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Pacific Sound Resources

Seattle, Washington
CERCLIS #WAD009248287

Site Exposure Potential

The Pacific Sound Resources site (formerly the Wyckoff Wood Treatment Facility) occupies 10 hectares in an industrialized area on the south shore of Elliott Bay in Seattle, Washington (Figure 1). Pacific Sound Resources has been a wood-treating facility since 1906. Activities conducted at the site included pressure-treatment of wood products using creosote, PCP, and chemonite (an inorganic, ammoniacal solution of copper, arsenic, and zinc salts). Other preservatives, such as phenol, chromium, boric acid, and fluoride, were used in the past (SAIC 1990).

Wood was treated at the site in a main operations area that includes nine retorts, two shops, a transfer table, several areas with storage tanks (for preservatives), a wood-preservative formulation area, and a process wastewater treatment area (Figure 2). After the wood treatment process, residual preservatives were collected in sumps, pretreated, and discharged to a City of Seattle sanitary sewer. Unknown quantities of waste products, including PCP sludge, copper arsenate sludge, and creosote sludge were stored at the site (Tetra Tech 1988). During the mid-1980s, EPA and the Municipality of Metropolitan Seattle documented the illegal dumping of creosote and wastewater to a storm drain that discharges to the West Waterway of the Duwamish River. EPA also found that hazardous waste had been illegally

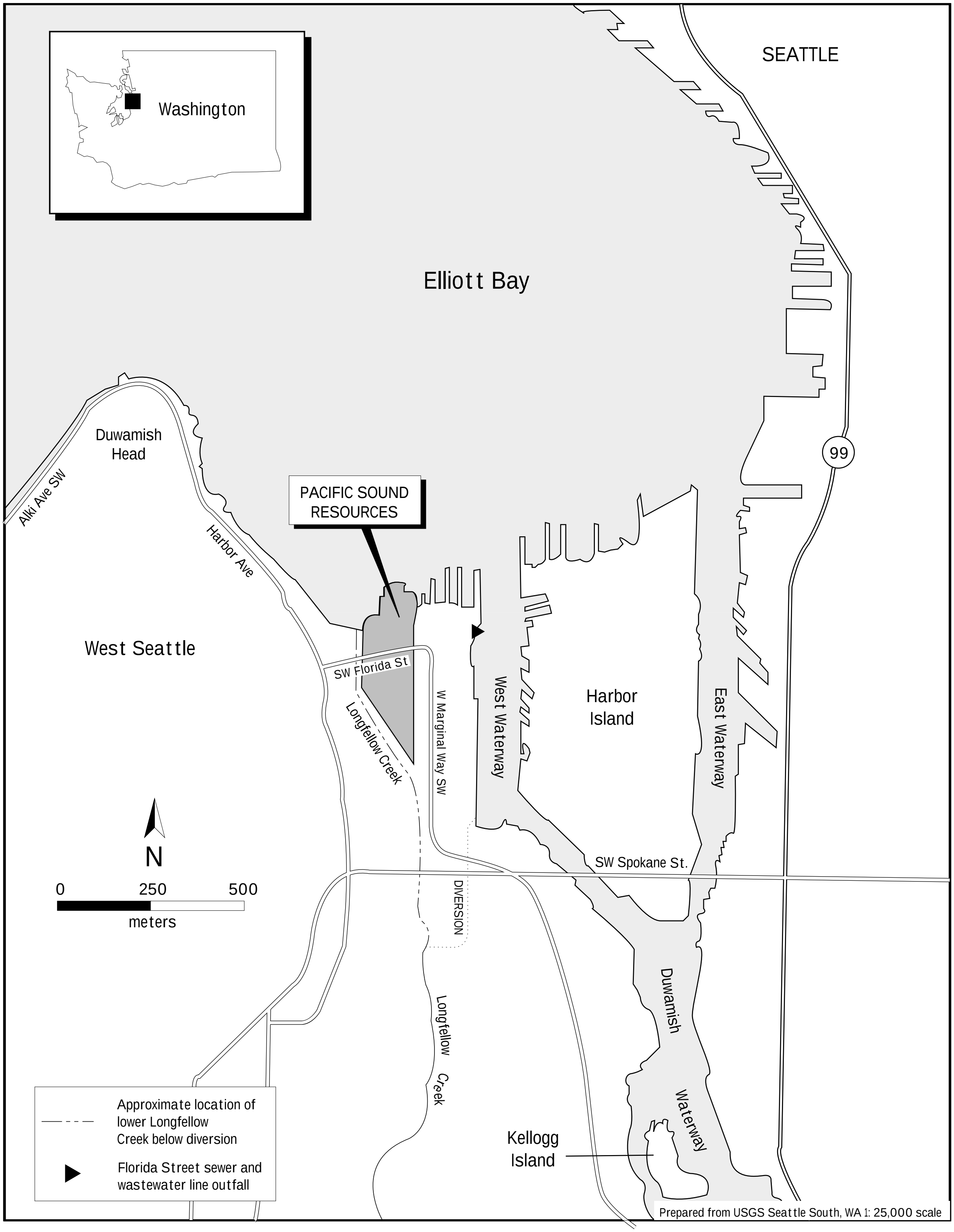

Figure 1. The Pacific Sound Resources site in Seattle, WA.

disposed in an unlined pond on the site (Hubbard and Sample 1988; Tetra Tech 1988).

Surface water runoff, groundwater, and direct discharge are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. The site is located on flat fill material next to Elliott Bay. When high tides are coupled with severe storm events, operational areas on the site are flooded and overland runoff discharges to Elliott Bay. Illegal discharge of site-related wastes turns the Florida Street storm sewer into a pathway for contaminant migration from the facility to the West Waterway. Surface runoff from the site may also enter Longfellow Creek. South of the site, a storm drain diverts the creek to discharge into the West Waterway (Figure 2). However, during high flow, upper Longfellow Creek may overflow the diversion structure and discharge via lower Longfellow Creek, which consists of a series of culverts, ditches, and ponds near the west border of the site. Surface runoff from the site has been observed to drain directly into exposed areas of the creek.

Groundwater is encountered at depths as shallow as 1 m below ground surface within an unconfined water table aquifer in the fill material. Regional geologic conditions suggest that the site is not likely to be underlain by a deep regional aquifer. Groundwater in the water table aquifer appears to flow north toward Elliott Bay and west toward lower Longfellow Creek. All wells north of Florida Street had elevated salinity and experienced tidal fluctuations in their water levels, especially in wells near the north end of the site, indicating a groundwater connection with the bay (SAIC 1990).

Contaminants may have been directly released into the bay as a result of storing freshly treated wood products on piers that extend over the bay. In addition, creosote was barged to the site by way of Elliott Bay and transferred to Tank Area 1 until 1985. Spills to the bay during the transfer process may have occurred, but have not been documented.

NOAA Trust Habitats and Species

The nearshore waters and sediments of Elliott Bay and the West Waterway at the mouth of the Duwamish River are the habitats of concern to NOAA. Elliott Bay, a functional estuary in Puget Sound, averages 85 m deep. The Bay has good circulation, with a flushing time estimated to range from two to ten days. Bottom substrates consist primarily of sandy muds, muddy sands, and coarse sands, except in the West Waterway where sandy substrates predominate (Dexter et al. 1981; PTI and Tetra Tech 1988). The shorelines of Elliott Bay and the Duwamish River have been modified with structures and almost all intertidal wetlands and shallow subtidal aquatic habitats have been eliminated (Port of Seattle 1985).

Elliott Bay provides habitat for numerous species of concern to NOAA, including anadromous fish,

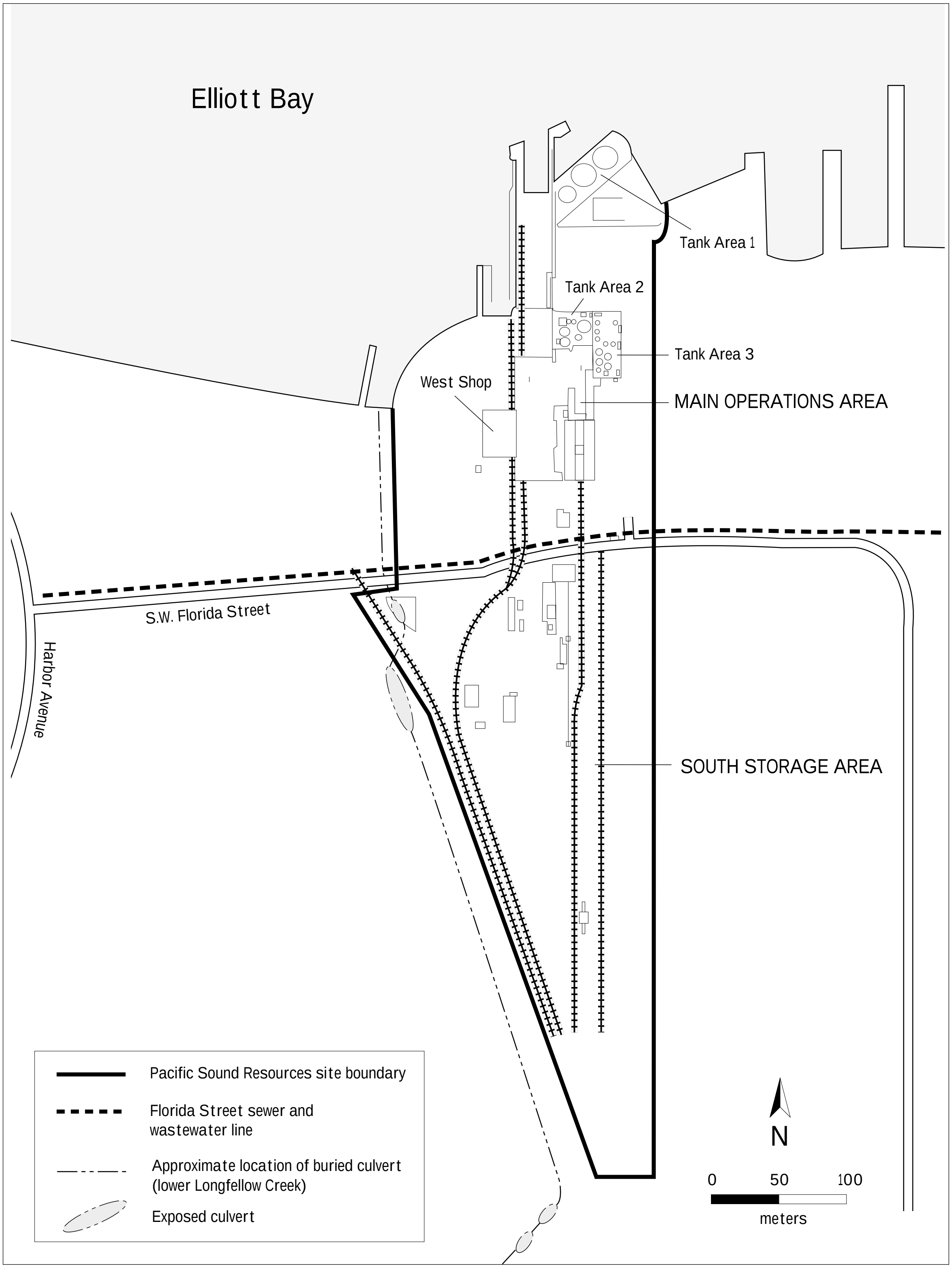

Figure 2. Detail of the Pacific Sound Resources site.

estuarine fish, invertebrates, and marine mammals (Table 1). Elliott Bay and the Duwamish River are documented migration corridors and juvenile nurseries for anadromous salmonids (Parametrix, Inc. 1982). The bay is also recognized as important rearing and foraging habitat for juvenile and adult estuarine fish species, as well as Dungeness crab (Williams et al. 1975; PTI and Tetra Tech 1988; Wood personal communication 1991).

Salmonid species use Elliott Bay and the Duwamish River as migration corridors to upstream spawning habitats in the Green River, which is one of the most prolific salmonid-producing streams in the Puget Sound basin. Chinook, chum, and pink salmon are the most common salmonids, followed by coho and sockeye salmon, steelhead trout, and cutthroat trout. Adult salmon congregate at the mouth of the Duwamish River before migrations, and juvenile salmon use the river mouth as nursery habitat (Dexter et al. 1981; Bradley personal communication 1991; Zichke personal communication 1991). There are seasonal multiple runs of both native and hatchery stocks in Elliott Bay and the Duwamish River. Spawning is widespread in the tributaries of the upper Duwamish basin (Bradley personal communication 1991; Pfeifer personal communication 1991).

Tribal salmon fisheries are the principal commercial fisheries in Elliott Bay. All salmon species are highly valued, and the fishery is intensively managed. Fishing locations vary between runs and over the years, but have included areas near the site. A general trend of diminishing catch totals has been observed in recent years (Washington Department of Natural Resources 1977; Bradley personal communication 1991; Pfeifer personal communication 1991; Zichke personal communication 1991).

Commercial fishing for estuarine fishes in Elliott Bay is limited by several factors, including a 1989 ban on commercial bottom trawling in Puget Sound south of Whidbey Island, low market values for demersal and mid-water pelagic species, commercial shipping and ferry traffic, and conflicts with sportfishing (Bargman personal communication 1991). Cumulatively, these factors have resulted in a low level of commercial fishing in Elliott Bay; the formerly large groundfish fishery for English, sand, and Dover sole, and starry flounder was particularly impacted. Commercial shellfishing is prohibited in Elliott Bay due to the likelihood of fecal coliform contamination (Suther personal communication 1994).

Recreational fishing is extremely popular in Elliott Bay and the Duwamish basin. Like the commercial fisheries, recreational harvests are dominated by salmon. The recreational salmon fishery is intensively managed and coincides with seasonal runs. Elliott Bay and the Duwamish River are particularly popular locations (Pfeifer personal communication 1991). The recreational fisheries in Elliott Bay for non-salmonid estuarine species are also active, but at a lower level than the salmon fisheries. There is a winter sport fishery for Pacific cod, hake, and walleye pollock in the bay near the Duwamish estuary. There is regular sportfishing for sea perch and black and

Table 1. NOAA trust resources using Elliott Bay near the mouth of the Duwamish River (Washington Department of Natural Resources 1977; Dexter et al. 1981; PTI and Tetra Tech 1988; Monaco et al. 1990).

Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS FISH						
Cutthroat trout	*Oncorhynchus clarki*		♦	♦		♦
Pink salmon	*Oncorhynchus gorbuscha*		♦	♦	♦	♦
Chum salmon	*Oncorhynchus keta*		♦	♦	♦	♦
Coho salmon	*Oncorhynchus kisutch*	♦	♦	♦	♦	♦
Steelhead trout	*Oncorhynchus mykiss*		♦	♦		♦
Sockeye salmon	*Oncorhynchus nerka*		♦	♦	♦	♦
Chinook salmon	*Oncorhynchus tshawytscha*		♦	♦	♦	♦
Longfin smelt	*Sprinichus thaleichthys*	♦	♦	♦	♦	♦
ESTUARINE FISH						
Pacific sand lance	*Ammodytes hexapterus*	♦	♦	♦		
Tube-snout	*Aulorhynchus flavidus*	♦	♦	♦		
Arrow goby	*Clevelandia ios*	♦	♦	♦		
Pacific herring	*Clupea harengus pallasi*		♦	♦	♦	♦
Sculpins (various)	*Cottidae*		♦	♦		
Sea perches (various)	*Embiotocidae*	♦	♦	♦	♦	♦
Northern anchovy	*Engraulis mordax*	♦	♦	♦		
Cods (various)	*Gadidae*	♦	♦	♦	♦	♦
3-spine stickleback	*Gasterosteus aculeatus*	♦	♦	♦		
Greenlings (various)	*Hexagrammidae*		♦	♦	♦	♦
Ratfish	*Hydrolagus colliei*		♦	♦		
Surf smelt	*Hypomesus pretiosus*	♦	♦	♦	♦	♦
Snake prickleback	*Lumpenus sagitta*	♦	♦	♦		
Flounders (various)	*Pleuronectiformes*	♦	♦	♦		♦
Big skate	*Raga binoculata*			♦		
Rockfishes (various)	*Sebastes* spp.	♦	♦	♦		♦
Spiny dogfish	*Squalus acanthias*			♦	♦	
INVERTEBRATE SPECIES						
Dungeness crab	*Cancer magister*	♦	♦	♦		♦
Red rock crab	*Cancer productus*	♦	♦	♦		
Bent-nosed clam	*Macoma nasuta*	♦	♦	♦		
Blue mussel	*Mytilis edulis*	♦	♦	♦		
Shrimp (various)	*Pandalus* spp.		♦	♦		
MARINE MAMMALS						
Harbor seal	*Phoca vitulina*			♦		
California sea lion	*Zalophus californianus*			♦		
Harbor porpoise	*Phocoena phocoena*			♦		

yelloweye rockfish in Elliott Bay. There is also considerable sportfishing for groundfish, notably sanddab and rock sole, in the bay (Bargman personal communication 1991).

There are no sport fishery closures within Elliott Bay. However, an advisory is in effect against consumption of fish taken from urban shorelines of King County (where the bay is located) due to potential contamination from urban sources in general (Baker personal communication 1991; Suther personal communication 1994).

Site-Related Contamination

Several investigations have characterized the extent of site-related contamination in the study area (Cubbage 1989; SAIC 1990). As part of these investigations, samples were collected from approximately 50 on-site surface soil stations and borings, 21 on-site groundwater monitoring wells, and 26 sediment locations in waters next to the site. The primary contaminants of concern to NOAA identified in these studies are PAHs associated with creosote, PCP, chlorinated dibenzodioxins (CDDs), arsenic, chromium, copper, and zinc. Maximum concentrations of these contaminants detected during site investigations are presented in Table 2.

Total PAHs were detected at very high, often percent-level, concentrations in the top 2 m of soil collected from the main operations area.

Table 2. Maximum concentrations of contaminants detected in environmental samples collected from the site.

Contaminant	On-Site Soil (mg/kg)	Avg. U.S. Soil[1] (mg/kg)	Sediment (mg/kg)	ERL[2] (mg/kg)	ERM[2] (mg/kg)	Groundwater (µg/l)	Marine Chronic AWQC[3] (µg/l)
INORGANIC SUBSTANCES							
Arsenic	8,300	5.0	34	8.2	70	5,000	36
Chromium	1,900	100	130	81	370	2,000	50
Copper	9,000	30	360	34	270	1,100	2.9
Zinc	7,700	50	690	150	410	8,600	86
ORGANIC COMPOUNDS							
Total PAHs	46,000	NA	3,600	4.0	45	1.1×10^8	NA
PCP	4,100	NA	0.17	NA	NA	1.0×10^6	7.9
2,3,7,8-TCDD[4]	0.059	NA	NT	NA	NA	48	0.00001*

1: Lindsay (1979).
2: Effects Range Low and Effects Range Median; the concentrations representing the lowest 10 percentile value and the median value, respectively, for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1992).
3: Ambient water quality criteria for the protection of aquatic organisms. Marine chronic criteria presented (U.S. EPA 1993).
4: Presented concentrations are calculated toxicity equivalents of 2,3,7,8-TCDD.
*: Value presented is the freshwater chronic Lowest Observed Effects Level (LOEL). No LOEL or AWQC have been developed for marine water (U.S. EPA 1993).
NA: Screening guidelines not available.
NT: Not tested.

Lower concentrations of PAHs were generally detected in soils collected from depths below 3 m and in soils collected from the South Storage Area. The highest concentrations of total PAHs in groundwater were observed in floating and sinking oil layers in six groundwater wells next to Tank Areas 2 and 3, and west of the West Shop. These oil layers were up to 2 m thick in floating layers and 1.4 m thick in sunken layers. Dissolved-phase PAHs were also observed in the groundwater, with maximum concentrations of up to 1,700,000 µg/l observed 100 m inland from the intertidal zone of Elliott Bay (SAIC 1990). PAH concentrations in nearshore sediment exceeded ERL concentrations by up to three orders of magnitude. The highest concentrations were observed along the shore near Tank Area 1, where creosote continues to be stored (ETI 1990). Very high concentrations of PAHs were also found in sediment beneath an area where treated poles were loaded onto barges.

As with PAHs, PCP was detected at the highest concentrations in the surface soils of the main operations area; however, concentrations were generally one to two orders of magnitude less than those of PAHs. Concentrations of PCP in groundwater were consistently higher than marine chronic AWQC. The distribution of PCP in groundwater was similar to the PAHs, but concentrations were generally an order of magnitude lower. PCP was not detected in marine sediments next to the site at concentrations above ERL concentrations. However, because detection limits in many cases were higher than the ERL concentrations (by up to four orders of magnitude), PCP concentrations may exceed those screening guidelines.

The CDD compounds are byproducts of the PCP manufacturing process. Because there was only limited sampling for CDDs, there were not enough data to determine the areal extent of contamination in soils and groundwater. Elliott Bay sediments next to the site were not analyzed for CDDs. However, total CDDs (expressed as 2,3,7,8-TCDD toxicity equivalents) were measured in the product layer of groundwater near Tank Area 2 at a concentration exceeding the LOEL for aquatic organisms by six orders of magnitude.

The distribution of arsenic, chromium, copper, and zinc in on-site soils and groundwater was similar to that observed for organic compounds. All four trace elements were observed in groundwater at concentrations that exceeded their respective marine chronic AWQCs by more than an order of magnitude. In nearshore sediment, trace elements were frequently observed at concentrations above their ERL concentrations. Contamination by copper and zinc was most prevalent; concentrations in more than 75 percent of the samples collected were higher than the ERL concentrations. The highest concentrations of arsenic, copper, and zinc in the entire Duwamish River were found at the sediment station at the outfall of the Florida Street storm drain.

Summary

Very high concentrations of chemicals associated with wood-treating processes, including PAHs, PCP, arsenic, chromium, copper, and zinc, were measured in soil, groundwater, and nearshore sediment collected from the site. Contaminants were detected in various environmental media at concentrations that often greatly exceeded concentrations that have been shown to adversely affect aquatic organisms. Elliott Bay and the Duwamish River are migration corridors for anadromous salmonids to upstream spawning areas in the Green River, one of the most prolific salmonid-producing streams in the Puget Sound basin. Contamination of sediment as a result of activities at the site may adversely impact anadromous fish and other NOAA trust resources in Elliott Bay and the Duwamish River.

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