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Pearl Harbor Naval Complex

Oahu, Hawaii

Cerclis # HI4170090076

Site Exposure Potential

The Pearl Harbor Naval Complex is midway along the southern coast of the island of Oahu in Hawaii (Figure 1). The Naval Complex was established in 1901 and development of the station continued through the 1940s. Today, Pearl Harbor is a major fleet homeport for nearly forty warships, service vessels, and submarines with their associated support, training, and repair facilities (Grovhoug, 1991). The Naval Complex includes six major facilities: the Naval Shipyard, the Naval Supply Center, the Naval Station, the Submarine Base, the Public Works Center, and the Inactive Ship Maintenance Facility (Table 1). A seventh facility, the Naval Magazine, is also being considered for inclusion in the Naval Complex.

The Naval Complex includes the East, West, Middle, and Southeast lochs of Pearl Harbor (Figure 1). Several streams cross the Base and transport fresh water into the harbor. These streams drain agricultural and newly urbanized areas before passing through the highly industrialized areas near the harbor. The streams are brackish for short distances upstream of their mouths (Grovhoug, 1991).

Two aquifers underlie the complex: an unconfined caprock aquifer of low permeability which ranges from 8.5 to 440 m deep, and a deeper, highly permeable basalt aquifer. Groundwater in both aquifers flows toward Pearl Harbor (Ecology and Environment, 1989).

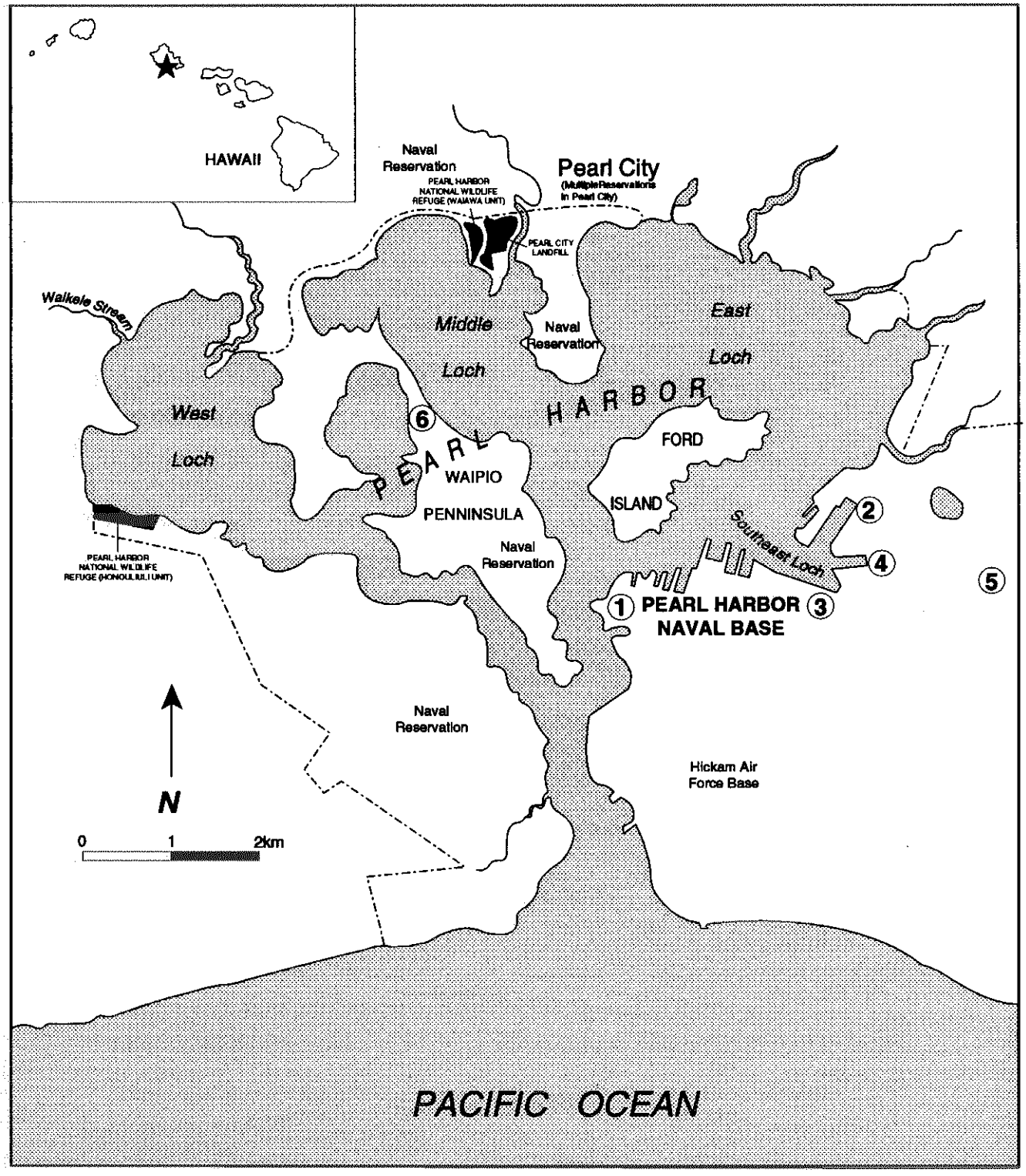

Figure 1. Pearl Harbor Naval Complex, Pearl Harbor, Hawaii. Numbers correspond to the six naval facilities of concern listed in Table 1.

Table 1. Major activities and associated wastes at the six facilities at the site.

	Activity	Types of Waste	Disposal Methods
1	Naval Shipyard major ship repair and overhaul	heavy metals and sulfates, battery acid waste, lead salts, metallic mercury waste, plating waste, PCBs, chromic acid, caustic and steam cleaning compounds, diesel fuel, solvents	1910-1982: runoff, storm drain to harbor, leaking tanks
2	Naval Supply Center fuel farms and storage warehouses	waste oils, tank bottom sludges, fuel, battery acid, lead	1940-1979: dumped, disposal pits
3	Naval Station maintenance and operation of harbor and shore based support facilities	PCBs, metal scraps, acid, oil based cleaning solvents, fuels, solid waste	1920s-1949: dumped to storm drains to harbor 1968: transformer spill
4	Naval Submarine base Homeport for almost 20 nuclear and conventional submarines of the Pacific Fleet; Maintains and operates facilities to support training and experimental operations of the submarine force	Unknown	Unknown
5	Public Works Center Contains a materials department, environmental and industrial laboratory, plumbing shop, paint shop, machine shop, refrigeration shop, electrical shop, transformer shop, pest control shop, and the Pearl City Landfill.	pesticides, PCBs, solvents, corrosives, paint, oils, fuel	1950-1978: dumped in disposal pit, buried drums
6	Inactive Ships Maintenance Depot Includes radiological operations, a machine shop, paint shop, and an automotive grease rack	battery acid, lead, radium	1947-1980: poured onto weeds 1982-present: left onboard ships

Contaminant transport to the Pearl Harbor ecosystem could occur via surface water pathways, groundwater, and sediment. Contaminant releases to both groundwater and surface water routes at the Pearl Harbor Naval Base have been documented, as have direct releases to the nearshore zone of the harbor (Ecology and Environment, 1989). Contaminated sediments have also been remobilized by dredging or vessel movement. Mobile biota can transfer contamination to other locations after accumulating contaminants from the water column, sediment, or from other biota. In addition, bioturbation can mobilize sediment contamination (Grovhoug, 1991).

NOAA Trust Habitats and Species

The habitats of primary concern to NOAA are surface water and sediments of Pearl Harbor. Pearl Harbor is an extremely complex habitat which supports substantial biological productivity (Naughton, personal communication 1991). Mean annual tidal range is approximately 0.5 m. Circulation in the harbor is primarily tidally driven and is generally weak. Water temperature, depth, and salinity are variable (Grovhoug, 1991).

Pearl Harbor provides valuable spawning, nursery, and forage habitats for a rich diversity of trust species; over ninety different fish species have been identified in Pearl Harbor. Most nearshore species known from Hawaii can be found in Pearl Harbor (Naughton, personal communication 1992); selected species are listed in Table 2. Species diversity and abundance in Pearl Harbor is generally greater near its mouth and ocean inlet than in its northern, more brackish areas (Naughton, personal communication 1991). Hawaiian anchovy is the most abundant species. Mullet (amaama, anae), jack (papio, ulua), surgeonfish (manini), Hawaiian tarpon (awa'aua), and goby are also widely distributed (Grovhoug, 1979). Butterfly fish, goatfish, blenny, shark, and barracuda are abundant in more saline waters (Gosline and Brock, 1960). Most of the undeveloped periphery of Pearl Harbor is colonized by mature red mangrove swamps which provide excellent juvenile fish and invertebrate habitat (Eilerts, personal communication 1991). Such brackish habitats are likely utilized by euryhaline fish species such as gobies, striped mullet, bonefish, tilapia, Hawaiian anchovy (nehu), threadfish (moi), needlefish (aha'aha), and milkfish (awa), and by invertebrate species, specifically Hawaiian crab, white crab, and stone crab (Gosline and Brock, 1960). Three species of bivalves are found in Pearl Harbor, none of them native to Hawaii (Oishi, personal communication 1991).

Echinoderm (sea urchin) and hermatypic (stony) coral families are found throughout most bays and harbors on Oahu but are absent in Pearl Harbor. The reason for their absence is unknown; however, both stony corals are relatively sensitive to siltation, freshwater, and industrial pollution (Grovhoug, 1991). Echinoderms are ubiquitous throughout Hawaii and ought to occur in Pearl Harbor (Naughton, personal communication 1991).

A bait fishery for Hawaiian anchovy is the only large-scale commercial fishery in Pearl Harbor (Grovhoug, 1991) and occurs in locations authorized by the U.S. Navy. Milkfish, jack, and mullet are fished commercially on a much smaller scale (Naughton, personal communication 1992). Along the periphery of Pearl Harbor, some low-level sport and subsistence fishing is allowed for people with access to the naval reservation (Oishi, personal communication 1991). All other commercial and sport fishing is prohibited for security reasons (Oishi, personal communication 1991).

There are no threatened or endangered mammal, fish, or invertebrate species reported to be present in Pearl Harbor, although the Hawaiian goby

Table 2. Selected NOAA trust species found in Pearl Harbor, Hawaii.

Species			Habitat			Fisheries	
Common Name	Scientific Name	Hawaiian Name	Spawning	Nursery	Adult Forage	Comm	Recr./Subsist.
RESIDENT SPECIES							
Marine/Estuarine fish							
Surgeonfish	*Acanthuridae*	Manini	♦	♦	♦		♦
Eagle ray	*Aetobatus narinari*	Hihimanu	♦	♦	♦		♦
Bonefish	*Albula vulpes*	'O'io	♦	♦	♦		♦
Cardinalfish	*Apogonidae*	Upapalu	♦	♦	♦		♦
Soft puffer	*Arothron hispidus*		♦	♦	♦		♦
Sleeper goby	*Asterropteryx*		♦	♦	♦		♦
Parrotfish	*Calotomus spinidens*	Uhu	♦	♦	♦		♦
Jack	*Carangidae*	Papio[2], Ulua[3]	♦	♦	♦	♦	♦
Black tip	*Carcharhinus limbatus*	Mano	♦	♦	♦		♦
Butterflyfish	*Chaetodontidae*		♦	♦	♦		♦
Milkfish	*Chanos chanos*	Awa	♦	♦	♦	♦	♦
Conger	*Conger cinreus*	Puhi uha	♦	♦	♦		♦
Porcupinefish	*Diodontidae*		♦	♦	♦		♦
Hawaiian tarpon	*Elops hawaiiensis*	Awa'aua	♦	♦	♦		♦
Hawaiian anchovy	*Encrasicholina purpurea*	Nehu	♦	♦	♦	♦	♦
Goby	*Gobiidae*	O'opu	♦	♦	♦		♦
Moray	*Gymnothorax undulatus*	Puhi	♦	♦	♦		♦
Halfbeak	*Hemiramphus depauperatus*		♦	♦	♦		♦
Squirrelfish	*Holocentridae*	U'u	♦	♦	♦		♦
Mountain bass	*Kuhlia sandvicensis*		♦	♦	♦		♦
Black-tail snapper[1]	*Lutjanus fulvus*	To'au	♦	♦	♦		♦
Striped mullet[1]	*Mugil cephalus*	Amaama[2], Anae[3]	♦	♦	♦	♦	♦
Goatfish	*Mullidae*	Weke	♦	♦	♦		♦
Blenny	*Omobranchus*		♦	♦	♦		♦
Boxfish	*Ostracion meleagris camurum*		♦	♦	♦		♦
Threadfish	*Polydactylus sexfilis*	Moi	♦	♦	♦		♦
Damselfish	*Pomacentrida*	Mamo	♦	♦	♦		♦
Lizardfish	*Saurida gracilis*	Ulae	♦	♦	♦		♦
Hammerhead shark	*Sphyrna lewini*	Mano kihikihi	♦	♦	♦		♦
Barracuda	*Sphyraena barracuda*	Kaku	♦	♦	♦		♦
Wrasse	*Stethojulis balteata*	Hinalea	♦	♦	♦		♦
Silvery tilapia[1]	*Tilapia melanotheron*		♦	♦	♦		♦
Mosambique tilapia[1]	*Tilapia mossambica*		♦	♦	♦		♦
Needlefish	*Tylosurus crocodilus*	Aha'aha	♦	♦	♦		♦
Invertebrates							
Japanese oyster[1]	*Crassostrea gigas*		♦	♦	♦		♦
Eastern oyster[1]	*Crassostrea virginica*		♦	♦	♦		♦
Hawaiian crab	*Podophthalmus vigil*		♦	♦	♦		♦
White	*Portunus sanguinolentus*		♦	♦	♦		♦
Common littleneck[1]	*Protothaca staminea*		♦	♦	♦		♦
Samoan crab[1] Blue claw crab	*Scylla serrata*						
Stone crab	*Thalamita*		♦	♦	♦		♦
Reptiles							
Green sea turtle[4]	*Chelonia mydas*				♦		

1: Species is not indigenous to Hawaii.
2: Juvenile
3: Adult
4: Federally threatened species

(*Lentipes concolor*) is under consideration by the USFWS as a threatened species (Eilerts, personal communication 1991). This goby is known to migrate through Pearl Harbor. Two species of endangered sea turtles commonly use nearshore habitat outside of Pearl Harbor (Eilerts, personal communication 1991); the federally threatened green sea turtle has been observed in Pearl Harbor (Naughton, personal communication 1992). The Pearl City Peninsula Landfill, one of the potential sites of concern at the Public Works Center, borders the Waiawa Unit of the Pearl Harbor National Wildlife Refuge, which was set aside for federally endangered water birds (Ecology and Environment, 1989).

Site-Related Contamination

During an Initial Assessment Study at the Pearl Harbor Naval Complex in October 1983, thirty potential sites were identified. Soil and groundwater samples were collected on the base; water and sediments were collected in the harbor. On the base, areas (and contaminants) of concern include a battery acid disposal area and former battery acid pit (lead), a storm drain used for disposal of transformer fluid (PCBs), and past sludge disposal areas (PAHs) (Ecology and Environment, 1989). High concentrations of several organic and inorganic contaminants have been reported in soil and groundwater samples collected from potential sources throughout the naval complex (Ecology and Environment, 1989). Maximum concentrations of selected contaminants reported during preliminary investigations are presented in Table 3.

Several trace elements were detected in surface water samples collected from the east end of Ford Island and the Southeast Loch within Pearl Harbor. Cadmium, lead, and mercury exceeded their respective ambient water quality criteria for the protection of marine life (Table 3).

Sediment contamination varies throughout the harbor. The highest concentrations were generally found in Southeast Loch sediment. The concentrations of chromium, copper, lead, mercury, silver, PCBs, and total PAHs exceeded their respective ER-L concentrations, levels at which biological effects are expected to occur (Table 2). The maximum concentrations of chromium (340 mg/kg) and mercury (9.5 mg/kg) were detected in harbor sediments collected near base storm drain outfalls (Ecology and Environment, 1989).

In a single 1979 sampling, chlordane was detected in fish (milkfish and mullet), hammerhead shark, blue claw crab, and Hawaiian crab caught in Middle Loch. Chromium was detected in blue claw crab, and mercury was observed in two fish species, milkfish and jack from the same area. Base activities may have caused elevated concentrations of chromium and mercury in 1979 catches of blue claw crab, Hawaiian crab, mullet, milkfish, or jack (Ecology and Environment, 1989).

Table 3. Maximum concentrations of selected contaminants detected during preliminary investigations at the Pearl Harbor Naval Complex.

	Soil		Water			Sediment	
	Soils mg/kg	Avgerage[1] U.S.Soil mg/kg	Ground-water µg/l	Surface Water µg/l	AWQC[2] µg/l	Sediment mg/kg	ER-L[3] mg/kg
ORGANIC COMPOUNDS							
Total PAHs	93,000	N/D	3,120	NA	300*	1000	4.0
PCBs	1,800	N/D	0.52	NA	0.03	1.1	0.05
Pesticides							
DDT	1,500	N/D	NA	NA	0.001	<0.03	0.003
chlordane	735	N/D	NA	NA	0.004	<0.3	0.0005
INORGANIC SUBSTANCES							
Trace Elements							
cadmium	7.5	0.06	NA	3.3	1.1+	1.5	5
chromium	1,370	100	100,000	1.7	11	340	80
copper	391	30	NA	3.0	12+	79	70
lead	395,000	10	NA	3.3	3.2+	55	35
mercury	0.66	0.03	NA	1.0	0.012	9.5	0.15
nickel	177	40	NA	53	160+	NA	30
silver	5	0.05	NA	0.3	N/D	3.7	1.0
zinc	6,680	50	NA	30	110+	107	120

1: Lindsay (1979)
2: Chronic Ambient Water Quality Criteria for the protection of marine aquatic life (EPA 1986).
3: Effects range-low; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long and Morgan (1990).
N/D: Not Determined
NA: Screening level not available.
*: Insufficient data to develop criteria; value presented is the Lowest Observed Effects Level (LOEL).
+: Hardness-dependent criteria; 100 mg/l assumed.

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