U.S. Naval Submarine Base, Bangor

Bangor, Washington
Region 10
WA5170027291

Site Exposure Potential

The U.S. Naval Submarine Base (Subase) Bangor is located approximately 16 km north of Bremerton near Bangor, Washington in Kitsap County (Figure 1). The 2,830-hectare subase is adjacent to Hood Canal, a major Puget Sound estuary. Established in 1944, the base originally served as an ammunition depot. In 1963, the Polaris Missile Facility Pacific was added, and in 1974 the base was designated a homeport for Trident submarines.

A wide variety of solid and liquid wastes were disposed of at Subase Bangor from the 1940s to the 1980s. General refuse, ordnance materials, demilitarization wastes, and Otto fuel were either burned or disposed of in landfills at various locations on the base. Ten areas on the subase were identified in the RI/FS process as potential uncontrolled hazardous waste sites (Hart CrowserInc. 1989).

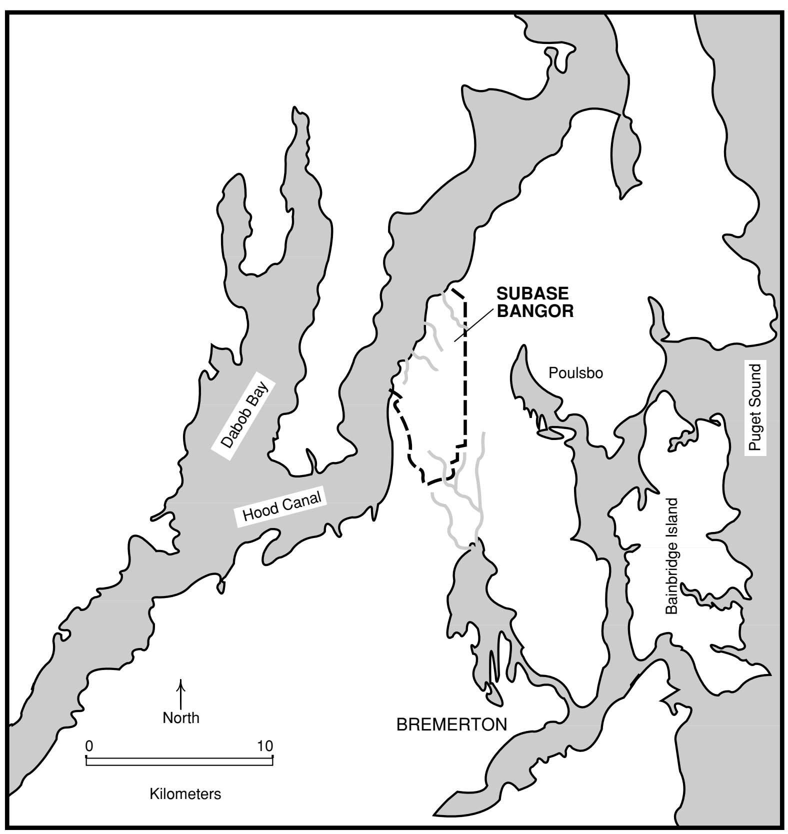

Figure 1.
The U.S. Naval Submarine Base, Bangor, Washington.

Site Exposure Potential, *cont.*

The Bangor facility can be divided into two main watersheds. The largest, Hood Canal watershed, includes Cattail Lake, Hunters Marsh, and DevilÕs Hole. Eight of the ten contaminated sites identified in the RI/FS process are located in this watershed. Contaminants within Hood Canal watershed could migrate via surface water runoff and groundwater transport into Hood Canal.

The second watershed is the Clear Creek watershed, which drains a comparatively small area in the southeastern portion of the Bangor facility. All surface and groundwater discharge from this small watershed flow into Clear Creek, which discharges into Dyes Inlet, another Puget Sound estuary, approximately 5.1 km downstream of the Subase.

Groundwater flow and surface water runoff are the primary pathways for off-site migration of contaminants from this watershed.

Site-Related Contamination

Trace elements are the primary contaminants of concern to NOAA. Maximum concentrations of contaminants over the entire subase are reported in Table 1 (Hart Crowser 1989; Ribic and Swartzman 1989). Concentrations of contaminants were generally elevated in surface waters collected within the Hood Canal Watershed, particularly in the Hunters Marsh area. Clear Creek watershed samples had elevated levels of chromium, copper, and lead. Mercury concentrations in groundwater samples collected from the Hunters Marsh area were high and concentrations of other inorganic substances were elevated.
Ordnance compounds were also reported at high levels in samples from Hunters Marsh and DevilÕs Hole. RDX and trinitrotoluene (TNT) concentrations were measured at 8,600 µg/l and 7,600 µg/l, respectively, in groundwater from the DevilÕs Hole area. The propellants picranic acid, picric acid, and Otto fuel were measured at 2,800 µg/l, 290,000 µg/l, and 5,000 µg/l in groundwater from the Hunters Marsh area.

Soil was contaminated with trace elements in the DevilÕs Hole area of the Hood Canal watershed and the Clear Creek watershed. Cadmium, copper, and zinc soil concentrations were

Site-Related Contamination, *cont.*

above background levels in both areas (Lindsay 1979). Nickel concentrations were slightly above average background levels in the Devil's Hole area. Chromium, mercury, and silver were above background levels in soil samples from the Clear Creek watershed. However, mercury was not measured in soil from other areas. Ordnance compounds were also detected in soil

Table 1. Maximum concentrations of major inorganic contaminants at the site compared with applicable screening levels.

	Water			Soil		Sediment	
	Surface Water µg/l	Ground-water µg/l	Chronic AWQC[1] µg/l	Soil mg/kg	Average U.S. Soil[2] mg/kg	Hood Canal Sediment mg/kg	ER-L[3] mg/kg
INORGANIC SUBSTANCES							
cadmium	4.6	1.2	9.3	16	0.06	2.2	5
chromium	6	17	50	150	100	28	80
copper	6	16	2.9	59	30	100	70
lead	10	<5	5.6	400	10	72	35
mercury	1.0	1.0	0.025	0.16	0.03	0.24	0.15
nickel	7	14	8.3	34	40	NT	30
silver	3	2.7	2.3[a]	1	0.05	NT	1
zinc	230	250	86	540	50	480	120

1: Ambient water quality criteria for the protection of aquatic life, marine chronic criteria presented (EPA 1986).
2: Lindsay (1979).
3: Effective range-low; the concentration representing the lowest10 percentile value for the data in which effects were observed or predicted in studies compiled by Long and Morgan (1990).
a Marine acute criteria presented; no chronic criteria available
NT: Not analyzed

from the Devil's Hole area; RDX and TNT were measured at 760 mg/kg and 6,000 mg/kg, respectively.

Sediment and clam tissues were collected from areas adjacent to the pier facilities in Hood Canal. Copper, lead, zinc, and mercury in Hood Canal sediment exceeded levels reported to be associated with toxic effects to aquatic organisms in other studies (Long and Morgan 1990). Trace elements were found

Table 2. Maximum concentrations of metals in tissues from shellfish collected in Hood Canal in the vicinity of the site compared to levels reported for Puget Sound.

	Mytilus edulis		*Macoma* spp.		*Saxidomus giganteus*	
	Bangor	Puget Sound[1]	Bangor	Puget Sound[2]	Bangor	Puget Sound[3]
		Max		Max		Max
cadmium	5.5	5.5	1.0	0.2	0.6	0.4
chromium	3.9	12.0	21.0	1.8	5.1	NT
copper	19.0	13.0	98.0	89.0	14.0	4.2
mercury	0.2	0.13	0.2	NT	0.08	0.04
lead	7.2	15.0	2.7	9.7	0.3	0.42
zinc	260.0	320	300	260	64.0	16.4

1: Olsen and Schell (1977).
2: Stober and Chew (1984); values are from a single sample only.
3: Faigenblum et al. (1988).
NT Not tested

Site-Related Contamination, *cont.*

in Hood Canal clam tissues (Table2; Olsen and Schell 1977; Stober and Chew 1984; Faigenblum et al. 1988; Ribic and Swartzman 1989). Concentrations of cadmium, chromium, copper, mercury, lead, and zinc exceeded maximum levels reported for Puget Sound in some species.

NOAA Trust Habitats and Species

The primary habitats of concern to NOAA are Hood Canal and Dyes Inlet. Habits of secondary concern include Clear Creek, DevilÕs Hole Lake, and Cattail Lake. Hood Canal is within the Puget Sound estuary and consists of a narrow inlet that extends 75 km southwest from Admiralty Inlet in northern Puget Sound.

The nearshore areas adjacent to the subase support numerous species of interest to NOAA and are of the most concern (Table 3; Peeling and Goforth 1975; Bax et al. 1978; USFWS 1981; Naval Energy and Environmental Support Activity 1983; Research Planning Institute Inc. 1985). Clams and mussels abound in the coves along Hood Canal in the area of the subase and oysters are found in protected areas. Subtidal geoduck beds occur intermittently along the shoreline, with the greatest abundances in the river delta areas. All species listed in Table 3 support commercial or recreational fisheries. Many of these are harvested recreationally along the shoreline of Subase Bangor and some are commercially harvested from offshore areas (National FisheryResearchCenter 1988).

Abundant eelgrass beds along the shoreline adjacent to the subase provide habitat for several marine species of interest to NOAA, including juvenile rockfish, lingcod, and English sole. Herring use nearshore areas for spawning and nursery grounds, especially where eelgrass is prevalent (Jongejan / Gerrard Associates 1974 ; Peeling and Goforth 1975; Naval Energy and Environmental Support Activity 1983).

Subtidal areas provide highly productive habitat for various crustacean species. The Puget Sound recreational shrimp fishery is dominated by the Hood Canal spot shrimp, which accounts for nearly 70 percent of all Puget Sound shrimp landings (Washington Department of Fisheries 1988). It is estimated that Hood Canal provides 30 percent of the total

NOAA Habitats and Species, *cont.*

annual catch of chum salmon for Puget Sound and 20 percent of the pink salmon catch (Jongejan / Gerrard Associates 1974). Salmonids enter Hood Canal from surrounding streams as juveniles during the late winter and spring and migrate north

Table 3. Major invertebrate and fish species use of Hood Canal, and major commercial and recreational fisheries in Hood Canal.

Table available in hardcopy

along the shoreline toward the Strait of Juan de Fuca (Jongejan / Gerrard Associates 1974). The out-migrating salmon use the shallow portions of the canal adjacent to the site for foraging.

Steelhead trout, and coho and chum salmon use the lower reaches of Clear Creek (National Fishery Research Center

NOAA Trust Habitats and Species, *cont.*

1988). DevilsÕHole Lake is a six-hectare lake connected to Hood Canal by a small stream with a fish ladder. The Navy uses the lake for rearing sea-run cutthroat trout and coho salmon (Munn personal communication 1990).
Cattail Lake supports a native, naturally reproducing stock of cutthroat trout, which spawn in the small streams entering the lake (National Fishery ResearchCenter 1988). There are currently no anadromous fish runs in Cattail Lake, as fish migration is prevented by a screened spillway. Historical records indicate that the stream may have supported anadromous fish runs in the past (Jongejan/Gerrard Associates 1974).

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