Lower Duwamish Waterway

Seattle, Washington

EPA Facility ID: WA0002329803

Basin: Duwamish

HUC: 17110013

Executive Summary

The Lower Duwamish Waterway (LDW) site is a heavily industrialized stretch of the Duwamish River in Seattle, Washington. This section of the Duwamish River is a major shipping route and the shoreline has been altered and developed for industrial and commercial operations. Direct discharge, spills, groundwater migration, and surface water runoff from surrounding properties have contributed to the elevated concentrations of PAHs, PCBs, trace elements (metals), and dioxins found in Duwamish Waterway sediment. The NOAA trust habitat of concern is the Duwamish Waterway and associated bottom sediments. The Duwamish River is a migratory corridor for juvenile and adult Pacific salmon, including the federally threatened chinook salmon, and other NOAA trust resources. Commercial, recreational, and subsistence fishing for Pacific salmon and other NOAA trust resources occurs in the Duwamish River near the Lower Duwamish Waterway site.

Site Background

The Duwamish River originates at the confluence of the Black and Green Rivers near Tukwila, Washington. It then flows northeast for approximately 21 river km (13 river mi) before discharging into Elliott Bay. The Lower Duwamish Waterway (LDW) site, which was placed on the National Priorities List on September 13, 2001, is a contaminated segment of the Duwamish River that empties into Elliott Bay in Seattle, King County, Washington. Elliott Bay is located in the Puget Sound Estuary and is Seattle's major harbor (Figure 1). The current LDW site boundary extends from Harbor Island at approximately river km 2.5 (river mi 1.6) upstream to Turning Basin #3 at river km 11.5 (river mi 7.1) (Figure 2). This section of the Duwamish River is tidally influenced and maintained as a navigation channel.

The Duwamish Waterway has been a major shipping route for over one hundred years. As a result, the shorelines of the lower Duwamish River have been developed for industrial and commercial operations. Past and present operations include cargo handling and storage; food processing; marine construction; petroleum storage; boat manufacturing at dry docks; marina operations; paper and metals fabrication; and airplane parts manufacturing. In addition, storm drains, several combined sewer overflows (CSOs), and other outfalls discharge into the Duwamish Waterway (USEPA 2000). Four major property owners along the Duwamish Waterway with potential responsibility for the sediment contamination are the Port of Seattle, King County, the City of Seattle, and The Boeing Company (USEPA 2002).

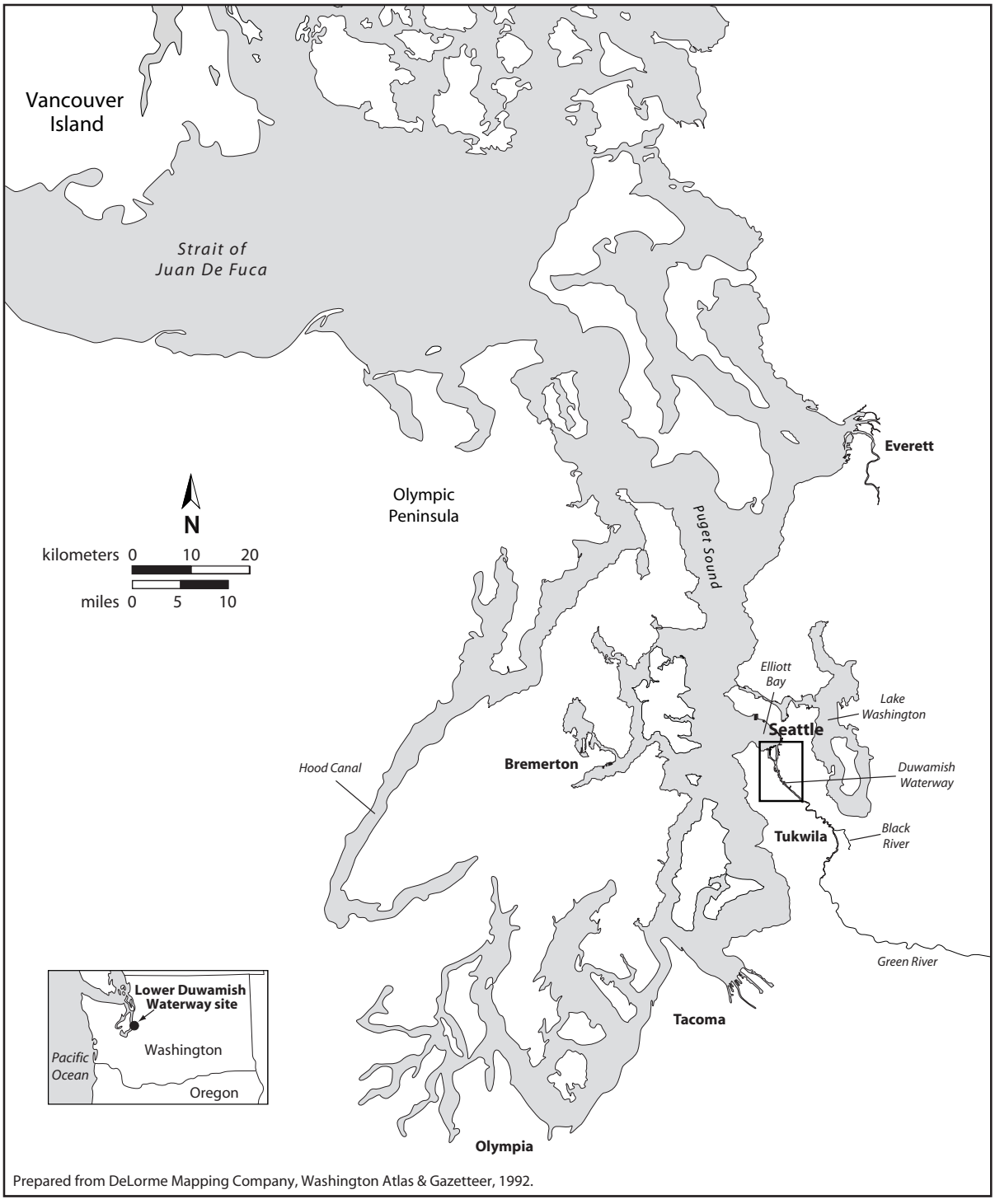

Figure 1. Location of Lower Duwamish Waterway, Seattle, Washington.

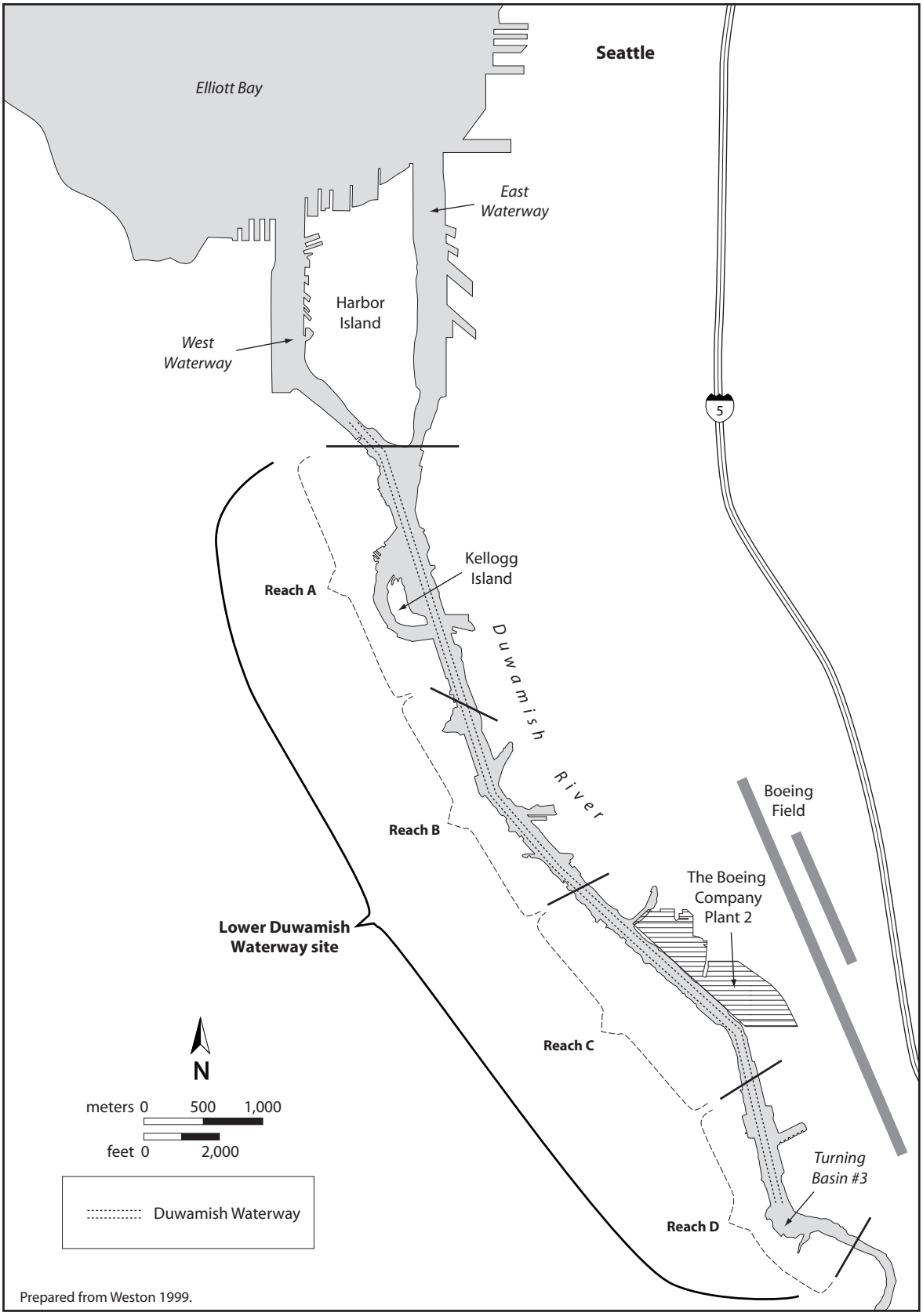

Figure 2. Detail of Lower Duwamish Waterway site.

The most likely sources of contamination at the LDW site include direct discharge, spillage during the loading of marine vessels, groundwater migration, and surface water runoff. Direct discharge includes discharge from storm drains, CSOs, and other outfalls. Approximately 1,210 million liters (318 million gallons) of raw untreated sewage are currently discharged annually into the Lower Duwamish Waterway via CSOs owned by King County and the City of Seattle. Groundwater flow near the LDW site is toward the Duwamish Waterway (Fabritz et al. 1998). Detailed information on spills at the Lower Duwamish Waterway site was unavailable at the time of this report.

NOAA Trust Resources

The NOAA trust habitat of concern is the Duwamish Waterway and associated bottom sediments. The Duwamish River is tidally influenced; the surface water is fresh to brackish, and the bottom water is more saline. Between 1910 and 1920, the Duwamish River delta and the surrounding tidelands were filled and graded to create a navigation channel. Although the lower Duwamish River has been altered and heavily industrialized, it still provides habitat for marine and anadromous fish species.

Composition of the bottom sediment varies throughout the Lower Duwamish Waterway. Medium-grained and coarse sands are present in areas near CSOs, storm drain discharges, riprap, and bridges. Silts and clays are present in mudflats, along channel sideslopes, and in portions of the navigation channel (Weston 1999).

The Duwamish River is a migratory route, nursery, and osmoregulatory transition zone for several anadromous fish (Table 1). These fish include coho, chinook, chum, pink, and sockeye salmon, as well as steelhead, cutthroat trout, and Pacific lamprey (Cropp 2002). Of these fish species, chinook and coho are the most common in the Duwamish River. Chinook salmon are a federally listed threatened species, and coho salmon are a federally listed candidate threatened species. These anadromous runs are a mixture of native and hatchery fish. The hatchery fish are from the State Hatchery Program located on the Green River (Weston 1999; USEPA 2000).

The mouth of the lower Duwamish River and the adjacent waters of Elliott Bay provide habitat for many marine fish species. Predominant marine species close to the LDW site include English sole, starry flounder, Pacific staghorn sculpin, shiner perch, and Pacific herring. Pacific herring, shiner perch, and threespine stickleback all spawn in or near the mouth of the lower Duwamish River (Parametrix Inc. 1980). All other marine species present near the LDW site use these surface waters mostly as juvenile nursery habitat (Monaco et al. 1990).

Commercial, recreational, and subsistence fishing occurs in the vicinity of the LDW site. Dominant commercial fisheries in the Duwamish River include chinook, coho, and chum salmon as well as steelhead. There is also recreational fishing for chinook and coho salmon, steelhead, and several marine species as well (Table 1). The Duwamish River is part of the traditional fishing grounds for the Muckleshoot and Squamish Indian tribes. Subsistence fishing of chinook salmon, chum salmon, and steelhead occurs in the Duwamish River (Cropp 2002; USEPA 2000).

No specific fish consumption advisories are currently in effect for the Duwamish River. There is, however, a general consumption advisory in effect for marine waters within King County. This advisory recommends against collecting and consuming bottom fish, shellfish, or seaweed from Puget Sound waters (WADOH 2002).

Table 1. NOAA trust resources present in the vicinity of the Lower Duwamish Waterway site (Parametrix 1980; Monaco et al. 1990; Bargman 1991; Weston 1999; Cropp 2002).

Species		Habitat Use				Fisheries		
Common Name	Scientific Name	Spawning Ground	Nursery Area	Migratory Route	Adult Habitat	Comm.	Rec.	Subsist.
ANADROMOUS FISH								
Chinook salmon	*Oncorhynchus tshawytscha*		◆	◆	◆	◆	◆	◆
Chum salmon	*Oncorhynchus keta*		◆	◆	◆	◆		
Coho salmon	*Oncorhynchus kisutch*		◆	◆	◆	◆	◆	◆
Cutthroat trout	*Oncorhynchus clarki*		◆	◆	◆			
Pacific lamprey	*Lampetra tridentata*			◆	◆			
Pink salmon	*Oncorhynchus gorbuscha*		◆	◆	◆			
Sockeye salmon	*Oncorhynchus nerka*			◆	◆			
Steelhead[a]	*Oncorhynchus mykiss*		◆	◆	◆	◆	◆	◆
ESTUARINE/MARINE FISH								
English sole	*Parophrys vetulus*		◆					
Pacific cod	*Gadus macrocephalus*		◆			◆	◆	
Pacific herring	*Clupea pallasi*	◆	◆			◆		
Pacific sand lance	*Ammodytes hexapterus*		◆				◆	
Pacific staghorn sculpin	*Leptocottus armatus*		◆					
Pacific tomcod	*Microgadus proximus*		◆					
Prickly sculpin	*Cottus asper*		◆					
Shiner perch	*Cymatogaster aggregata*	◆	◆		◆			
Starry flounder	*Platichthys stellatus*		◆			◆	◆	
Surf smelt	*Hypomesus pretiosus*		◆				◆	
Threespine stickleback	*Gasterosteus aculeatus*	◆	◆		◆			
Walleye pollock	*Theragra chalcogramma*		◆				◆	

a: The term steelhead is applied to a sea-run rainbow trout and some populations from lakes.

Site-Related Contamination

The primary contaminants of concern to NOAA that were detected in sediment at the LDW site include polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and trace elements (metals). The extent of the sediment contamination was documented during several environmental investigations, including a 1999 site investigation (SI) by the U.S. Environmental Protection Agency (USEPA) and focused investigations conducted on behalf of The Boeing Company. During the SI, 300 surface and 17 subsurface sediment samples were collected from 300 sampling stations at the LDW site and were analyzed for metals, semivolatile organic compounds (SVOCs) including PAHs, volatile organic compounds (VOCs), pesticides, PCBs, organotins, and dioxins (Weston 1999). Consultants for The Boeing Company collected sediment samples from 61 locations in the vicinity of Boeing Plant 2. These samples were analyzed for PCBs and metals (Pentec and FSM 2001a; Pentec and FSM 2001b). The maximum concentrations of selected contaminants are summarized in Table 2.

Table 2. Maximum concentrations of contaminants of concern detected in sediment from the Lower Duwamish Waterway site compared to screening guidelines (Weston 1999; Pentec and FSM 2001a; Pentec and FSM 2001b).

	Sediment (mg/kg)	
Contaminant	Site Sediment	ERL[a]
Trace Elements		
Arsenic	620	8.2
Cadmium	29	1.2
Chromium	300	81
Copper	800	34
Lead	630	46.7
Mercury	1.6	0.15
Nickel	96	20.9
Selenium	28	1.0[b]
Silver	7.3	1
Zinc	1,800	150
PAHs/SVOCs		
Acenaphthene	75	0.016
Acenaphthylene	5.1	0.044
Anthracene	87	0.0853
Benz(a)anthracene	250	0.261
Chrysene	220	0.384
Dibenz(a,h)anthracene	50	0.0634
Fluoranthene	1,100	0.6
Fluorene	98	0.019
2-Methylnaphthalene	31	0.07
Naphthalene	20	0.16
Pentachlorophenol	0.3	NA
Phenanthrene	920	0.24
Pyrene	770	0.665
Pesticides/PCBs		
Chlordane	0.026	0.0005
DDD	0.84	0.002
DDE	0.37	0.0022
DDT	1.7	0.00158[c]
Dieldrin	0.28	0.00002
Heptachlor Epoxide	0.002	NA
Total PCBs (as Aroclors)	12	0.0227
Aroclor 1242	2.5	NA
Aroclor 1254	16	NA
Aroclor 1260	51	NA
Dioxins/Furans		
Total TCDD	0.000075	NA
Total TCDF	0.00015	NA
TEQ	0.00022	NA

a: Effects Range-Low represents the 10th percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al. (1998).

b: Marine Apparent Effects Threshold (AET) for amphipod bioassay. The AET represents the concentration above when adverse biological impacts would be expected.

c: Expressed as Total DDT.

NA: Screening guidelines not available.

PCBs were detected in sediment from all of the SI stations sampled and from many of the stations sampled during The Boeing Company investigations. In SI surface sediment samples, total PCB concentrations ranged from 0.02 to 12 mg/kg. Total PCBs were detected in SI subsurface sediment at concentrations ranging from 0.037 to 4 mg/kg. Aroclors 1242, 1254, and 1260 were the most frequently detected Aroclors at the LDW site. The maximum concentrations of total PCBs, Aroclor 1254, and Aroclor 1260 were all detected in sediment collected from Reach C (Figure 2). The maximum concentration of Aroclor 1242 was detected in a sample collected from Reach A. The maximum total PCB concentration exceeded the screening guidelines by two orders of magnitude (Table 2).

Several SVOCs were detected in sediment samples from throughout the LDW site during the SI. Detected SVOC concentrations in sediment ranged from 0.3 mg/kg (pentachlorophenol) to 1,100 mg/kg (fluoranthene). Maximum concentrations of SVOCs were detected in Reach A (eight compounds), Reach C (four compounds), and Reach B (one compound). The maximum concentrations of acenaphthene, anthracene, fluoranthene, fluorene, phenanthrene, and pyrene were all detected at three orders of magnitude greater than their screening guidelines (Table 2). All maximum concentrations of SVOCs were detected in the surface sediment samples except for 2-methylnaphthalene, which was detected in a subsurface sample.

Metals were detected in sediment from all stations sampled during both the SI and The Boeing Company investigations. Maximum concentrations of all metals listed in Table 2 except chromium, nickel, and silver exceeded their respective screening guidelines by at least one order of magnitude (Table 2). The majority of the maximum concentrations of metals were detected in samples collected from Reaches A and C. Cadmium, chromium, silver, and zinc were all detected at maximum concentrations near Boeing Plant 2 during The Boeing Company investigations.

Pesticides and dioxins were detected in sediment samples collected during the SI. The maximum concentrations of all detected pesticides were found in sediment from Reach C. The maximum concentrations of the pesticide DDT and its metabolites DDD and DDE, as well as of dieldrin, all exceeded their respective screening guidelines by at least two orders of magnitude (Table 2). Dioxins were detected at all of the SI surface sediment sampling stations. The maximum toxicity equivalent (TEQ), total TCDD, and total TCDF concentrations were detected in a sediment sample collected from Reach B.

References

Bargman, G. Resource Manager for the Washington State Department of Fisheries, Marine Fish and Shellfish Division. Personal communication July 10, 1991.

Cropp, T. Fisheries Biologist for the Washington Department of Fish and Wildlife. Personal communication May 23, 2002.

Fabritz, Jason, Joel Massman, and Derek Booth. 1998. Development of a three-dimensional, numerical groundwater flow model for the Duwamish River basin. Seattle, WA: University of Washington, Center for Urban Water Resource Management.

Long, E.R., L.J. Field, and D.D. MacDonald. 1998. Predicting toxicity in marine sediments with numerical sediment quality guidelines. Environmental Toxicology and Chemistry 17(4):714-727.

References, *cont.*

Monaco, M. E., D. M. Nelson, R. L. Emmett, and S. A. Hinton. 1990. Distribution and abundance of fishes and invertebrates in West Coast estuaries, Volume I: Data summaries. ELMR Rpt. No. 4. Rockville, MD: Strategic Assessment Branch, NOS/NOAA. 240 pp.

Parametrix Inc. 1980. Port of Seattle Terminal 107 Fisheries Study. Seattle, WA: prepared for the Port of Seattle. 52 pp.

Pentec Environmental and Floyd Snider McCarthy Inc. (Pentec and FSM). 2001a. Data Report, Design Data Collection, Southwest Bank Interim Measure, Boeing Plant 2: Seattle/Tukwila, Washington. Edmonds, WA: Prepared for The Boeing Company.

Pentec Environmental and Floyd Snider McCarthy Inc. (Pentec and FSM). 2001b. Data Report, DSOA Vertical Characterization and Outfall 12 Data Collection, Duwamish Sediment Other Area, Preferred Remedy Interim Measure, Boeing Plant 2: Seattle/Tukwila, Washington. Edmonds, WA: Prepared for The Boeing Company.

Roy F. Weston Inc. (Weston). 1999. Site Inspection Report, Lower Duwamish River (RK 2.5 to 11.5), Seattle, Washington, Volume 1 - Report and Appendices. Document Control No. 4000-19-38-AAAL. Seattle, WA: Prepared for the U.S. Environmental Protection Agency (USEPA).

U.S. Environmental Protection Agency (USEPA). 2000. NPL Site Narrative at Listing Lower Duwamish Waterway, Seattle, Washington. Available: http://www.epa.gov/superfund/sites/npl/nar1622.htm.

U.S. Environmental Protection Agency (USEPA). 2002. U.S. Environmental Protection Agency, Region 10: The Pacific Northwest. Available: http://yosemite.epa.gov/r10/cleanup.nsf/webpage/Lower+Duwamish+Waterway+Site.

Washington State Department of Health (WADOH). 2002. Fish and Shellfish Consumption Advisories in Washington State Due to Chemical Contamination. Available: http://www.doh.wa.gov/ehp/oehas/EHA_fish_adv.htm#King%20County.