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NSWC INDIAN HEAD
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LETTER FROM U S NAVY REGARDING THE PRELIMINARY NATURAL RESOURCE SURVEY AT SITES 5, 8, 12, 39, 41, 42, 53 AND 56 NOVEMBER 1996 WITH TRANSMITTAL
NSWC INDIAN HEAD MD
1/29/1997
NSWC INDIAN HEAD

5600

DEPARTMENT OF THE NAVY
INDIAN HEAD DIVISION
NAVAL SURFACE WARFARE CENTER
101 STRAUSS AVE
INDIAN HEAD MD 20640-5035

5090
Ser 046C/22
29 Jan 97

From: Commander, Indian Head Division, Naval Surface Warfare Center
To: Commander, Engineering Field Activity Chesapeake, Naval Facilities Engineering Command, Code 181RS, 901 M Street SE, Washington DC 20374-5018

Subj: PRELIMINARY NATURAL RESOURCE SURVEY

Encl: (1) Preliminary Natural Resource Survey of Nov 96

1. We are forwarding for your review, a copy of the Preliminary Natural Resource Survey that was prepared by the National Oceanic and Atmospheric Administration. Mr. Shawn Jorgensen of my staff will be coordinating comments on the document. Therefore, please provide your comments to him by Friday, 14 February 1997.

2. If you have any questions or comments concerning this matter, please contact Mr. Jorgensen on (301) 743-6745 or DSN 354-6745.

CHERYL L. DESKINS
By direction

D R A F T

NOAA PRELIMINARY NATURAL RESOURCE SURVEY

Naval Surface Warfare Center, Indian Head Division
Indian Head, Maryland Cerclis # MD7170024684
November 1996 Site ID:

FINDINGS OF FACT

SITE OVERVIEW

The Naval Surface Warfare Center, Indian Head Division (NSWC Indian Head), first established in 1890, produces ordnance propellants and explosives. The main facility area is located on the Cornwallis Neck Peninsula in Maryland and is bounded by the Potomac River to the north and west, and by Mattawoman Creek to the south and east. Eighteen waste sites on the main area of NSWC Indian Head have been identified for remedial investigation and feasibility studies (RI/FS), and include the sites of primary concern to the National Oceanic and Atmospheric Administration (NOAA) — Sites 5, 8, 12, 39, 41, 42, 53, and 56. The remaining RI/FS sites at NSWC Indian Head are of secondary importance to NOAA based on a lower extent of contamination and limited pathways for migration of contamination from those sites to NOAA trust resource habitats.

The resources of concern to NOAA include trust habitats in Mattawoman Creek plus associated ponds and wetlands. These areas provide nursery and adult habitat for numerous trustee species. Mattawoman Creek is a spawning area for several anadromous species, including blueback herring, white perch, and gizzard shad. The value of these resources is further recognized by the state since Cornwallis Neck Marshes at NSWC Indian Head have been designated as a Natural Protection Area by the Maryland Department of Natural Resources. Data indicate that contaminants have migrated from hazardous waste sites at NSWC Indian Head to these habitats.

The primary contaminants of concern are lead, mercury, and silver. These contaminants are found in surface waters and sediments of NOAA trust habitats at concentrations which indicate a threat to aquatic organisms when compared to NOAA screening guidelines. In addition, concentrations similar to those measured in the sediments and surface waters near NSWC Indian Head, have been reported in literature to be toxic to species of fish and invertebrates known to be present in those habitats.

SITE HISTORY

The NSWC Indian Head naval station consists of two areas located on two separate peninsulas along the eastern shore of the Potomac River in Charles County, MD (Figure 1). The main area covers approximately 930 hectares on the Cornwallis Neck Peninsula, and is bounded by the Potomac River to the north and west, and Mattawoman Creek to the south and east. The Stump Neck Annex covers approximately 450 hectares on the Stump Neck Peninsula. This report addresses only those hazardous waste sites located on the main area of NSWC Indian Head. The Stump Neck Annex has a separate EPA Identification Number and its sites are being addressed under a Resource Conservation and Recovery Act (RCRA) Corrective Actions Permit (Halliburton NUS 1995).

NSWC Indian Head was established in 1890 as the Naval Proving Ground, and was initially used for field-testing projectiles and producing smokeless powder. During World War II, it served as a site for research in rocketry and rocket propellants. In the early 1960s, 23 new buildings were constructed for producing base propellant grain, nitroplasticizers, and space rocket and torpedo propellants. In 1992 the station became a division of the newly-formed Naval Surface Warfare Center. Currently, NSWC Indian Head provides services in energetics for all warfare centers. The station researches, develops, tests, and evaluates energetic materials and ordnance devices and components, including chemicals, propellants and propulsion systems, explosives, pyrotechnics, warheads, and simulators (Brown and Root 1996a).

A site management plan was prepared in 1995, which identified 57 waste sites at Indian Head (Halliburton NUS 1995a). Nine of these sites (Sites 30-38) are located on Stump Neck Annex, which is considered a separate hazardous waste area. Of the 48 sites at the main area of Indian Head, eighteen waste sites have been identified as RI/FS sites (Sites 5, 8, 12, 39, 41-50, 53-56); three have been identified as needing no further action (Site 40, 51, and 52); 26 sites will be subjected to a site screening process, and an Engineering Evaluation/Cost Analysis will be initiated for Site 57. This report addresses only the 18 RI/FS sites at Indian Head (Figure 2). Because limited data have been collected to date at Sites 1-29 and Site 57, these sites are not evaluated in this report. In addition, Sites 40, 51, and 52 are not addressed because these sites are not a primary concern to NOAA based on information in the site management plan (Halliburton NUS 1995a). Table 1 presents background information for the 18 sites addressed in this report.

PATHWAY CHARACTERIZATION

Surface water runoff and groundwater migration are the primary contamination transport pathways to NOAA trust habitats. Waste waters consisting of industrial, sanitary, and storm effluents from the station are discharged either directly to, or via tributaries to, either the Potomac River or Mattawoman Creek (Brown and Root 1996b).

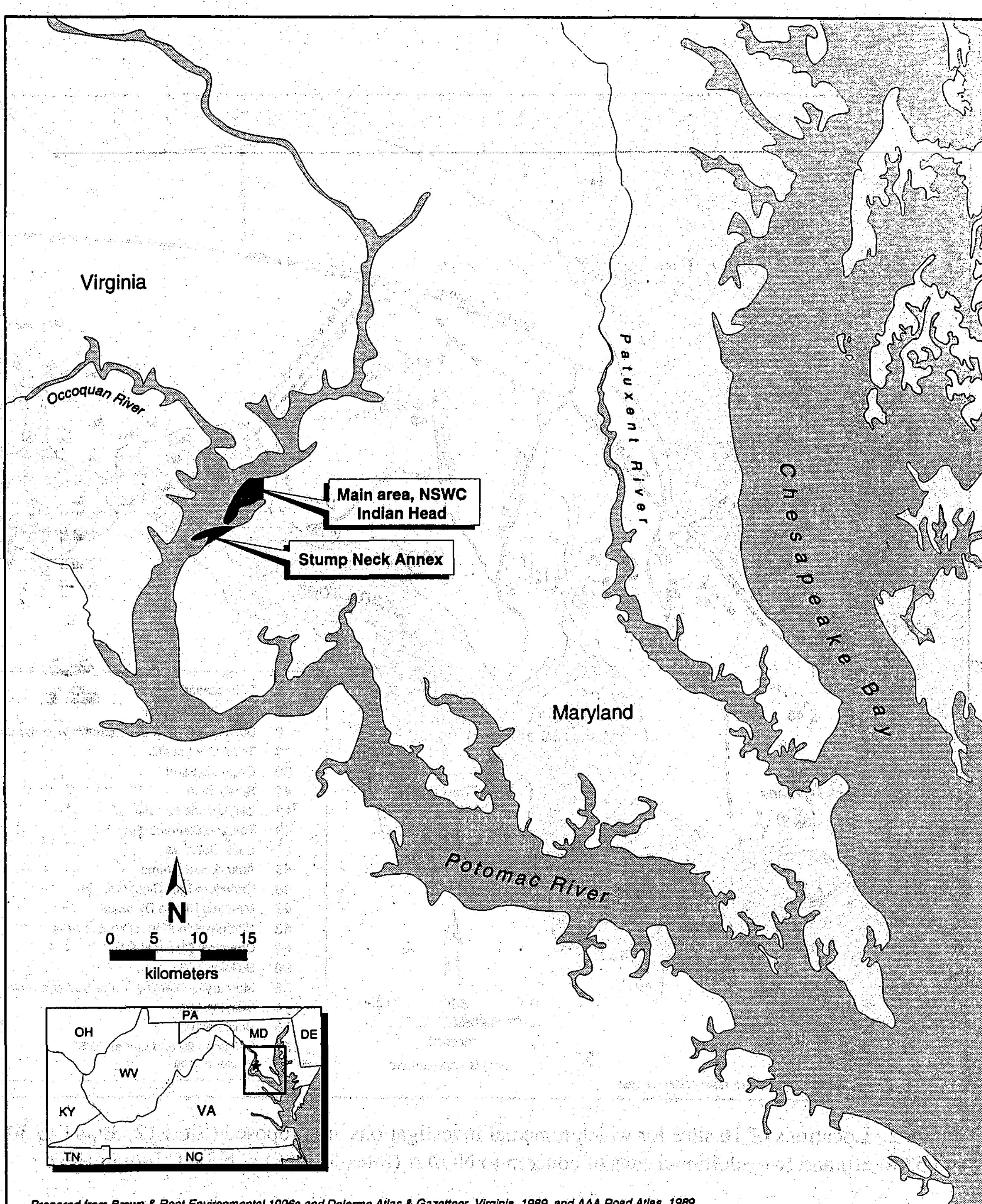

Figure 1. Location of NSWC Indian Head, Indian Head, Maryland.

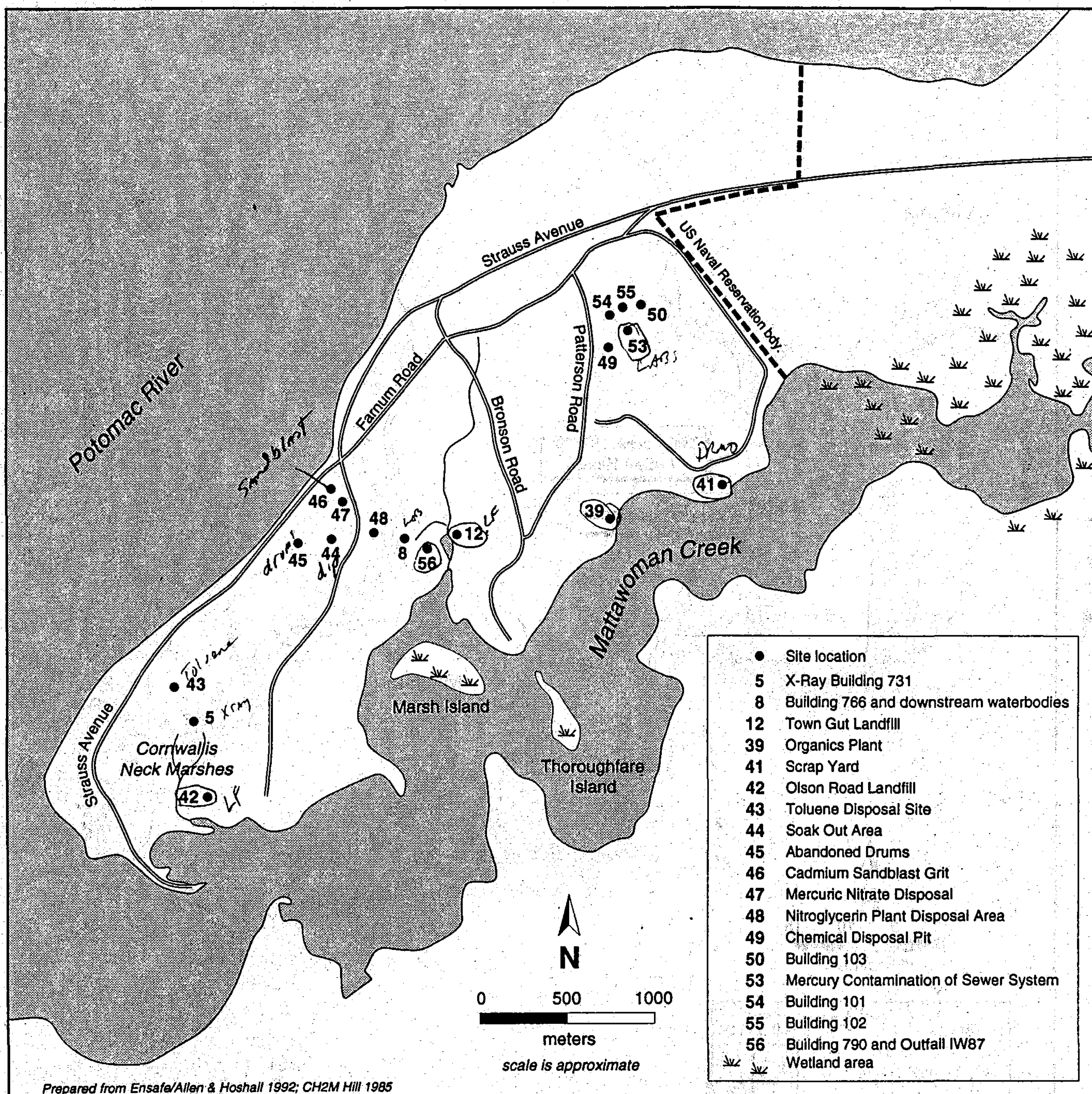

Figure 2. Locations of 16 sites for which remedial investigations are proposed (Sites 12, 39, 41 to 50, and 53 to 56) and two additional sites of concern to NOAA (Sites 5 and 8) at NSWC Indian Head.

Table 1. Descriptions of 16 sites for which remedial investigations are proposed (Sites 12, 39, 41-50, and 53-56) and two additional sites of concern to NOAA (Sites 5 and 8)

Site	Dates of Operation	Disposal Activities	Contaminants of Concern	Contaminant Migration Pathways	Site of Primary Concern to NOAA?
5–X-Ray Building 731	1953 to 1965	Silver-laden photographic processing wastewaters were discharged from Building 731 into two drainage swales.	Silver	Drainage swales lead to a natural stream channel and then to a marsh on the north bank of Mattawoman Creek.	Yes
8–Building 766; including drainageways downstream to Site 8 Pond and marsh	1953 to 1981	Mercury used in laboratory tests in Building 766 was disposed through drains and discharged to Site 8.	Mercury, lead	Tidal pond and marsh discharge into Mattawoman Creek.	Yes
12–Town Gut Landfill	1968 to 1980	Solid waste, paint and varnishes, demolition waste, and chemical wastes were disposed of in this 0.8-hectare landfill.	Trace elements	Adjacent to tidal wetlands which drain into Mattawoman Creek.	Yes
39–Organics Plant	1961 to 1965	Accidental releases to Mattawoman Creek occurred via an outfall from the plant.	Silver, acetal/formal, dinitropopanol, ethylene dichloride, methylene chloride, and formaldehyde	A discharge pipe conveys flow to Mattawoman Creek.	Yes
41–Scrap Yard	Unknown to present	Metal materials and scraps, including empty storage drums, spent lead batteries, and 17 PCB-contaminated electrical transformers have been stored on the site. The transformers are believed to have leaked.	Trace elements, PCBs, SVOCs	Adjacent to Mattawoman Creek.	Yes

Table 1, cont.

42–Olson Road Landfill	1982 to 1987	Unknown; the 0.8-hectare landfill was used as an unauthorized solid waste disposal area.	Trace elements, SVOCs	Drainage swales flow into two ponds and subsequently Mattawoman Creek.	Yes
43–Toluene Disposal Site	Late 1950s to 1989	About 87,000 to 114,000 liters of solvents, used to remove propellants and oily residues from various metal parts, were disposed of on the ground and in a drainage ditch.	VOCs	Surface water flow is limited near the site.	No
44–Soak Out Area	Late 1960s to early 1970s	Two 55-gallon drums welded together were thought to contain a polysulfide solvent and mercaptan. Solvents were spilled directly on the ground around the tank.	VOCs, mercaptan	Surface water flow is limited near the site.	No
45–Abandoned Drums	From about 1975 to present	About 20 empty rusted drums were present at this site, and may have originated from Site 44. The drums have been removed.	Unknown	The site is near a small wetland area; not clear if this drains to the Potomac River.	No
46–Cadmium Sandblast Grit	Mid-1960s to mid-1970s	Approximately 114 liters of grit from sandblasting rocket motor catapult tubes were disposed of monthly.	Cadmium, other trace elements	Limited surface water runoff from the site may occur; not clear if this drains to the Potomac River.	No
47–Mercuric Nitrate Disposal Area	1957 to 1965	Over an eight-year period, approximately 124 kg of mercuric nitrate were poured onto the ground over limestone chips.	Mercury, trace elements	Drainage ditch from the site usually exhibits low flow; eventually drains to Mattawoman Creek via other ditches.	No
48–Nitroglycerine Plant Disposal Area	Unknown	Miscellaneous debris was disposed of, including solvent containers, bottles, metal scrap, and refuse, over approximately 465 m^2.	Unknown	Surface runoff drains into a stream which flows into the pond adjacent to Site 12, about 0.8 km away.	No

Table 1, cont.

49–Chemical Disposal Pit	Unknown to 1970s	Laboratory wastes were disposed of in a 0.8-m diameter pit which drained to the sanitary sewer system.	Trace elements, VOCs, SVOCs	The underground sewer system does not discharge to any areas where contaminants could migrate to aquatic habitats.	No
50–Building 103, Crawl Space	1902 to 1985	Spent mercury was spilled down sink drain lines directly to the soil surface beneath Building 103.	Mercury, trace elements	No contaminant migration pathways from the building to outside habitats exist.	No
53–Mercury Contamination of the Sewage System	Unknown	Mercury was discharged into storm sewer lines and sanitary sewer lines from Buildings 101, 102 and 103. It is estimated that 12,700 kg of mercury were discharged to the drain lines from Building 102 from 1909 to 1986.	Mercury, trace elements, SVOCs	Sanitary sewage is pumped to Station treatment facility. Storm water flows to a discharge outfall that was not identified.	Yes
54–Building 101	Unknown	Mercury was discharged into the building through leaks in drainage pipes.	Mercury, trace elements, SVOCs	There are no pathways from this buliding to NOAA trust resource habitats.	No
55–Building 102	1909 to 1989	Metallic mercury leaked from the first floor into the basement of the building.	Mercury, trace elements, SVOCs	There are no pathways from this building to NOAA trust resource habitats.	No
56–Building 790 and IW87 - Lead Contamination	1953 to present	An outfall from the Biazzi Nitration Plant and Building 790, also known as NPDES sampling point IW87; discharges contained elevated lead concentrations.	Lead	Upstream from the pond adjacent to Site 12.	Yes

SOURCE: Halliburton NUS 1995a; Halliburton NUS 1993; CH2M Hill 1985.

Surface Runoff Pathway

A drainage divide extends down the length of Indian Head Peninsula, with surface water east of the divide flowing to Mattawoman Creek, and surface water west of the divide flowing to the Potomac River. Most of the surface water on the peninsula flows to Mattawoman Creek (Brown and Root 1996b). The Indian Head peninsula has gently rolling topography with elevations ranging from sea level to 34 m (Brown and Root 1996b). Generally, the land surface slopes to the east and southeast with slopes of 5 percent or less. The coast along the Potomac River is characterized by 12 to 15-m high bluffs, whereas the coast along Mattawoman Creek grades more gently except for a few areas with 3-12 m high bluffs (Brown and Root 1996b).

Groundwater Pathway

The surficial geology of the Indian Head Peninsula consists of fluvial and marine sedimentary deposits (Brown and Root 1996b). Shallow, unconfined groundwater occurs from near the ground surface down to approximately six meters. Typically, the shallow groundwater occurs in perched water-bearing zones and is recharged from infiltration (Brown and Root 1996b). Little data on groundwater levels and flow rates were available. It is assumed that shallow groundwater flow follows topography i.e., toward Mattawoman Creek east of the drainage divide, and toward the Potomac River west of the divide. Soils on the site are considered to be of low permeability (Brown and Root 1996b).

POTENTIALLY EXPOSED RESOURCES

Primary habitats of concern to NOAA include the surface waters, bottom substrates, and associated wetlands of the Site 8 Pond (described below), Mattawoman Creek, and the Potomac River. The area around NSWC Indian Head is highly productive, providing spawning and nursery habitat and adult forage for NOAA resources (Table 2). Mattawoman Creek includes tidal marshes and supports an excellent tidal fishery (Brown and Root 1996a). Of these, the Cornwallis Neck Marshes (Figure 2) have been designated as a Natural Protection Area (MDNR 1992, as cited in Brown and Root 1996a).

Habitat Characterization

Mattawoman Creek

The lower portion of Mattawoman Creek is a tidal freshwater stream for most of the year. During periods of low freshwater flow, usually late summer and early fall, salinity reaches 1 part per thousand (McGinty pers. comm. 1996, USFWS 1990). Extensive wetlands are found around Mattawoman Creek (USFWS 1990, Brown and Root 1996b). Tidal freshwater wetlands are characterized by emergent vegetation near shorelines and the presence of submerged aquatic vegetation (Lippson et al. 1979, USFWS 1990).

Table 2. NOAA trust resources that inhabit or are likely to inhabit the surface waters and tidal marshes of Mattawoman Creek and the Potomac River in the vicinity of NSWC Indian Head

		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning	Nursery Ground	Adult Forage	Comm.	Recr.
ANADROMOUS /CATADROMOUS SPECIES						
Atlantic sturgeon	*Acipenser oxyrhynchus*	◆	◆	◆		
Blueback herring	*Alosa aestivalis*	◆	◆	◆		
Alewife	*Alosa pseudoharengus*	◆	◆	◆		
Hickory shad	*Alosa mediocris*	◆	◆	◆		◆
American shad	*Alosa sapidissima*	◆	◆	◆		
American eel	*Anguilla rostrata*		◆	◆		
Gizzard shad	*Dorosoma cepedianum*	◆	◆	◆		
White perch	*Morone americana*	◆	◆	◆	◆	◆
Striped bass	*Morone saxatilis*	◆	◆	◆	◆	◆
MARINE/ESTUARINE SPECIES						
Bay anchovy	*Anchoa mitchilli*	◆	◆	◆		
Atlantic menhaden	*Brevoortia tyrannus*	◆	◆	◆		◆
Killifish	*Fundulus* spp.	◆	◆	◆		
Spot	*Leiostomus xanthurus*	◆	◆	◆		◆
Silversides	*Menidia* spp.	◆	◆	◆		
Atlantic croaker	*Micropogonias undulatus*	◆	◆	◆		◆
Winter flounder	*Pleuronectes americanus*	◆	◆	◆		◆
Hogchoker	*Trinectes maculatus*	◆	◆	◆		
INVERTEBRATE SPECIES						
Blue crab	*Callinectes sapidus*	◆	◆	◆	◆	◆
Atlantic rangia	*Rangia cuneata*	◆	◆	◆		

SOURCE: Thomas pers. comm. 1996, Brown and Root Environmental 1996b, USFWS 1990

Sediments in the main channel of Mattawoman Creek near Sites 39 and 41 range from coarse-grained sands to large pebbles, and along the shoreline range from medium-grained sands to pebbles. Tidal flats contain fine-grained sediments comprised of silts and clays (Halliburton NUS 1993). The substrate of the main channel of Mattawoman Creek is a mixture of silty sand toward the head and gravel and cobble toward the mouth (McGinty pers. comm. 1996)..

Wetland vegetation of Mattawoman Creek is primarily composed of large stands of jewelweed, alger, marsh cattail, weedgrass, sedge, three square bulrush, wild rice, saltmarsh cordgrass, smartweed, and marsh mallow (Brown and Root 1996b). These wetlands are very important as they support a diverse and productive ecosystem (USFWS 1990). In general, tidal marshes are necessary for fish species that use the area for spawning, as a nursery zone and juvenile habitat, and year-round for food and protection (Mitsch and Gosselink 1986). Fish and invertebrate species benefit from both the shelter afforded by marshes and the organic production exported from them (Heinle et al. 1977, Turner 1977, Thayer et al. 1979). Juvenile fish and invertebrates are generally most abundant in the shallow areas, often using submerged marsh vegetation for protection from predators.

Potomac River

The Potomac River near the facility is considered mesohaline, and salinities fluctuate with rainfall, urban runoff, and saltwater intrusion (Thomas pers. comm. 1996). Substrate in the main channel of the Potomac River is sand with small pebbles and cobble. Along the shoreline, the substrate is predominantly mud with pebbles and cobble, with silt likely in depositional areas (Bossart pers. comm. 1996).

Site 8 Pond

The Site 8 Pond, located about midway along the south site of the Cornwallis Neck Peninsula, is approximately 220 m long and varies from 30 to 60 m wide (Figure 3). The pond receives drainage from several sites on Indian Head NSWC and drains to Mattawoman Creek. The pond is a natural sediment trap which retains silt, detritus, and organic matter from upstream because the velocity of the stream is reduced as it widens and flows into the marsh and pond (Halliburton NUS 1995c).

The Site 8 Pond is assumed to be a predominantly freshwater system based on the number of freshwater fish species that were collected at the site by USFWS and Halliburton as reported in Halliburton NUS (1995c).

The emergent macrophyte present in the pond appeared to be spatterdock or yellow pond lily (Bossart pers. comm. 1996, Perkowski pers. comm. 1996).

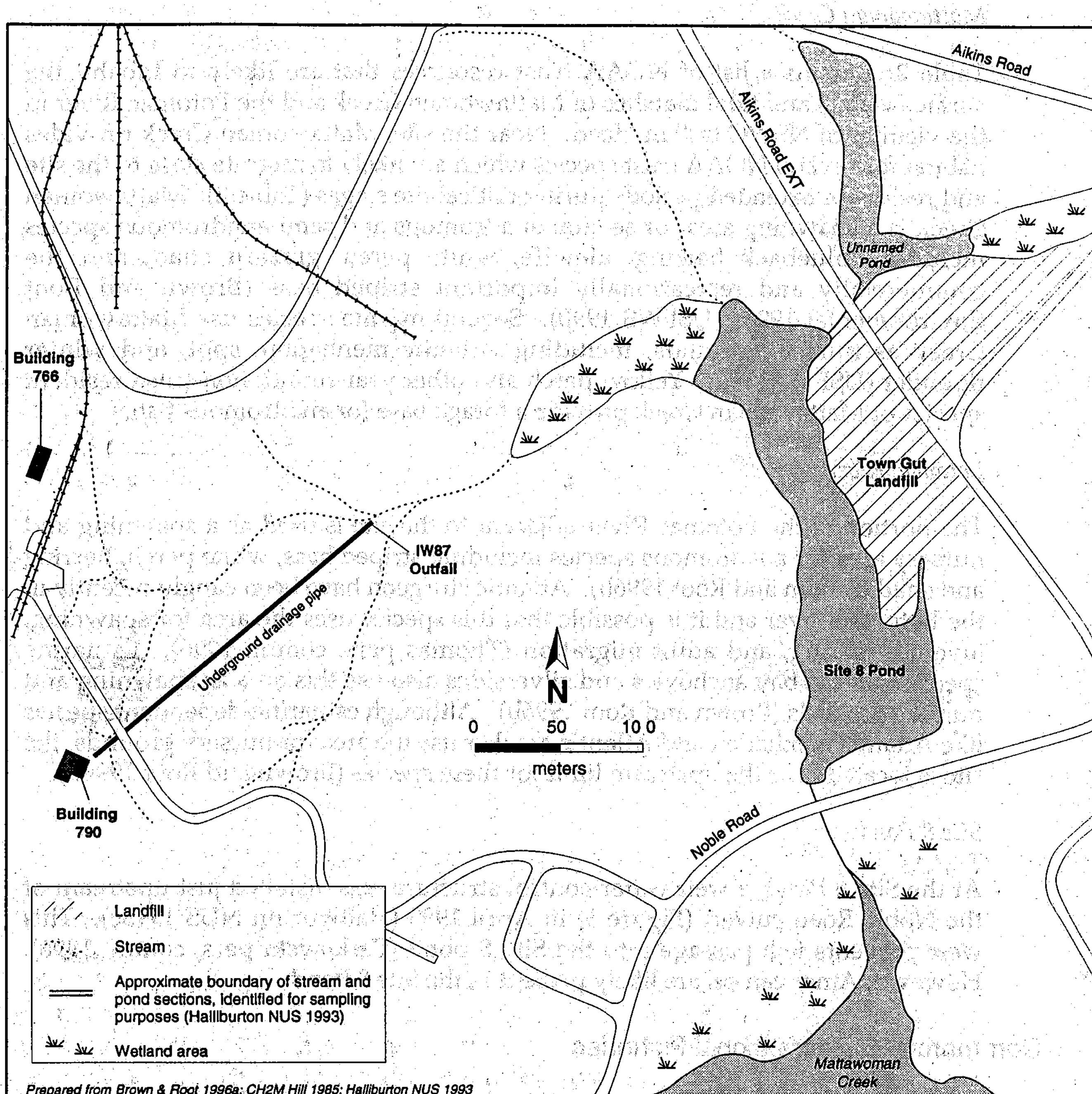

Figure 3. Location of sites within the watershed of the Site 8 Pond: Site 8 (Building 766, stream, and Site 8 Pond), Site 56 (Building 790 and IW87 Outfall), and Site 12 (Town Gut Landfill), Indian Head, Maryland

Resource Utilization

Mattawoman Creek

Table 2 contains a list of NOAA trust resources that are likely to inhabit the surface waters and tidal marshes of Mattawoman Creek and the Potomac River in the vicinity of NSWC Indian Head. Near the site, Mattawoman Creek provides habitat for several NOAA trust species which are likely to migrate close to the site and reside for extended periods during critical life stages (Table 2). Mattawoman Creek is a spawning area for several anadromous and semi-anadromous species including blueback herring, alewife, white perch, gizzard shad, and the commercially and recreationally important striped bass (Brown and Root Environmental 1996b, USFWS 1990). Several marine species use Mattawoman Creek as nursery grounds, including Atlantic menhaden, spot, and winter flounder (USFWS 1990). Yellow perch and other year-round, non-trust, resident species of Mattawoman Creek provide a forage base for anadromous fish.

Potomac River

The portion of the Potomac River adjacent to the site is used as a spawning and nursery area for anadromous species including striped bass, white perch, herring and shad (Brown and Root 1996b). Atlantic sturgeon have been caught recently in the Potomac River and it is possible that this species uses the area for spawning, juvenile rearing, and adult migration (Thomas pers. comm. 1996). Estuarine species such as bay anchovies and silversides also use this area as spawning and nursery grounds (Brown and Root 1996b). Although estuarine-dependent species like Atlantic menhaden and Atlantic croaker use the area for nursery grounds, the site is located near the upstream limit for these species (Brown and Root 1996b).

Site 8 Pond

At the Site 8 Pond, a weir water-control structure was installed just upstream of the Noble Road culvert (Figure 3) in April 1993 (Halliburton NUS 1995c). This weir prevents fish passage into the Site 8 pond (Perkowski pers. comm. 1996). However, American eel are likely present in the Site 8 Pond.

Commercial & Recreational Fisheries

In 1995, there were three trust species that were commercially targeted in the Potomac River: white perch, striped bass, and blue crab (Holbrook pers. comm. 1996).

There is a large recreational fishery for striped bass near Indian Head NSWC (McGinty pers. comm. 1996, Thomas pers. comm. 1996). Striped bass, white perch, Atlantic menhaden, spot, Atlantic croaker, and blue crab are the most popular sport fisheries in the area (Thomas pers. comm. 1996).

There are no health advisories for finfish or crab in the Potomac River or Mattawoman Creek near the site (Brohawn pers. comm. 1996). Because shellfish are not commercially harvested near the site, their quality is not monitored (Brohawn pers. comm. 1996).

Since January of 1995, a moratorium on fishing for American shad, hickory shad, and Atlantic sturgeon has been in effect for the entire Potomac River. The moratorium, issued by the Potomac River Fisheries Commission, bans the catch of those species due to depleted stocks. The moratorium also bans the incidental catch of those species which is more than 2% of the total catch of other species by volume and no more than one bushel.

CHEMICAL CONTAMINANTS OF CONCERN

To identify substances that might pose a threat to NOAA trust resources, this report screens contaminant concentrations found in surface and groundwater samples against applicable ambient water quality criteria (AWQC) for the protection of freshwater organisms, for those substances for which criteria have been developed (U.S. EPA 1993).[1] Regulatory criteria are less abundant for contaminated soil and sediments than for water. For screening purposes in this report, trace element contaminant concentrations in soils are compared to their average concentrations in soils of the earth's crust (Lindsay 1979).[2] Concentrations of contaminants in sediments are compared to the Effects Range-Low (ERL) concentrations reported by Long et al. (1995).[3]

Remedial investigations have not yet been conducted at any sites at NSWC Indian Head, although numerous preliminary site investigations have been conducted at various sites of concern to NOAA. Based on comparisons of available data to screening guidelines, primary contaminants of concern to NOAA appear to be trace metals, particularly lead, mercury, and silver. These contaminants have been detected at elevated concentrations in environmental media collected from on-site source areas, aquatic transport pathways, and aquatic habitats of NOAA trust resources, as discussed in the following sections.

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1 Because releases from hazardous waste sites are often continuous and long term, chronic AWQC were used. Surface water concentrations were compared directly with AWQC. Groundwater concentrations were also screened against AWQC. On the basis of dilution expected during migration and upon discharge to surface water, the screening value used for groundwater samples was 10 times the AWQC applicable to the local surface water.

2 NOAA screens soil concentrations only to estimate which trace elements may be elevated on site and represent sources for potential contaminant migration. Until regional baseline levels in soils are available, national averages are used as a benchmark for comparison purposes only. Soil concentrations are not used for estimating exposure levels to aquatic species.

3 The ER-L value is the concentration equivalent to that reported at the lower 10th percentile of the available sediment toxicity data screened for only those samples in which adverse biological effects were observed or predicted in the studies compiled by Long et al. (1995). As such, it represents the low end of the range of concentrations at which effects may occur.

Source and Pathway Characterization

Of the 18 sites assessed for this report (Table 1), eight appear to be potential major sources of contamination to NOAA trust habitats, based on the types and amounts of contaminants disposed of; the presence of pathways to NOAA trust resources; and the distance from the sites to important aquatic habitats. For the purpose of this report, these eight primary sources are divided into four groups based on their proximity to each other: 1) Sites 8, 12, and 56, which are in the watershed of the Site 8 Pond (Figure 3); 2) Sites 39 and 41, along the shoreline of Mattawoman Creek; 3) Sites 5 and 42, which drain into Mattawoman Creek near its mouth, and 4) Site 53, contamination of the storm and sanitary sewer system. Information on the locations of storm and sanitary sewer outfalls at Indian Head was not available. The remaining ten sites (Sites 43-50, 54, and 55), while located in watersheds that drain to Mattawoman Creek, have limited pathways for contaminant migration to the creek. In addition, the extent of contamination at most of these latter sites is relatively lower compared to the other eight, so they are considered of secondary importance as sources for this report.

Sites 8, 12, and 56

As shown in Figure 3, Sites 8, 12, and 56 are in the watershed of the Site 8 Pond. During confirmation studies conducted for Site 8 in 1984 and 1985, sediment and surface water samples were collected from the drainage pathways leading from Building 766 (CH2M Hill 1985). These samples were analyzed for mercury only. The highest concentration of mercury in sediment (1,100 mg/kg) was found at the sampling location closest to Building 766 in the upper section of the stream (Table 3; Figure 3). Mercury was also detected in surface water at its highest concentration (170 µg/L) at the same sampling location. As shown in Table 3, elevated concentrations of mercury were detected in both sediment and surface water throughout the upper, middle, and lower portions of the stream leading from Building 766 to the marsh and Site 8 Pond.

A characterization study of Site 8 conducted in 1993 included collection of numerous sediment samples for mercury analysis from the upper, middle, and lower portions of the stream draining from Building 766 to the marsh and Site 8 Pond (Halliburton NUS 1993). Two of these sediment samples were scanned for trace elements, while the others were analyzed only for mercury. Mercury was the only trace element detected in pathways from Building 766 to the pond at concentrations that exceeded its ERL concentration. The highest concentrations of mercury (maximum of 670 mg/kg) were detected in the upper portions of the stream (Table 3). In October 1994, mercury-contaminated soil containing concentrations above 10 mg/kg was removed from the upper section of the stream identified as Site 8 (Brown and Root 1996a). However, no additional details regarding this soil removal action were available for review.

Table 3. Maximum concentrations of mercury and trace elements detected in sediment (0 to 6 cm) and surface water collected during site characterization and confirmation studies for Site 8 at NSWC Indian Head

CONTAMINANT	UPPER STREAM		MID STREAM		LOWER STREAM		MARSH/ STREAM TRANSITION		POND		SCREENING GUIDELINE
	1984-1985	1993	1984-1985	1993	1984-1985	1993	1984-1985	1993	1984-1985	1993	ERL [A]
Sediment (mg/kg)											
n=	3	42		18	6	20	3	16	2	57	
Arsenic	NA	<1.3	NA	NA	NA	NA	NA	NA	32	37	8.2
Cadmium	NA	<0.86	NA	NA	NA	NA	NA	NA	2.0	<1.6	1.2
Copper	NA	<6.2	NA	NA	NA	NA	NA	NA	NA	70	34
Lead	NA	11	NA	NA	NA	NA	NA	NA	160	440	46.7
Mercury	1,100	670	11	<16	54	7.4	220	1.4	6.0	14	0.15
Silver	NA	<0.25	NA	NA	NA	NA	NA	NA	1.7	2.3	1.0
Zinc	NA	110	NA	NA	NA	NA	NA	NA	290	290	150
SURFACE WATER (µg/L)											
Mercury	170	NC	19	NC	110	NC	NA	NC	0.6	NC	0.012

SOURCE: Halliburton NUS 1993; CH2M Hill 1985.

NOTE: NC indicates that no samples were collected.
NA indicates that samples were not analyzed for that contaminant.

[a] Freshwater chronic ambient water quality criteria (U.S. EPA 1993).
[b] Count of sedimetn samples includes those characterzed as "soil/sediment."

At Site 12, the Town Gut Landfill, no sampling of the landfill itself has been conducted (Halliburton NUS 1995a). However, in a leachate sample collected during the Initial Assessment Study in 1983 along the bank of the landfill, arsenic was detected at a concentration of 31 mg/L; data were not reported for other contaminants (Brown and Root 1996b).

Lead is the primary contaminant of concern at Site 56. Maximum concentrations of lead detected in surface water and sediment samples collected from the site in 1993 were 4,400 µg/L and 18,200 mg/kg, respectively; the location of these samples was not presented (Halliburton NUS 1995a). Water discharging from Site 56 at the IW87 outfall has been monitored for lead concentrations since 1988 (Brown and Root 1996b). Results from this monitoring showed that the NPDES lead limit of 83 µg/L was frequently exceeded. The maximum concentration of lead detected at Outfall IW87 during NPDES monitoring was not presented.

Sites 39 and 41

Neither soil nor groundwater has been sampled at Site 39, the Organics Plant, to characterize sources or pathways of contamination. However, data collected in Mattawoman Creek, at the outfall of Site 39, indicate that the site may have been a source of contamination. Those data are presented in the following section on characterization of NOAA trust habitats.

At Site 41, the Scrap Yard, soil samples were collected from eight borings during a site inspection in 1992 (Ensafe/Allen & Hoshall 1992). In addition, groundwater samples were collected from three monitoring wells, and one water sample was collected from a large on-site puddle. PCBs and trace elements are the primary contaminants of concern at Site 41 (Table 4). Levels of copper and silver in both soil and groundwater exceeded screening guidelines. Arsenic, cadmium, lead, mercury, nickel, and zinc were also detected in soils at concentrations exceeding screening guidelines. DDT and its metabolites were detected in soils, at levels up to a couple parts per million. In the water sample collected on site, cadmium, lead, mercury, and silver were present at concentrations that exceeded their AWQC concentrations by 95, 230, 230, and 68 times, respectively. Total PCBs detected in the puddle water at 47 µg/L exceed the AWQC of 0.014 µg/L by over three orders of magnitude.

Sites 5 and 42

At Site 5 , sediment samples were collected in 1985 from the two drainage swales that lead from Building 731; these samples were analyzed for silver only (CH2M Hill 1985). In sediment from the eastern swale (Swale 1), concentrations of silver were as high as 475 mg/kg near Building 731, and were at 260 mg/kg in one composite sample collected from three locations along the entire length of the swale. The only sediment sample collected from the western swale (Swale 2) was composited with two other samples collected from the stream channel below the swale; the concentration of silver in this composite sample was 1,920 mg/kg.

Table 4. Maximum concentrations of contaminants detected in environmental media collected from Sites 39 and 41 at NSWC Indian Head compared to NOAA screening guidelines

Contaminant	Source and Pathway					Habitat		
	Soil (mg/kg)		Ground water (µg/L)	On-site Ponded Water (µg/L)		Sediment (mg/kg)		
	Site 41 n=8 locations	Screening Guideline [a]	Site 41 n=3 wells	Site 41 n=1 sample	AWQC	Site 39 n=6 samples	Site 41 n=11 samples	ERL
Arsenic	330	5	22	7.2	190	7.7	8.8	8.2
Cadmium	2.0	0.06	N/A	100	1.1[b]	1.0	3.8	1.2
Copper	63	30	140	150	12[b]	36	45	81
Lead	46	10	21	720	3.2[b]	90	110	46.7
Mercury	0.28	0.03	N/A	2.8	0.012	9.5	0.78	0.15
Nickel	53	40	110	40	160[b]	60	31	20.9
Silver	10	0.05	5.5	8.1	0.12	43	8.7	1.0
Zinc	97	50	670	1,200	110[b]	190	250	150
PCBs	ND	N/A	ND	47	0.014	N/A	ND	0.0027

SOURCE: Ensafe/Allen & Hoshall 1992.

NOTE: N/A - data or screening guidelines were not available
ND - contaminant was not detected; detection limit not given

a Average concentration in earth's crust (Lindsay 1979)

b Hardness-dependent criteria; 100 mg/L $CaCO_3$ assumed

Removal actions have been conducted for silver-contaminated sediment in both drainage swales at Site 5. The removal action for Swale 1 was completed in January 1993. According to the Removal Action Findings Report (ABB 1993), post-excavation field sampling confirmed that removal of the contaminated sediment with concentrations of silver above the action level of 10 mg/kg was achieved. The removal action at Swale 2 was completed in January 1995. Confirmatory sampling after excavation of these soils also indicated that the cleanup concentration of 10 mg/kg silver was achieved (Halliburton NUS 1995b).

A Site Investigation for Site 42 was conducted in 1991-2, and included collection of 75 soil samples from 24 borings, 7 surface soil samples, 7 groundwater samples, and 8 sediment samples from drainage swales at the site (Brown and Root 1996b). The only data available for review were presented in the Work Plan for the RI (Brown and Root 1996b) as an example of findings. These data indicate that the primary contaminant of concern at Site 42 is silver. Groundwater and surface soil data for silver were not presented. Sediments from the drainage swales were highly contaminated with silver; at four of the sampling locations concentrations ranged from 100 to 200 mg/kg, and at the other four locations concentrations ranged from 3.6 to 27 mg/kg.

Data from these two sites suggests a significant potential for migration of contaminants to the Cornwallis Neck Marsh area, and ultimately, Mattawoman Creek. Based on existing information, silver appears to be the only contaminant of concern to NOAA associated with these sites.

Site 53

In 1969, approximately 4.5 kg of mercury were recovered from a storm sewer manhole at this site. In early 1989, approximately another 0.45 kg of mercury were recovered from a sanitary storm sewer manhole (Brown and Root 1996b). During a Site Inspection in 1992, 13 soil samples were collected from borings adjacent to the sewer lines, and four sediment samples were collected from manholes. Mercury was not detected in any of the soil boring samples. Three of the four sediment samples contained mercury at concentrations ranging from 2.5 to 81 mg/kg (Brown and Root 1996b). These data indicate that the storm sewer system in this area appears to be structurally intact, yet it is a contaminant transfer pathway for mercury to its discharge point on Mattawoman Creek.

Habitat Exposure Characterization

Data from contaminant source areas and within contaminant migration pathways off site suggest that there are at least four locations for substantial contaminant transfer to the habitat areas of Mattawoman Creek. These locales are associated with Site 8 pond, Site 39, Site 41, and the Cornwallis Neck Marshes which are downgradient from Sites 5 and 42.

Site 8 Pond

Sediment samples were collected from Site 8 Pond and its marsh areas in 1984 and 1985 as part of separate confirmation studies for Sites 8 and 12. Numerous samples were analyzed for mercury, but only two samples (collected from the pond to evaluate Site 12) were analyzed for other trace elements. Similarly, in the 1993 Site Characterization study, numerous sediment samples were collected and analyzed for mercury, but only one sample was analyzed for additional trace elements. Maximum concentrations detected during these studies are presented in Table 3. The concentrations of mercury and lead exceeded their ERL concentrations by the greatest margin, followed by arsenic, silver, copper, zinc, and cadmium. Only one sediment sample was collected in 1985 downstream from the outlet of Pond 8 to Mattawoman Creek, below Noble Road. This sample contained 3.5 mg/kg mercury, indicating significant migration of at least mercury from the pond to the creek. Samples from six locations sampled in 1993 at, and downstream from, Noble Road indicated mercury was still present at concentrations up to 1.6 mg/kg. Only one surface water sample was collected from the pond, in 1985. It contained 0.6 µg/L mercury. This observation further suggests an aqueous contaminant migration pathway to Mattawoman Creek.

Mattawoman Creek near Sites 39 and 41

During a site inspection of Sites 39 and 41, surface sediment samples were collected from Mattawoman Creek (Ensafe/Allen & Hoshall 1992). At Site 39, one sample was collected at the outfall discharge point, another where the effluent enters the creek, and four samples from depositional zones along the main channel of the creek. Maximum concentrations of contaminants detected in the sediment samples from Site 39 are presented in Table 4.

At Site 41, 11 sediment samples were collected in depositional areas of Mattawoman Creek adjacent to the site. Maximum concentrations of contaminants detected in the sediment samples are also presented in Table 4. Appendix C of the Site Inspection Report (Ensafe/Allen & Hoshall 1992), which contains all analytical data results, was not available for review, so it was not possible to determine where the maximum concentrations were detected, or whether there is a gradient of contamination within the creek. The data indicate that silver and mercury are contaminants of major concern, particularly in Site 39 sediments. Maximum concentrations of silver (43 mg/kg) and mercury (9.5 mg/kg) in Mattawoman Creek were more than 40 and 60 times their respective ERL concentrations. DDT and metabolites were detected below screening values.

Mattawoman Creek near Sites 5 and 42

Drainage ditches from Site 5 flow into a stream channel which enters a tidal marsh adjacent to Mattawoman Creek. Sediment from this marsh was sampled in January 1984 and analyzed for silver only (CH2M Hill 1985). One composite sediment sample was collected from three stations in the marsh, and one discrete sample was collected from the discharge point of the marsh to Mattawoman Creek, near Site 42. The composite marsh sample contained 22 mg/kg silver, and the discrete sample at the mouth of the marsh contained 2.3 mg/kg silver. In addition, one surface water sample was collected where the marsh discharges into Mattawoman Creek; this sample contained 3 µg/L silver, well above the AWQC.

Site 53 Storm and Sanitary Sewer Outfalls

Information on the locations of storm and sanitary sewer outfalls at Indian Head, including the sewer and outfall which might release contaminants from the Site 53 area to Mattawoman Creek, was not available. It does not appear that any sampling has been conducted in Mattawoman Creek or the Potomac River to specifically address possible releases from Site 53 either. In addition, it was not possible to determine whether sediment sampling for other sites has addressed potential contamination related to Site 53.

EFFECTS ON HABITATS AND SPECIES

The contaminants of primary concern to NOAA are lead, mercury, and silver. This section discusses bioassessment studies conducted at the site, including surface water bioassays, benthic macroinvertebrate studies, and histopathological investigations of fish. Bioaccumulation studies, measuring concentrations of lead and mercury in fish tissues, are also discussed. These data provide some indication of the bioavailability of those contaminants, as well as a qualitative indication of exposure level. The last section, on predicted impacts, discusses data from the literature on effects of lead, mercury, and silver.

Measured Impacts

Surface water bioassays using invertebrates (*Ceriodaphnia dubia*) and fathead minnows (*Pimphales promelas*) were conducted with samples collected near Marsh Island in Mattawoman Creek in 1986 (USFWS 1990). For both tests, organisms were exposed to 100% ambient water from the Marsh Island site, an upstream reference site, and a laboratory reference water sample. Measurement endpoints for the *Ceriodaphnia* test were survival and number of young produced, and endpoints for the *Pimphales* test were survival and growth. In addition, Microtox bacteria bioassays were conducted. The only test that indicated toxicity of Marsh Island surface water was the *Ceriodaphnia* test; the mean number of young produced was significantly reduced at Marsh Island (33.1) compared to the upstream reference site (36.3; probability level not reported). Reproduction in both groups was higher than the 25.9 young produced in the laboratory reference water. Surface water samples were not analyzed for contaminants. Sediment bioassays have not been conducted at NWS Indian Head.

A benthic macroinvertebrate monitoring study was conducted in the Site 8 Pond from January 1994 to February 1995 (Halliburton NUS 1995c). Seven transects of the pond were sampled five separate times over the sampling period. The macroinvertebrate benthic population of both Site 8 Pond and Stump Neck Beaver Pond, a control site, contained low density and low diversity of organisms. At both sites the benthic population consisted primarily of oligochaetes and chironomids. Statistical differences were not reported. The biomonitoring report concluded that low density and diversity of benthic communities are typical of tidal freshwater marshes and ponds of the east coast which contain featureless sand and mud substrates (Halliburton NUS 1995c).

Brown bullhead collected from Mattawoman Creek in the vicinity of Marsh Island and from a reference location upstream from NSWC Indian Head were examined histopathologically (USFWS 1990). Results indicated chronic health effects at Marsh Island. Nearly twice as many lesions were found on fish from Marsh Island (91) than on fish from the reference site (55). In addition, there were significantly more non-parasitic lesions on Marsh Island fish than on reference fish (62 vs. 21), but there was no statistical difference in the number of parasitic lesions. The study concluded that the significantly higher incidence of non-parasitic lesions at Marsh Island most likely reflects exposure to contaminants.

Three fish tissue studies have been conducted at NSWC Indian Head. During the earliest study, in 1985, the U.S. Fish and Wildlife Service (USFWS) measured concentrations of mercury in fish collected from Mattawoman Creek (USFWS 1990). From 1987 to 1991, the USFWS conducted a 5-year monitoring program for mercury in fish tissue from Mattawoman Creek (USFWS 1992). Most recent was a biomonitoring study conducted from 1992 through 1994 in which fish from Site 8 Pond were collected and analyzed for lead and mercury (Halliburton NUS 1995c). Results from these studies are shown in Table 5.

For both lead and mercury in whole-body fish samples, maximum concentrations were always higher in the site-related samples than in the reference samples for those species where samples were collected at both site-related and reference sites. These data confirm that exposure to these metals is greater in Site 8 Pond and Mattawoman Creek near the pond discharge than in reference areas.

Predicted Impacts

On an individual basis, each of the substances observed in environmental media collected from NSWC Indian Head can adversely affect ecological receptors. The combination of substances may result in additive effects, synergistic effects (the overall effect is greater than expected on the basis of exposure to each substance individually), or antagonistic effects (the overall effect is less than additive). It is not possible to predict the actual effect of a mixture of contaminants on aquatic receptors because the overall effect depends on the toxicity of the chemicals in question, the specific physical and chemical conditions of the site, and internal synergistic/antagonistic effects within organisms. The simple comparisons presented below may thus underestimate the actual threat posed by contaminant releases.

Table 5. Concentrations of mercury and lead detected in whole-body fish samples collected from the Site 8 Pond and Mattawoman Creek during three investigations

	Mercury						Lead	
	1985 (mg/kg ww)		1987 - 1991 (mg/kg dw)		1992-1994 (mg/kg ww)		1992-1994 (mg/kg ww)	
Species	Marsh Island	Reference[a]	Marsh Island	Reference[b]	Site 8 Pond	Reference[c]	Site 8 Pond	Reference[a]
Bluegill	NA	NA	0.05-0.29	0.10	0.02-0.09	<0.02-0.04	<0.2-0.4	<0.2
Brackish water clam	ND-0.025	NA	NA	NA	NA	NA	NA	NA
Brown bullhead	ND-0.072	NA	NA	NA	0.04-0.06	<0.02-0.05	0.5-1.2	0.3
Gizzard Shad	ND-0.034	ND-0.028	NA	NA	NA	NA	0.7-1.6	NA
Channel catfish	0.04-0.068	0.028-0.061	0.10-0.36	0.10	NA	NA	NA	NA
Largemouth bass	NA	NA	0.36-0.77	0.37	NA	0.10-0.29	<0.2-0.7	<0.2
Mosquitofish	NA	NA	NA	NA	0.06-0.27	NA	0.3	NA
Spot	ND-0.035	NA	NA	NA	NA	NA	NA	NA
White perch	0.027-0.072	NA	NA	NA	NA	NA	NA	NA

SOURCE: USFWS 1990; USFWS 1992; Brown and Root 1995; Halliburton NUS 1995c.

NOTE: ND- contaminant was not detected; detection limits were not specified.
NA - samples were not analyzed for that contaminant.

a Upstream from NSWC Indian Head in Mattawoman Creek
b Nanjamoy Creek
c Stump Neck Beaver Pond and Mattawoman Creek

Lead

Lead is toxic to most organisms, although its toxicity in aquatic environments depends largely on the chemical form. Organolead compounds such as tetramethyl and tetraethyl lead are the most toxic. Inorganic forms of lead also elicit toxic responses, but at higher concentrations than organolead compounds (Eisler 1988). Organolead compounds bioaccumulate rapidly and to high concentrations; these compounds tend to concentrate in the fatty tissue of aquatic organisms. There is no evidence, however, of biomagnification of lead up the food chain in the aquatic environment.

The only surface water samples collected from NWSC Indian Head that were analyzed for lead were those collected from Site 56. A concentration of 4,400 µg/L was reported, although it was not clear where this sample was collected (Halliburton NUS 1995a). For comparison, it has been shown that chronic exposure of mummichog to a concentration of 100 µg/L resulted in spinal deformities (U.S. EPA 1984). Mud crab (*Rhithropanopeus harrisii*) experience delayed larval development when exposed to 50 µg/L lead. In an acute toxicity study, lead in marine water was lethal to 50 percent of the test population of blue mussel (*Mytilus edulis*) larvae at 480 µg/L and to 50 percent of the test population of mummichog at 320 µg/L (U.S. EPA 1984).

Maximum concentrations of lead in sediment at NWS Indian Head were measured at 440 mg/kg in the Site 8 Pond (Halliburton NUS 1993), and 110 mg/kg in Mattawoman Creek adjacent to Site 41 (Ensafe/Allen & Hoshall 1992). Limited data on the toxicity of lead-contaminated sediments are available. Exposure to sediment from Los Angeles Harbor, California containing lead at a concentration of 41 mg/kg resulted in greater than 50 percent mortality to grass shrimp (Lee and Mariani 1977). In Baltimore Harbor, Maryland, lead in sediment at concentrations of 210 to 510 mg/kg was associated with toxic effects in mummichog (Tsai et al. 1979).

Mercury

Mercury and its compounds have no known biological function, and their presence in the cells of living organisms is undesirable and potentially hazardous. Forms of mercury with relatively low toxicity can be transformed into forms which are highly toxic, such as methyl mercury, through physical, chemical, and biological processes. Mercury can be bioconcentrated in organisms and biomagnified through food chains. Mercury is a mutagen, teratogen, and carcinogen, and it causes embryocidal, cytochemical, and histopathological effects. Methylmercury is the most hazardous mercury species because it is highly stable and readily bioaccumulates even when present at low concentrations. Mercury compounds in an aqueous solution are chemically complex. A wide variety of chemical species can be formed, depending on pH, alkalinity, redox, and other variables (Eisler 1987).

The concentration of mercury (0.6 µg/L) detected in the Site 8 Pond was more than an order of magnitude greater than the chronic AWQC for mercury (0.012 µg/L) developed by the U.S. EPA to protect freshwater organisms (U.S. EPA 1993). In the lower stream at Site 8, which discharges into the Site 8 Pond, the concentration of mercury in surface water was as high as 110 µg/L. In a chronic toxicity study, exposure to mercury at a concentration of 5.0 µg/L for 60 days altered the blood chemistry in striped bass (Dawson 1982), a species found in the vicinity of the site. Methylmercury is more acutely toxic to fish than inorganic mercury, but was not measured during site investigations. Acute toxicity of inorganic mercury to aquatic organisms may be observed at a concentration as low as 0.1 µg/L (Eisler 1987).

In the sediment samples from the Site 8 Pond at NSWC Indian Head, the maximum concentration of mercury was 14 mg/kg; sediments from Mattawoman Creek adjacent to Site 39 contained mercury at a concentration of 9.5 mg/kg. When compared to effects data for mercury, these site-related concentrations indicate a potential risk to NOAA trust resources. For example, in Baltimore Harbor, Maryland, mercury in sediment at concentrations ranging from 0.4 to 1.6 mg/kg was associated with toxic responses in mummichog (*Fundulus heteroclitus*) (Tsai et al. 1979). Mortality to 10 percent of grass shrimp (*Palaemonetes pugio)* was observed in Stamford, Connecticut sediments containing mercury at a concentration of 0.2 mg/kg (Lee and Mariani 1977).

Silver

Silver is very toxic to aquatic life but does not appear to be highly mobile under typical conditions in many aquatic habitats. Uptake by aquatic organisms appears to be almost entirely from the dissolved form in the water column; little evidence exists to support the general occurrence of biomagnification of silver within marine or freshwater food webs (Connell et al. 1991). Acute responses have been observed at concentrations of 4.1 µg/L, with chronic responses observed at 0.12 µg/L in freshwater environments. Toxic responses to silver have been reported at concentrations as low as 0.25 µg/L for freshwater invertebrates and 4.7 µg/L for saltwater species (U.S. EPA 1980). Silver was not measured in any surface water samples collected from NOAA trust resource habitats at the NSWC Indian Head installation.

Sediments contaminated with silver have been shown to elicit toxic responses at relatively low concentrations; sediment bioassays suggest that chronic effects can occur at concentrations as low as 1 mg/kg (McGreer 1979). In comparison, sediment collected from NSWC Indian Head contained silver at 43 mg/kg in one sample from Mattawoman Creek, and 22 mg/kg in a composite sample collected from a tidal marsh adjacent to Mattawoman Creek, downgradient from Sites 5 and 42.

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NOAA

PRELIMINARY NATURAL RESOURCE SURVEY

Naval Surface Warfare Center, Indian Head Division
Indian Head, Maryland — Cerclis # MD7170024684
November 1996 — Site ID:

SUMMARY REPORT

SITE CLASSIFICATION: POTENTIAL PAST INJURY/FUTURE INJURY POTENTIAL

Injury to adult and juvenile populations of NOAA trust resources, plus their supporting habitats, is predicted to have occurred; however, biological data (*e.g.*, bioassays, community analyses) do not exist to provide firm confirmation of this hypothesis. The site has the potential for causing injury, if specific actions are not taken to control hazardous materials on site, and impacts to fish have been observed associated with elevated levels of sire-related contaminants. Continuing injury could be adequately addressed as part of remedial action at the site. Significant residual injury to resources after all remedial actions at all operable units are completed can be prevented.

SUBSTANTIATION OF NOAA POSITION

The major areas of concern to NOAA at this installation are trust habitats in Mattawoman Creek plus its associated ponds and wetlands. Mattawoman Creek is a spawning area for several anadromous species, including blueback herring, white perch, and gizzard shad. This area also provides nursery and adult forage habitat for numerous trustee species. The Cornwallis Neck Marshes at NSWC Indian Head designation as a Natural Protection Area by the Maryland Department of Natural Resources recognizes the value of these aquatic habitats.

The available data indicate that contaminants have migrated from hazardous waste sites at NSWC Indian Head to aquatic habitats. The primary contaminants of concern are lead, mercury, and silver. These contaminants are found in surface waters and sediments of NOAA trust habitats at concentrations which indicate a threat to aquatic organisms when compared to NOAA screening guidelines. In addition, literature describing studies performed elsewhere indicate that these contaminants, at concentrations similar to those measured in the sediments and surface waters near NSWC Indian Head, were toxic to species of fish and invertebrates known to be present in those habitats. PCBs and DDT are also possible contaminants of concern to NOAA.

Fish collected in the vicinity of Marsh Island had twice as many lesions as reference fish and thus exhibited chronic health effects. The study concluded that the significantly higher incidence of non-parasitic lesions at Marsh Island most likely reflects exposure to contaminants. Three fish tissue studies have been conducted at NSWC Indian Head. Body burdens of both lead and mercury in whole-body fish samples were always higher in the site-related samples than in the reference samples. These data confirm exposure to these metals is greater in Site 8 Pond and Mattawoman Creek near the pond discharge than reference areas.

ADDITIONAL INFORMATION REQUIREMENTS

Additional sampling has been proposed at six of the eight sites of primary concern to NOAA (Sites 12, 39, 41, 42, 53, and 56) as part of remedial investigations (RIs) to be conducted (Brown & Root 1996). Table 1 presents a summary of the work plan and number of samples proposed for collection at each of these sites. The following sections provide recommendations for additional information needed to determine a remedy that would protect NOAA trust resources. Because the sites of known concern to NOAA involve trace elements as the primary contaminant, measurements of simultaneously extracted metals and acid volatile sulfide (SEM/AVS) should be conducted in any subsequent investigations to provide information regarding availability of certain metals.

Sites 8, 12, and 56

As previously mentioned, additional sampling at Site 8 was not addressed in the RI work plan. The RI Work Plan noted that soil containing more than 10 mg/kg mercury was removed from the upper section of the stream identified as Site 8, but no additional details were available. Analytical data should be provided to show that the 10 mg/kg cleanup goal was achieved.

Sampling proposed for Site 12 focuses on the landfill as a contributory source of contamination to the Site 8 Pond, since sampling of the landfill itself has not been previously conducted. The proposed sampling will include sediment and surface water samples collected around the edge of the landfill in the Site 8 Pond, as well as soil and groundwater samples. Samples will be analyzed for organic compounds, trace elements, pesticides, and PCBs. This sampling should provide sufficient information to estimate the potential for transport of contaminants from the landfill into the pond.

Proposed removal actions at Site 56 include soil removal from a pit located at the corner of Building 790 and along the entire open channel for Outfall IW87. Lead concentrations of 35 mg/kg in sediment and 82 µg/L in surface water have been established as cleanup goals (Brown and Root 1996). After this removal is completed, it is proposed that five sediment samples be collected from the stream channel downstream from Outfall IW87. The samples will be analyzed for trace elements. This sampling should provide information about whether the cleanup goal for lead has been met. This removal action and sampling effort will not address historical transport of contaminants into the Site 8 Pond however.

It is recommended that an ecological risk assessment (ERA) be conducted for the Site 8 Pond and portions of Mattawoman Creek downstream from the pond to determine the risk posed to aquatic organisms from contaminants that have been transported from Sites 8, 12, and 56. According to the RI work plan, an ERA is proposed for Site 12, the Town Gut Landfill area. This ERA should address the risk to NOAA trust resources in the Site 8 Pond and Mattawoman Creek from elevated concentrations of trace elements and organic compounds. Data collected to date indicate that several contaminants are present in sediment at concentrations exceeding screening guidelines. Therefore, the risk assessment should include bioassays to determine sediment toxicity.

Sites 5 and 42

Additional sampling at Site 5 was not addressed in the RI work plan, although sampling at Site 42, just downstream from Site 5, was proposed. Removal actions involving excavation of soil and sediment in source areas and pathways were recently conducted. However, it is likely that silver-contaminated sediments remain in the marsh downstream from Site 5. Given the marsh's designation as a Natural Protection Area by the Maryland Department of Natural Resources (Brown and Root 1996), the potential impact from residual silver contamination should be assessed.

The proposed remedial investigation does not adequately address potential migration of contaminants to Mattawoman Creek, because only two sediment samples will be collected in marsh areas immediately downstream from Site 42. The elevated concentrations of silver previously detected in sediment from drainage swales leading to the marsh (up to 200 mg/kg) indicate that silver has been transported to Mattawoman Creek at concentrations of concern. In addition, the limited sampling conducted in the marsh in 1984 found a maximum silver concentration of 22 mg/kg in a composite sediment sample, and 3 µg/L of silver in a surface water sample (CH2M Hill 1985). It is recommended that additional sediment and surface water sampling be conducted to determine the current extent of silver contamination in the marsh. Samples should be collected along a gradient from potential sources of contamination to the confluence with Mattawoman Creek, in addition to one or two samples from the creek itself. If concentrations of contaminants appear to pose a risk based on comparison to screening guidelines, then an ecological risk assessment may be indicated.

Sites 39 and 41

Previous sediment sampling conducted in Mattawoman Creek showed that mercury and silver were the trace elements of greatest concern based on comparison to NOAA sediment screening guidelines (Ensafe/Allen & Hoshall 1992). The RI/FS work plan proposed that eight sediment samples be collected from Mattawoman Creek near both Sites 39 and 41, near where samples were collected during a site inspection in 1992 (Ensafe/Allen & Hoshall 1992). Sediment would be analyzed for trace elements and organic compounds. Additional soil and groundwater samples will be collected at Site 41. These sediment, soil, and groundwater samples should provide additional information regarding the nature and extent of contamination at Sites 39 and 41. In addition, it is recommended that sediment samples be collected farther downstream from the Site 39 outfall than the 30 m distance proposed in the RI work plan, to determine the extent to which contaminants may have migrated downstream. Toxicity tests and bioaccumulation studies should be considered in conjunction with contaminant migration investigations.

Site 53

The proposed sampling of soil and groundwater for Site 53 addresses possible sources and pathways of contaminant migration from the site. However, sediment sampling should be conducted if the outfall from this site discharges to aquatic habitats. Depositional areas should be targeted during sampling. Mercury is the primary contaminant of concern, but a subset of samples should be analyzed for trace elements and organic compounds because so little is known about potential releases via the sewer system.

REMEDY AND MONITORING

Removal actions have been conducted at source and drainage areas of Sites 5 and 8. Analytical data have shown that cleanup goals were achieved at Site 5, but it is not clear whether such data were collected at Site 8. Monitoring of sediment and surface water at Sites 5 and 8 should be conducted for several years to determine the concentrations of contaminants remaining in source and drainage areas. Monitoring of sediment and surface water should also be conducted for several years at Site 56 after removal actions have been completed.

Results from additional studies and ERAs conducted in aquatic habitats of Site 8 Pond, Mattawoman Creek, and associated wetlands will need to be evaluated to determine protective remedies for those areas. Long-term monitoring following remedial actions is recommended in both source areas and NOAA trust resource habitats to evaluate the success of the chosen remedies.

NOAA CONTACTS:

Technical	Peter Knight	215•566•3321

REFERENCES

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Ensafe/Allen & Hoshall. 1992. Draft final site inspection report, phase II, Indian Head Division, Naval Surface Warfare Center. Washington, DC: Chesapeake Division Naval Facilities Engineering Command.

Table 1. Summary of additional sampling proposed at six sites at NSWC Indian Head as part of the RI/FS.

	Work Plan Summary	Soil	Ground Water	Surface Water	Sediment
Sites 8, 12, and 56					
Site 8	NA	NA	NA	NA	NA
Site 12	An investigation of surface and subsurface soils, sediments, surface water, and groundwater, will be conducted.	5 surface 4 subsurface	4	6	10
Site 56	The post removal action conditions will be evaluated by collecting sediment samples downgradient of Outfall IW87.	--	--	--	5
Sites 5 and 42					
Site 5	NA	NA	NA	NA	NA
Site 42	Surface water and sediment samples will be collected concerning contact pathway and transport off site. An additional round of groundwater sampling will be conducted.	--	4	4	2
Sites 39 and 41					
Site 39 and 41	The outfall will be further evaluated and sediment samples will be collected from Mattawoman Creek.	--	--	--	8
Site 41	The possibility of transport of contamination off site to Mattawoman Creek will be evaluated.	6 surface	4	--	--
Site 53					
Site 53	The sewer system will be evaluated to determine layout and condition. Soil and groundwater samples will be collected	--	1	--	8

SOURCE: Halliburton NUS 1996

NOTE: -- indicates that no sampling is proposed
NA - information was not available regarding additional sampling