. Comparison of relative percent distribution of PAH compounds in sediment from Station EW-12 and sediment from CSO E007.

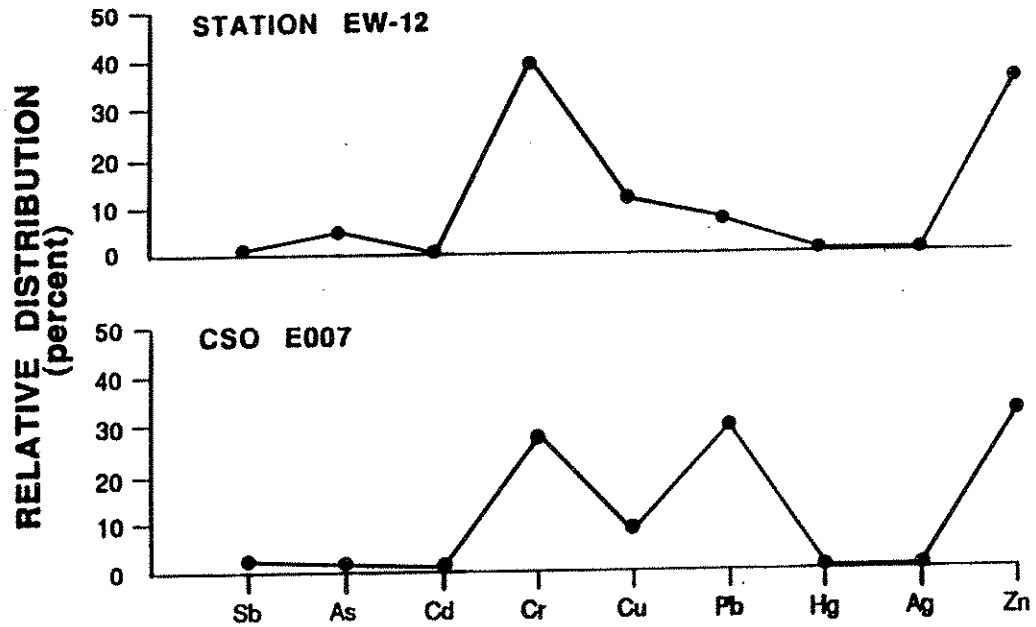

Figure 21. Comparison of relative percent distribution of metals in sediment from Station EW-12 and sediment from CSO E007.