Coastal and Estuarine

Hazardous Waste Site Reports

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Hazardous Waste Site Reports

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Contents

Acronyms and abbreviations

AST	Above-ground Storage Tank
AWQC	Ambient water quality criteria for the protection of aquatic life
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BHC	benzene hexachloride
BNA	base, neutral, and acid-extractable organic compounds
BOD	biological oxygen demand
BSL	brine sludge lagoon
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
cis-1,2-DCE	cis-1, 2-dichloroethylene
cm	centimeter
COC	contaminant of concern
COD	chemical oxygen demand
COE	U.S. Army Corps of Engineers
CRC	Coastal Resource Coordinator
DCE	1,2-dichloroethylene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DNAPL	dense non-aqueous phase liquid
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DOI	U.S. Department of the Interior
EPA	U.S. Environmental Protection Agency
ERL	Effects Range - Low
ERM	Effects Range - Median
ft	foot
ha	hectare
HMX	cyclotetramethylene tetranitramine
HRS	Hazard Ranking System
HUC	Hydrologic Unit Code
kg	kilogram
km	kilometer
L	liter
LNAPL	light, non-aqueous phase liquid
LOEL	lowest observed effects level
m	meter
mi	mile
m^3/second	cubic meter per second
µg/g	micrograms per gram (ppm)
µg/kg	micrograms per kilogram (ppb)
µg/L	micrograms per liter (ppb)
µR/hr	microroentgens per hour
MEK	methyl ethyl ketone a.k.a. 2-Butanone
MTBE	methyl tert-butyl ether
mg	milligram
mg/kg	milligrams per kilogram (ppm)
mg/L	milligrams per liter (ppm)
mR/hr	milliroentgens per hour
NAPL	non-aqueous phase liquid
NFA	no further action
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	operable unit
PAH	polycyclic (or polynuclear) aromatic hydrocarbon
PA/SI	Preliminary Assessment/Site Investigation

PCB	polychlorinated biphenyl
PCE	perchloroethylene (aka tetrachloroethylene)
pCi/g	picocuries per gram
PCP	pentachlorophenol
PNRS	Preliminary Natural Resource Survey
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand or parts per trillion
PRP	Potentially Responsible Party
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RDX	cyclonite
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SVOC	semi-volatile organic compound
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
TCL	Target Compound List
TNT	trinitrotoluene
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
<	less than
>	greater than

Introduction

The National Oceanic and Atmospheric Administration (NOAA) regularly evaluates hazardous waste sites that are proposed for addition to the National Priorities List (NPL), a U.S. Environmental Protection Agency (USEPA) listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose the greatest threat. The NPL is compiled under authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (United States Code, Title 42, Chapter 103). This volume identifies hazardous waste sites that could impact natural resources for which NOAA acts as a federal trustee under the National Oil and Hazardous Substances Pollution Contingency Plan (commonly referred to as the National Contingency Plan or NCP) (Code of Federal Regulations, Title 40, Part 300). NOAA serves as the federal trustee for marine and estuarine natural resources, including fish, shellfish, corals, marine mammals and the habitats that support these organisms.

Waste site reports of the type included in this volume often represent NOAA's first examination of a site. NOAA has published 396 waste site reports. Appendix Table 1 provides a summary of all the Coastal and Estuarine Hazardous Waste Site Reviews published to date.

Not all hazardous waste sites will affect NOAA trust resources; NOAA is concerned about sites located near trust resources and their habitats in states along the Atlantic Ocean including Puerto Rico and the Virgin Islands, along the Pacific Ocean including Hawaii and the Pacific Islands, the Gulf of Mexico, and the Great Lakes. NOAA works with USEPA to identify, assess, and mitigate the risks posed to natural resources from the release of hazardous chemicals and pollutants. NOAA also works directly with responsible parties to restore injured natural resources through habitat protection and restoration projects.

NOAA uses information from this volume to establish priorities for further site investigations. NOAA's Regional Resource Coordinators will follow up on sites that appear to pose ongoing problems. These scientists work with other agencies and trustees to communicate any concerns to the USEPA. They also review sampling and monitoring plans for the sites, help plan the investigation, and set objectives for site cleanups. This coordinated approach protects all natural resources, not just those for which NOAA is a steward. The USEPA can use the waste site reports to help identify the types of information that may be needed to complete environmental assessments of the sites. Other federal and state trustees can use the reports to help evaluate the potential impacts to their resources.

Each waste site report contains an executive summary and three distinct sections. The first section, Site Background, describes the site, previous site operations and disposal practices, and pathways by which contaminants could migrate to NOAA trust resources. The second section, NOAA Trust Resources, describes the species, habitats, and commercial and recreational fisheries near the site. The final section, Site-Related Contamination, identifies the contaminants of concern to NOAA and describes contaminant distribution at the site.

In addition to the waste site reports, this volume contains a list of acronyms and abbreviations (p. vii) and a glossary of terms (p. 127) that commonly appear throughout the reports. Appendix Table 1 lists all of the waste site reports that NOAA has published to date.

Chemical-Specific Screening Guidelines

Most waste site reports contain a table that focuses on the contaminants in different media that have potential to degrade natural resources. These site-specific tables highlight only a few of the many contaminants often found at hazardous waste sites. We compare the chemical concentrations reported in the tables against published screening guidelines for surface water, groundwater, soil, and sediment. Because contaminant releases from hazardous waste sites to the environment can span many years, we are concerned about long-term effects to natural resources. This is why we compare site contaminant levels against screening guidelines for chronic effects rather than for short-term effects.

Contaminant levels at each site are compared to site-specific or regional-specific criteria (or guidelines) when available. In the absence of such data, the contaminant levels detected in surface water and groundwater are compared to the ambient water quality criteria (AWQC; USEPA 2002, 2006); contaminants detected in sediment are compared to the effects range-low (ERL) values (Long and Morgan 1991) and threshold effects concentrations (TECs; MacDonald et al. 2000a). Only when there is a soil pathway for the migration of contaminants to NOAA trust resources do we examine contaminant levels in soil samples. Chemical concentrations in soil that exceed screening guidelines can indicate a potential source of contamination. Contaminants detected in soil are compared to ecological soil screening levels (USEPA 2008) and values from the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997). Any exceptions to these guidelines are noted in the contaminant table.

There are no national criteria for sediment comparable to the AWQC established for water. In the absence of national criteria, we compare sediment concentrations to several published screening guidelines (Long and Morgan 1991; MacDonald et al. 1996; MacDonald et al. 2000a; MacDonald et al. 2000b). Studies that associate contaminant concentrations in sediment with biological effects provide guidance for evaluating contaminant concentrations that could harm sediment-dwelling aquatic organisms. These studies include Long and MacDonald 1992; Long et al. 1995; MacDonald et al. 1996; Smith et al. 1996; Long et al. 1998; and Kemble et al. 2000. However, screening guidelines are often based on effects from individual chemicals. Their application may be difficult when evaluating biological effects that could be attributed to combined effects from multiple chemicals, unrecognized chemicals, or physical parameters that were not measured.

NOAA's National Status and Trends Program has used chemical and toxicological evidence from a number of modeling, field, and laboratory studies to determine the ranges of chemical concentrations associated with toxic biological effects (Long and Morgan 1991; Long and MacDonald 1992):

- No Effects Range — the range of concentrations over which toxic effects are rarely observed;
- Possible Effects Range — the range of concentrations over which toxic effects are occasionally observed; and
- Probable Effects Range — the range of concentrations over which toxic effects are frequently observed.

Two slightly different methods (Long and Morgan 1991; MacDonald 1993) were used to determine these chemical ranges. Long and Morgan (1991; Long et al. 1995) compiled chemical data associated with adverse biological effects. The data were ranked to determine where a chemical concentration was associated with an adverse effect (the ERL) — the lower 10th percentile for the data set in which effects were observed or predicted. Sediment samples were not expected to be toxic when all chemical concentrations were below the ERL values.

MacDonald (1993) modified the approach used by Long and Morgan (1991) to include both the “effects” and “no effects” data, whereas Long and Morgan used only the “effects” data. TELs were derived by taking the geometric mean of the 15th percentile of the “effects” data and the 50th percentile of the “no effects” data.

Although different percentiles were used for these two methods, their results closely agree (Kemble et al. 2000). We do not advocate one method over the other, and we use both screening guidelines to help focus cleanup efforts in areas where natural resources may be at risk from site-related contaminants.

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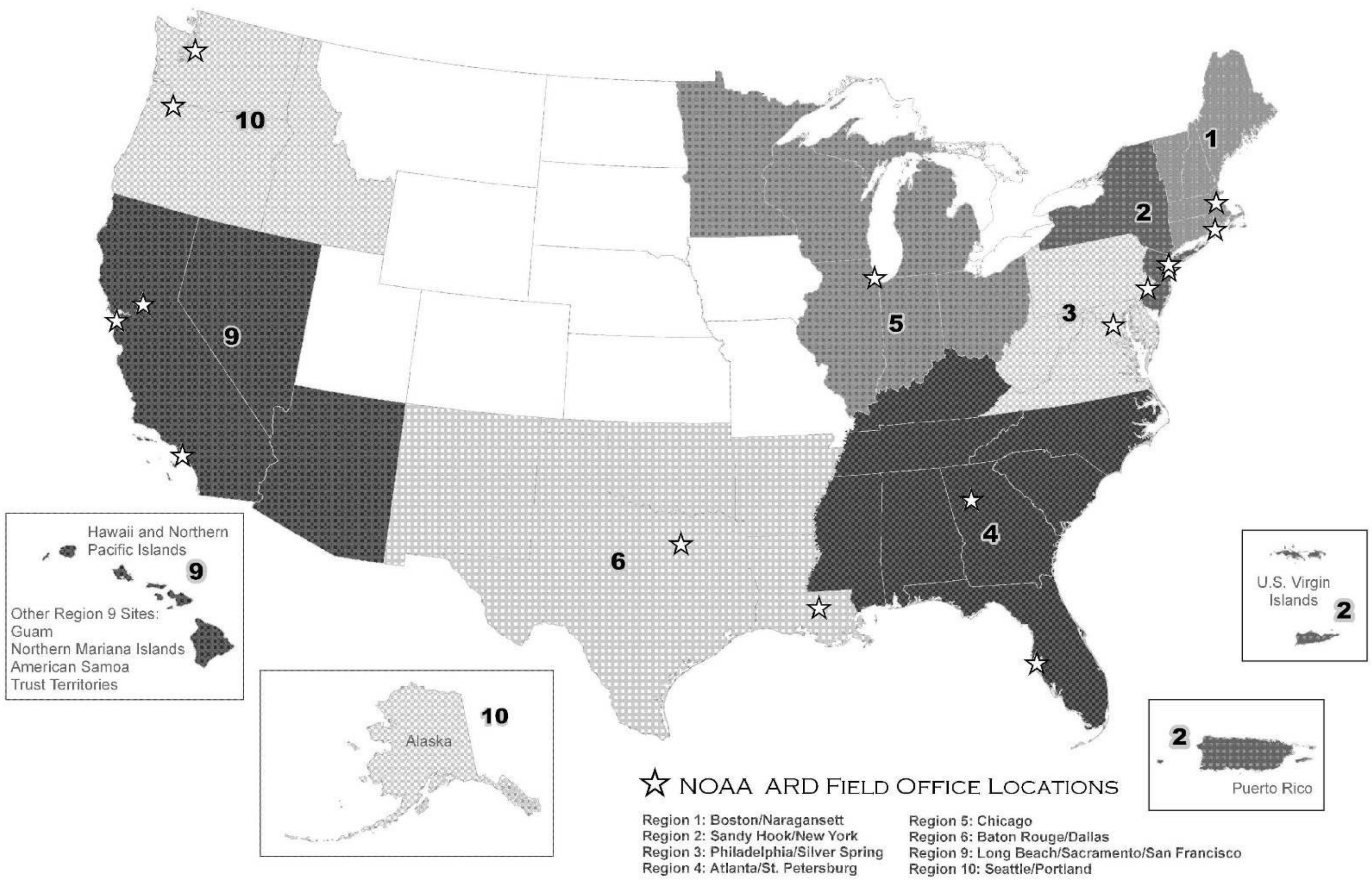

Olin Chemical

Wilmington, Massachusetts
EPA Facility ID: MAD001403104
Basin: Charles
HUC: 01090001

Executive Summary

The Olin Chemical site is a former chemical manufacturing facility in an industrial area of Wilmington, Massachusetts. The site is located within the headwaters of both the Aberjona River Basin and the Ipswich River Basin. Although the site is close to the headwaters of the Ipswich River the site is not hydraulically connected to the drainage. Surface water runoff from the site is collected in a series of ditches, which ultimately flow into Halls Brook and then into the Aberjona River. Sources of contamination at the site are a tank storage farm, buried drums, and residues from former waste disposal practices. Several investigations have detected elevated concentrations of inorganic and organic compounds in sediment, surface water, groundwater, and soil samples collected from and adjacent to the Olin Chemical property. Metals and SVOCs are the primary contaminants of concern to NOAA. The primary pathways for the migration of contaminants from the site to NOAA trust resources are surface water and groundwater discharge to surface water. The lower Mystic River provides habitat to NOAA trust resources, including anadromous blueback herring and alewife. Currently, dams downstream of the site impede the migration of anadromous species to the section of the river near the site. Small numbers of the catadromous American eel have been found in the lower Mystic River downstream of the site.

Site Background

The Olin Chemical site is a 21-ha (53-acre) former chemical manufacturing facility in an industrial area of Wilmington, Middlesex County, Massachusetts (Figure 1). The site is approximately 0.5 km (0.3 mi) east of Maple Meadow Brook, a headwater tributary of the Ipswich River and 1.5 km (0.9 mi) north of Halls Brook, which ultimately drains to the Aberjona River. Wetlands associated with Maple Meadow Brook are present on and adjacent to the property.

From 1953 to 1986, the Olin Chemical facility produced stabilizers, antioxidants, and other chemicals for the plastics and rubber industries. Wastewater disposal practices conducted by a series of owners have contributed to contamination at the site. Prior to 1970, liquid wastes from manufacturing processes were discharged into unlined waste pits and ponds, including the Lake Poly Liquid Waste Disposal Area (Lake Poly) (Figure 2). In 1970, an acid treatment and neutralization system and several lined settling lagoons were installed (Figure 2) (USEPA 2005). After the waste was treated and neutralized, wastewater was discharged into the lined settling lagoons, where calcium sulfate was allowed to settle out of the waste. The remaining liquid portion of the waste was discharged into an unlined drainage ditch system on the property consisting of the south ditch, east ditch, west ditch, and an ephemeral drainage (Figure 2). After 1972, treated wastewater was routed into the municipal sewer system (USEPA 2005). Calcium sulfate sludge from the lagoons was periodically dredged and transferred to an unlined landfill in the southwest corner of the property. That landfill was capped by the property owners in 1986.

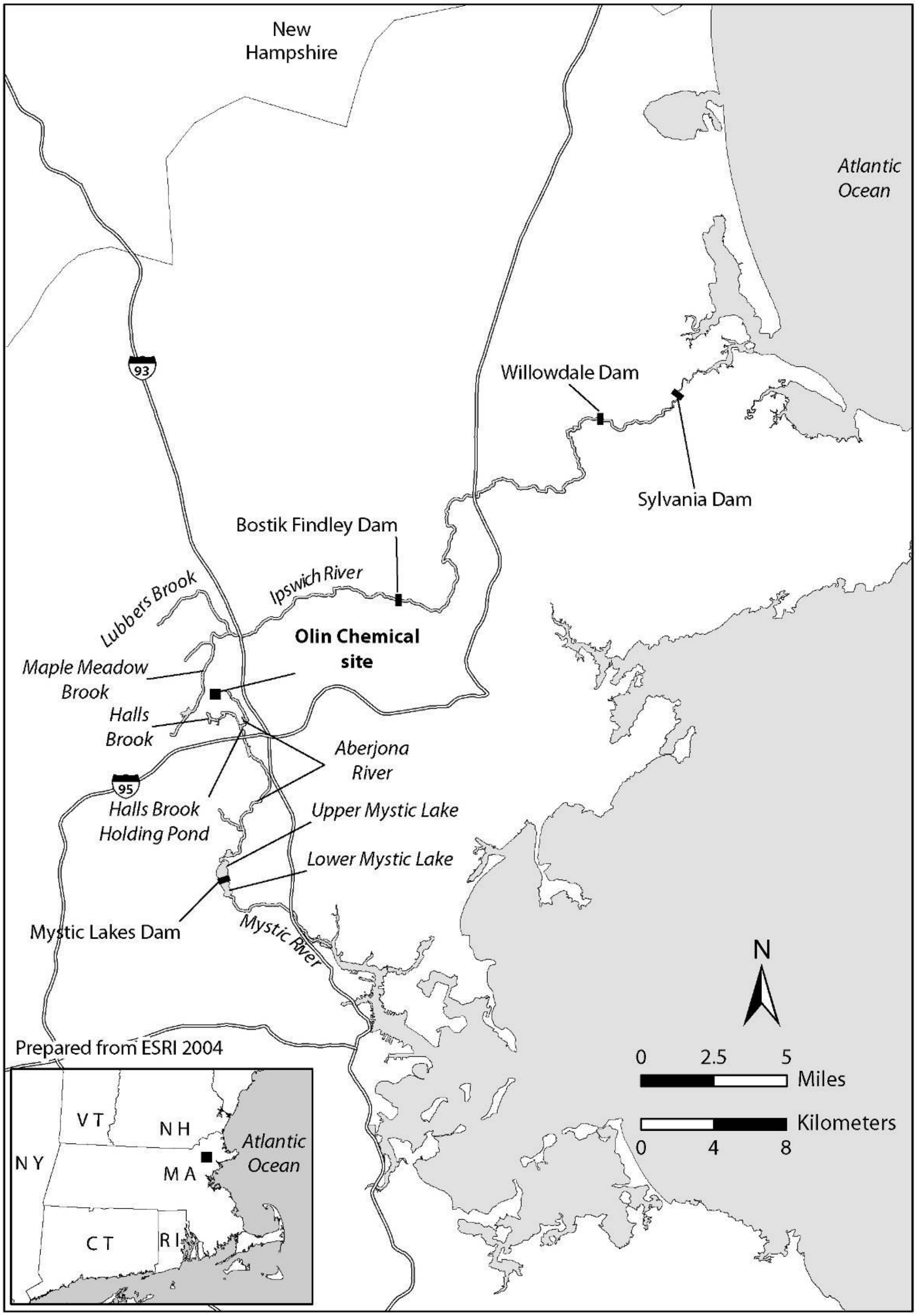

Figure 1. Location of the Olin Chemical site, Wilmington, Massachusetts.

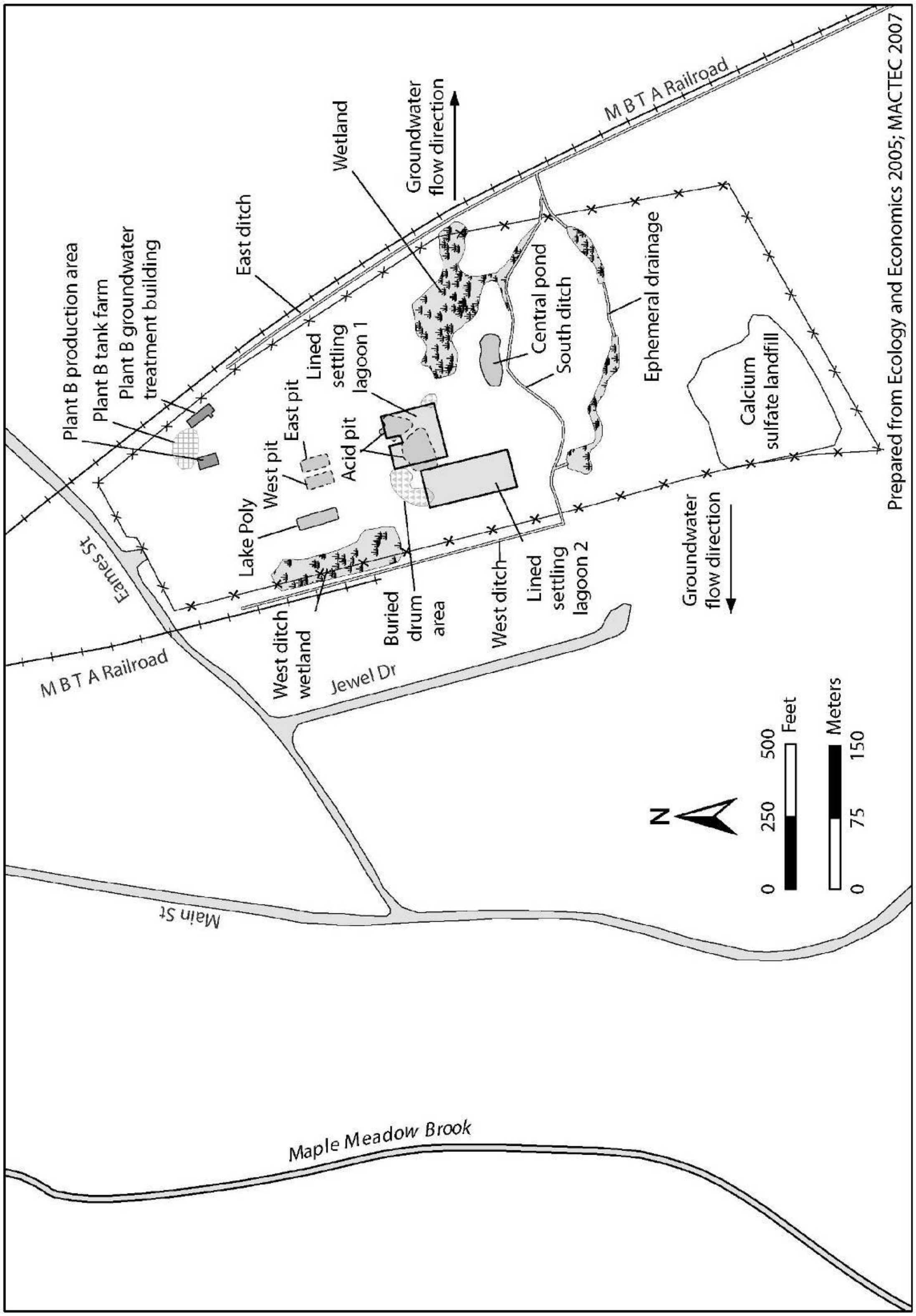

Figure 2. Detail of the Olin Chemical property.

Other potential sources of contamination at the site are a former tank farm associated with Plant B and several areas where drums and other debris were buried (Figure 2) (USEPA 2005). At the Plant B tank farm, raw materials used in the chemical production process were stored in large tanks. Before 1980, these tanks were in direct contact with the ground surface and had no spill-containment mechanism (USEPA 2005). Since 1982, groundwater containing contaminants associated with the tank farm, which include bis(2-ethylhexyl)phthalate, N-nitrosodiphenylamine (NDPA), di-n-octylphthalate, and trimethylpentenes, has been pumped from underneath the tanks and treated. In 2000, the buried drums and associated contaminated soil were excavated and removed from the site. Contaminants associated with the drums include NDPA, chromium, bis(2-ethylhexyl)phthalate, and trimethylpentenes (USEPA 2005).

Several investigations conducted at the site have detected elevated concentrations of inorganic compounds, such as ammonia, chloride, chromium, and sulfate, in surface water, sediment, groundwater, and soil samples collected from and adjacent to the Olin Chemical property. Several organic compounds, including N-nitrosodimethylamine (NDMA) and bis(2-ethylhexyl)phthalate, have also been detected at the site (USEPA 2007).

The site was placed on the U.S. Environmental Protection Agency's (USEPA) National Priorities list on April 18, 2006 (USEPA 2007). In June 2007, the USEPA reached an agreement with the potentially responsible parties for completion of a remedial investigation and feasibility study at the site (USEPA 2007). A focused remedial investigation was completed at the site in 2007 (MACTEC 2007).

The Olin Chemical property is on a groundwater divide that directs groundwater flow to the west, east, and south. East of the divide, groundwater flows east and south toward the ditch system on the property and west of the divide it flows toward Maple Meadow Brook (USEPA 2005). The site is located within the headwaters of both the Aberjona River Basin and the Ipswich River Basin. The site is not hydraulically connected to the Ipswich River Basin and as a result contamination from the site has not been found to have impacted the surface water or sediment in Maple Meadow Brook or the Ipswich River. Surface water runoff from the site is collected in a series of ditches, which ultimately flow into Halls Brook. Halls Brook discharges into the Halls Brook Holding Pond, which then connects to the Aberjona River. The Aberjona River is a tributary to the coastally connected Mystic River.

The primary pathways for the migration of contaminants from the site to NOAA trust resources are surface water and groundwater discharge to surface water.

NOAA Trust Resources

As was mentioned above, the site is located within the headwaters of both the Aberjona River Basin and the Ipswich River Basin. To the west of the site is Maple Meadow Brook, which flows to the northeast approximately 6.4 km (4 mi) before merging with Lubbers Brook to form the Ipswich River. The site is not hydraulically connected to the Ipswich River Basin. Surface water runoff from the site discharges to Halls Brook via the east ditch approximately 1.5 km (0.9 mi) south of the site. Halls Brook then flows into the Halls Brook Holding Pond, which connects to the Aberjona River. The Aberjona River flows into the Mystic River at the north end of Upper Mystic Lake. From its confluence with the Aberjona River, the Mystic River flows approximately 16 km (10 mi) before discharging into Boston Harbor.

The lower Mystic River and the Aberjona River provide spawning and rearing habitat for anadromous species, including alewife and blueback herring, and adult habitat for the catadromous American eel (Table 1). Currently, the Mystic Lake Dam impedes fish passage upstream of Lower Mystic Lake (MRWA 2006). River herring including blueback herring and alewife are present in Lower Mystic River but are not able to migrate past the Mystic Lake Dam. Fish passage options have been evaluated for the dam but it has been determined to not currently be structurally sound enough for a fish ladder to be installed (MRWA 2006). The Massachusetts Department of Conservation and Recreation is in the process of developing plans to rehabilitate the dam, which includes the addition of fish passage facilities. American eel are found in the Mystic River system and may occasionally make it past the Mystic Lake Dam (MADMF 2006).

Table 1. NOAA trust resources present in the Ipswich River near the Olin Chemical site (MADMF 2006; MRWA 2006).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH[1]						
Alewife	*Alosa pseudoharengus*	♦		♦		
Blueback herring	*Alosa aestivalis*	♦		♦		
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		

1: These species are not currently present in the Aberjona River near the site; if fish passage facilities were installed on downstream dams, these species might use habitat near the site.

The Massachusetts Division of Marine Fisheries has placed a moratorium on the harvest, possession, or sale of river herring, including blueback herring and alewife, through 2008 (MDMF 2005), and river herring are therefore not fished commercially or recreationally in Massachusetts waters. Fishing of American eel is permitted, but sufficient numbers of these fish are not likely present near the site to support a recreational or commercial fishery.

No fish consumption advisory is in effect for the Aberjona River or Halls Brook. A fish consumption advisory does exist for the lower Mystic River below Lower Mystic Lake because of polychlorinated biphenyl (PCB), chlordane, and DDT contamination. The advisory recommends that no one eat any fish from this section of the river (MDPH 2008).

Site-Related Contamination

Sediment, surface water, groundwater, and sediment have been collected at the site during several large investigations between 1993 and 2007. The samples were analyzed for a wide range of constituents. Based on the results of these investigations the contaminants of concern to NOAA at this time are metals and semi-volatile organic compounds (SVOCs).

Table 1 summarizes the maximum concentrations of select contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for surface water are the ambient water quality criteria (AWQC; USEPA 2006); the screening guidelines for sediment in a freshwater environment are the probable effects concentrations (PECs;

MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008). Exceptions to these screening guidelines, if any, are noted on Table 1. Only maximum concentrations that equaled or exceeded relevant screening guidelines, or for which screening guidelines are not currently available, are discussed below. When known, the general sampling locations are also provided.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Olin Chemical site MACTEC 2007. Contaminant values in bold exceed screening guidelines.

	Soil (mg/kg)		**Water (µg/L)**			**Sediment (mg/kg)**	
Contaminant	Soil	ORNL-PRG[a]	Ground-water	Surface Water	AWQC[b]	Sediment	PEC[c]
METALS/INORGANICS							
Arsenic	89	9.9	1100	230	150	120	33
Chromium	62,000	0.26[d]	2,300,000	11,000	11[f]	10,000	111
Mercury	7	0.00051	3	0.63	0.77[g]	1.8	1.06
Nickel	67	30	10,000	53	52[e]	89	48.6
SVOCs							
Benz(a)anthracene	18	NA	140	2.2	NA	3.1	1.05
Benzo(a)pyrene	23	NA	2.3	2.1	NA	3.1	1.45
Benzo(b)fluoranthene	17	NA	19	2.3	NA	4.1	NA
Bis(2-ethylhexyl)phthalate	6,700	NA	85,000	220	NA	25,000	0.75[h]
Indeno(1,2,3-cd)pyrene	13	NA	2.4	1.9	NA	19	0.330[h]
N-nitrosodimethylamine	ND	NA	26	0.21	NA	ND	NA
N-nitrosodiphenylamine	3,400	NA	5,200	ND	NA	2.6	NA

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Freshwater chronic criteria presented.
c: Probable Effects Concentration (PEC). Concentration above which harmful effects are likely to be observed (MacDonald et al. 2000).
d: Ecological soil screening guidelines (USEPA 2008).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guidelines represent concentrations for $Cr.^{+6}$
g: Derived from inorganic, but applied to total mercury.
h: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
NA: Screening guidelines not available.
ND: Not detected.

Sediment

Four metals were detected in sediment collected from the Olin Chemical site at concentrations greater than the PEC (Table 2). Maximum arsenic and nickel concentrations were detected in samples collected from the east ditch at a factor of three and two times the PEC, respectively. The maximum concentrations of chromium and mercury were detected in samples collected from the south ditch. Chromium concentrations in the south ditch exceeded the PEC by more than an order of magnitude. The maximum mercury concentration slightly exceeded the PEC.

Concentrations of three SVOCs were detected at concentrations greater than the PEC and three SVOCs were also detected for which no screening guideline is currently available (Table 1). The maximum concentrations of benz(a)anthracene, bis(2-ethylHexyl)phthalate, indeno(1,2,3-cd)pyrene, and N-nitrosodiphenylamine were detected in sediment samples collected from the south ditch. The maximum concentration of indeno(1,2,3-cd)pyrene exceeded the PEC by an order of magnitude. Concentrations of benz(a)anthracene exceeded the PEC by approximately a factor of three. Maximum concentrations of benzo(a)pyrene and benzo(b)fluoranthene were detected in samples from the east ditch. Benzo(a)pyrene concentrations in the east ditch exceeded the PEC by almost a factor of two. No screening guidelines are currently available for comparison to the maximum concentrations of bis(2-ethylhexyl)phthalate, N-nitrosodiphenylamine, and benzo(b)fluoranthene detected in the sediment samples.

Surface Water

Three metals were detected in surface water collected from the Olin Chemical site at concentrations greater than the AWQC (Table 2). Arsenic was detected in the east ditch at a maximum concentration that exceeded the AWQC by a factor of 1.5. Chromium was detected in south ditch at a maximum concentration that exceeded the AWQC by three orders of magnitude. The maximum concentration of nickel slightly exceeded the AWQC in a sample from the west ditch.

Screening guidelines are not currently available for any of the SVOCs detected in surface water at the site. Maximum concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were detected in surface water samples collected from the east ditch. Maximum concentrations of bis(2-ethylhexyl)phthalate and N-nitrosodiphenylamine were detected in samples collected from the south ditch.

Groundwater

Four metals were detected in samples from near lined lagoon 2 at maximum concentrations that exceeded the AWQC (Table 2). Chromium concentrations near lagoon 2 were more than five orders of magnitude greater than the AWQC. The maximum concentration of nickel exceeded the AWQC by two orders of magnitude. The maximum arsenic and mercury concentrations exceeded the AWQC by factors of seven and three, respectively.

Screening guidelines are not currently available for any of the SVOCs detected in groundwater at the site. The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, indeno(1,2,3-cd)pyrene, and N-nitrosodiphenylamine were detected near plant B. The maximum concentration of N-nitrosodimethylamine was detected in a sample collected near the west ditch.

Soil

The maximum concentrations of four metals were detected at concentrations greater than the screening guidelines (Table 2). The maximum concentration of arsenic was detected in sample collected from near the central pond and exceeded the ORNL-PRG by a factor of eight. Chromium and nickel were detected at maximum concentrations in samples collected from the south ditch. Chromium concentrations from the south ditch exceeded the USEPA's ecological soil screening guidelines by five orders of magnitude and nickel concentrations exceeded the ORNL-PRG by a factor of two. The maximum concentration of mercury was detected in a sample collected near Lake Poly and it exceeded the ORNL-PRG by four orders of magnitude.

Screening guidelines are not currently available for any of the SVOCs detected in soil at the site. The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were detected in samples collected near plant B. Maximum concentrations of bis(2-ethylhexyl)phthalate and N-nitrosodiphenylamine were detected in samples collected near Lake Poly. The maximum concentration of indeno(1,2,3-cd)pyrene was detected in a sample from the south ditch.

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10 EPA Region 1

Pike Hill Copper Mine

Corinth, Vermont
EPA Facility ID: VTD988366720
Basin: Waits
HUC: 01080103

Executive Summary

The Pike Hill Copper Mine site is an abandoned copper mine in a forested rural area of Corinth, Vermont. Investigations conducted by state and federal agencies detected elevated concentrations of metals in surface water, sediment, and soil samples taken from the site, nearby Pike Hill Brook, and the Waits River. Cadmium, copper, and zinc are the primary contaminants of concern to NOAA. Surface water is the primary pathway for the migration of contaminants from the site to NOAA trust resources. The Waits River is the habitat of primary concern to NOAA. The Waits River provides habitat to Atlantic salmon, which is the trust resource of concern to NOAA in the vicinity of the site.

Site Background

The Pike Hill Copper Mine site (Pike Hill) is an abandoned copper mine in a forested rural area of Corinth, Vermont (Figure 1). The Pike Hill site includes two large mine areas referred to as the Eureka Mine and the Union Mine, as well as a small mine area called the Smith Mine, located to the south of the Eureka and Union mines (Figure 2). The combined area of the three mines is approximately 87 ha (216 acres). Copper was mined at the Pike Hill site from 1847 until 1919. Approximately 18,000 metric tons (20,000 short tons) of waste rock and mine tailings remain in waste piles at the site (Piatak et al. 2006).

Investigations conducted by state and federal agencies detected elevated concentrations of metals in surface water, sediment, and soil samples taken from the site, nearby Pike Hill Brook, and the Waits River (Figure 1). Since 1997, the Vermont Department of Environmental Conservation has been conducting a study of the macroinvertebrate and fish populations in Pike Hill Brook downstream of the site; the study shows that these populations have been significantly impacted by acid mine drainage from the site (Fiske and Langdon 2006; USEPA 2006a). As a result, Pike Hill Brook is listed as an impaired water of the state.

The headwaters of Pike Hill Brook are near the Eureka and Union mines, and surface water runoff from waste piles at these mines drains into the brook. From the Pike Hill site, Pike Hill Brook flows approximately 5.6 km (3.5 mi) before emptying into the Waits River (Figure 1). Surface water runoff from the Smith Mine tailings pile flows into an unnamed stream, a tributary of Cookville Brook. Cookville Brook flows approximately 6 km (4 mi) before emptying into the South Branch Waits River, which flows approximately 6 km (4 mi) before discharging into the Waits River. The Waits River flows for approximately 40 km (25 mi) and ultimately discharges to the Connecticut River. Surface water is the primary pathway for the migration of contaminants from the site to NOAA trust resources.

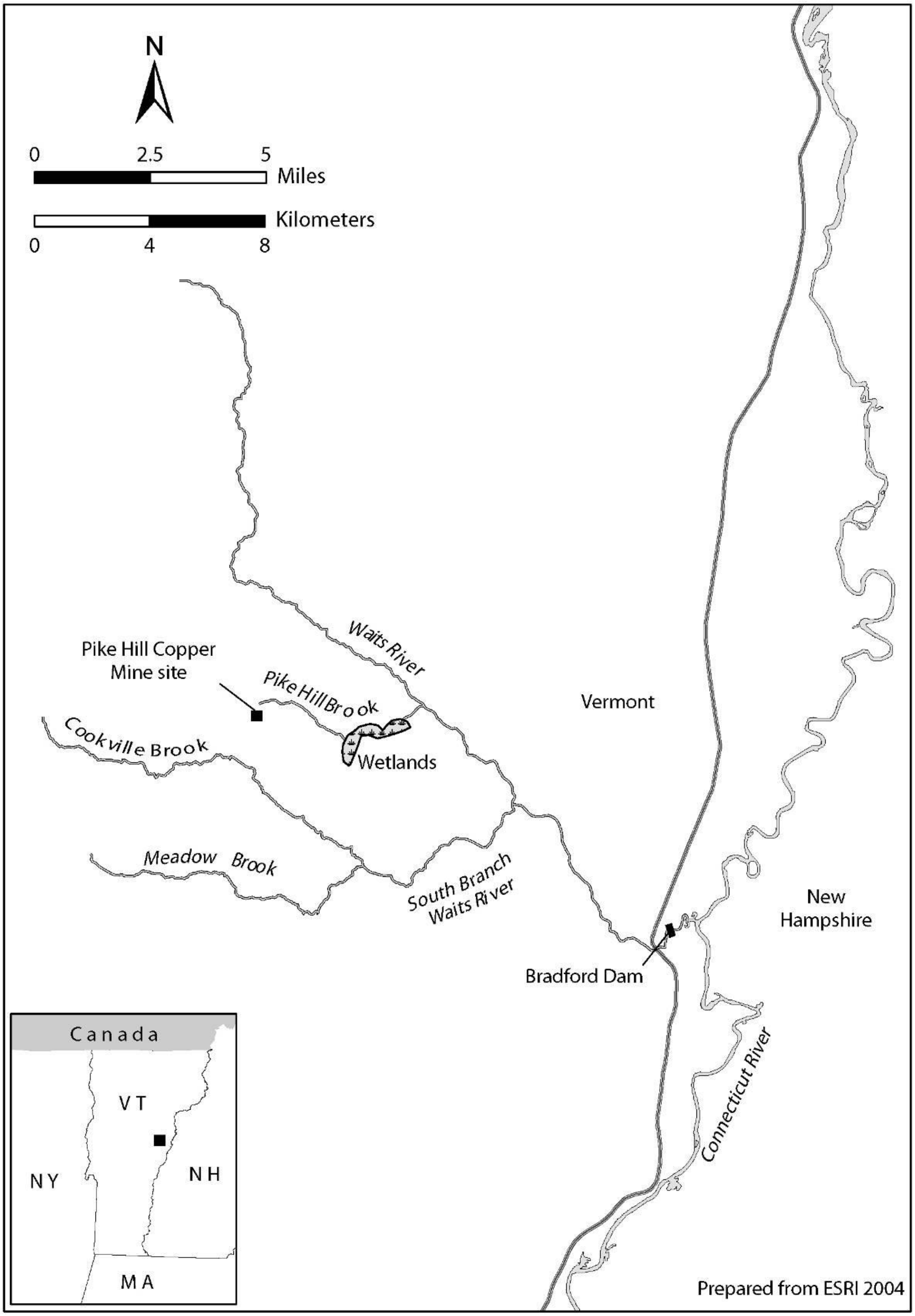

Figure 1. Location of the Pike Hill Copper Mine site, Corinth, Vermont.

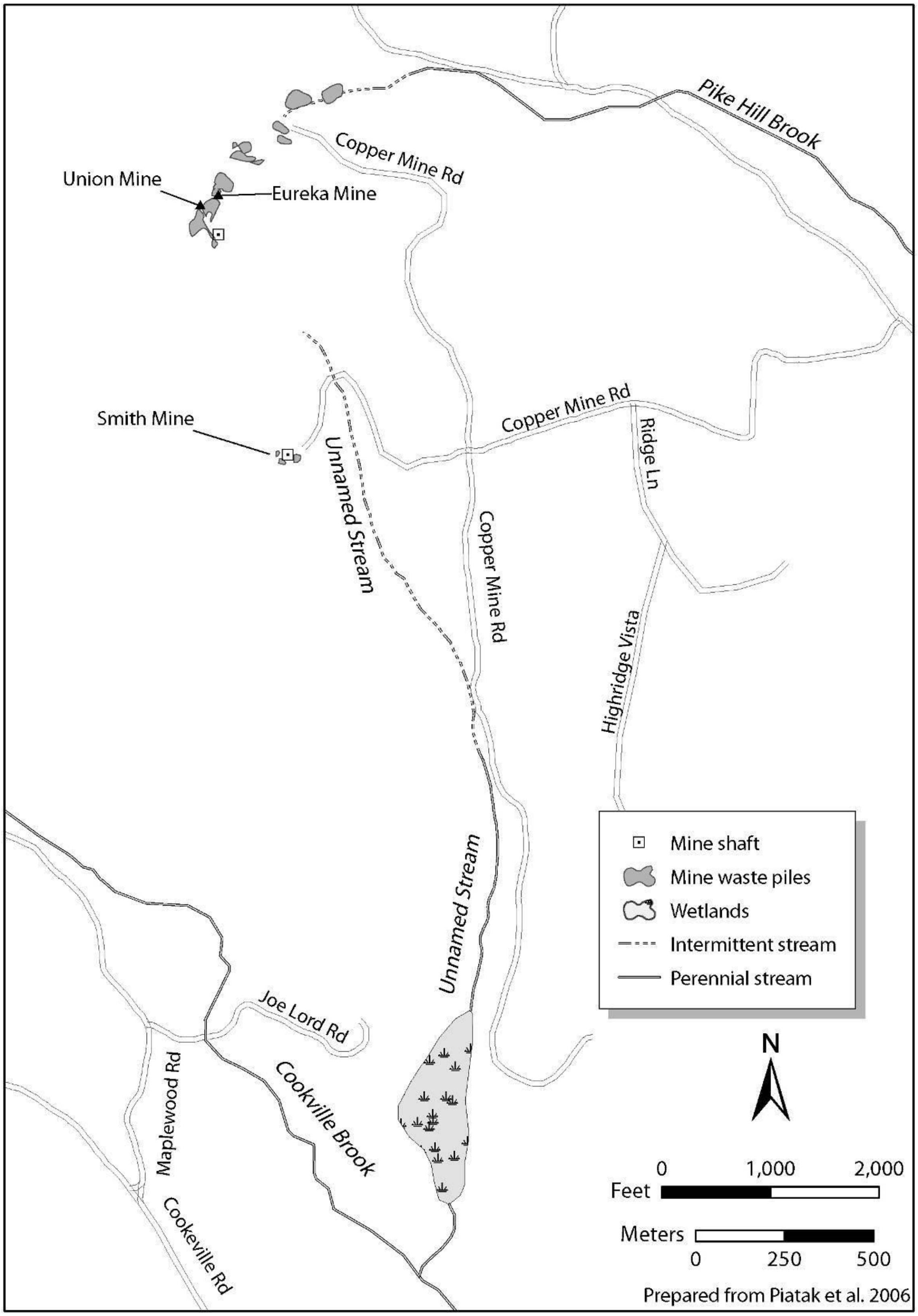

Figure 2. Detail of the Pike Hill Copper Mine property.

The site was placed on the U.S. Environmental Protection Agency's (USEPA) National Priorities List in July 2004 (USEPA 2007a). During 2004 and 2005, the U.S Geological Survey (USGS) conducted investigations to characterize the mine waste, mine drainage, sediment quality, hydrology, and surface water quality at the Pike Hill site. In 2005, the USEPA initiated a remedial investigation/feasibility study at the site; this investigation is still in progress (USEPA 2007a).

NOAA Trust Resources

The Waits River is the habitat of primary concern to NOAA. The Waits River provides habitat to Atlantic salmon, a NOAA trust resource. The Waits River is part of the Connecticut River Atlantic Salmon Restoration Program. Stocking in the Waits River has taken place above and below the confluence of Pike Hill Brook (Hunter 2004). The information reviewed for this report did not provide information on the presence or absence of Atlantic salmon in Pike Hill Brook and Cookville Brook, but juvenile Atlantic salmon are stocked in streams throughout the Connecticut River watershed as far north as the Nulhegan River in northern Vermont (USFWS 1998).

Fish passage is in place or planned at all dams on the Connecticut River downstream of the site. The Bradford Dam on the Waits River downstream of the site does not currently have fish passage. Installation of fish passage facilities at the Bradford Dam has been deferred until greater numbers of anadromous fish are present upstream and downstream of the dam (USFWS 1998).

Recreational and commercial fishing of Atlantic salmon has been banned in the Connecticut River and its tributaries, which includes the Waits River, until additional progress on restoring this species has been made (USFWS 2007).

The Vermont Department of Health has issued a general fish consumption advisory for all Vermont waters (VDOH 2007) because of mercury contamination. The advisory recommends that:

- High-risk individuals, which includes women of child-bearing age and children age six and under, should not eat walleye, and the general public should reduce consumption of walleye to one meal per month.

- High-risk individuals should eat no more than one meal per month of American eel, chain pickerel, lake trout, and smallmouth bass, and the general public should eat no more than three meals per month of these species.

- High-risk individuals should eat no more than two meals per month of largemouth bass and northern pike, and the general public should eat no more than six meals per month of these species.

- High-risk individuals should eat no more than three to four meals per month of brook trout, brown trout, rainbow trout, and yellow perch.

Site-Related Contamination

During 2004 and 2005, 44 surface water, 11 sediment, and four soil samples were collected at the site by the USGS (Kiah et al. 2007; Piatak et al. 2006). All of the samples were analyzed for metals. In 2006, toxicity tests were conducted by exposing the freshwater cladoceran species *Ceriodaphnia dubia* and fathead minnow *Pimephales promelas* to surface water collected from Pike Hill Brook downstream of the Pike Hill Copper Mine site. The results of the toxicity tests indicate that Pike Hill Brook is being impacted from acid drainage from the mine (TechLaw 2006). Based on the analytical and toxicity results, cadmium, copper, and zinc are the primary contaminants of concern to NOAA at the Pike Hill Copper Mine site.

Table 1 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for surface water are the ambient water quality criteria (AWQC; USEPA 2006b); the screening guidelines for sediment in a freshwater environment are the probable effects concentrations (PECs; MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008). Exceptions to these screening guidelines, if any, are noted on Table 1. Only maximum concentrations that equaled or exceeded relevant screening guidelines, or for which screening guidelines are not currently available, are discussed below. When known, the general sampling locations are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines.

Surface Water

Six metals were detected in surface water samples collected from the Pike Hill site at maximum concentrations that exceeded the AWQC (Table 1). The maximum concentrations of cadmium and copper were detected in a sample collected from Pike Hill Brook approximately 240 m (800 ft) downstream of the Eureka Mine and Union Mine waste piles (Figure 2). The maximum concentration of copper exceeded the AWQC by three orders of magnitude. The maximum concentration of cadmium exceeded the AWQC by two orders of magnitude. The maximum concentrations of lead and zinc were detected in a sample collected from a pool in the Eureka Mine shaft. The maximum concentration of zinc exceeded the AWQC by one order of magnitude while lead exceeded the AWQC by a factor of approximately two. Chromium and nickel were detected at maximum concentrations that slightly exceeded the AWQCs in a surface water sample collected from an unnamed stream, a tributary to Cookville Brook near the Smith Mine.

Sediment

Three metals were detected in sediment samples taken from Pike Hill Brook at maximum concentrations that exceeded the PECs, and selenium was also detected for which no screening guideline is currently available (Table 1). Maximum concentrations of cadmium, copper, selenium, and zinc were detected in a sample collected from Pike Hill Brook approximately 240 m (800 ft) downstream of the Eureka Mine and Union Mine waste piles (Figure 2). The maximum concentration of copper exceeded the PEC by one order of magnitude; zinc concentrations exceeded the PEC by a factor of two, and cadmium concentrations slightly exceeded the PEC. No screening guideline is currently available for comparison to the maximum concentration of selenium detected in the sediment samples.

Soil

Five metals were detected in soil samples taken from the Pike Hill site down-slope of the southernmost Smith Mine waste pile (Figure 2) at maximum concentrations that exceeded screening guidelines (Table 1). Maximum concentrations of chromium, selenium, and zinc exceeded the ORNL-PRGs by one order of magnitude. The maximum concentration of copper exceeded the USEPA's ecological soil screening guideline by one order of magnitude. The maximum concentration of cadmium slightly exceeded the USEPA's ecological soil screening guideline.

Table 1. Maximum concentrations of contaminants of concern to NOAA at the Pike Hill Copper Mine site (Piatak et al. 2006; Kiah et al. 2007). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		**Surface Water (µg/L)**		**Sediment (mg/kg)**	
Contaminant	Soil	ORNL-PRG[a]	Surface Water	AWQC[b]	Sediment	PEC[c]
METALS/INORGANICS						
Arsenic	0.6	9.9	3	150	23	33
Cadmium	**0.49**	0.36[d]	**93**	0.25[e]	**5.8**	4.98
Chromium	**39**	0.4	**12**	11[f]	75	111
Copper	**1,100**	28[d]	**31,000**	9[e]	**8,100**	149
Lead	22	40.5	**4.2**	2.5[e]	62	128
Nickel	25	30	**62**	52[e]	32	48.6
Selenium	**2.1**	0.21	2.9	5.0[g]	52	NA
Zinc	**520**	8.5	**7,400**	120[e]	**1,100**	459

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006b). Freshwater chronic criteria presented.
c: Probable Effects Concentration (PEC). Concentration above which adverse effects are likely to be frequently observed (MacDonald et al. 2000).
d: Ecological soil screening guideline (USEPA 2008).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guideline represents concentration for Cr^{+6}.
g: Criterion expressed as total recoverable metal.
NA: Screening guideline not available.

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Rolling Knolls LF

Green Village, New Jersey
EPA Facility ID: NJD980505192
Basin: Hackensack-Passaic
HUC: 02030103

Executive Summary

The Rolling Knolls LF site is an inactive landfill in Green Village, Morris County, New Jersey. From the early 1930s through 1968, the landfill received municipal solid waste, construction and demolition debris, residential septic tank waste, and industrial waste. Pesticides, herbicides, and oil were applied to the landfill property for pest, weed, and dust control. Pesticides, polycyclic aromatic hydrocarbons (PAHs), and metals have been detected in soil, groundwater, surface water, and sediment samples collected at the site and are the primary contaminants of concern to NOAA. Sediment, surface water runoff, and groundwater transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The habitats of primary concern to NOAA are Loantaka Brook, Great Brook, and Black Brook, which all flow through the Great Swamp National Wildlife Refuge, also a habitat of concern. These streams ultimately discharge to the Passaic River and Newark Harbor. Passage of NOAA trust resources to the upper Passaic River is blocked by Great Falls and Dundee Dam downstream; however, a fish passage project is planned. Adding fish passage to the dam will allow NOAA trust resources to migrate to the base of Great Falls, but further migration will be impeded by the falls.

Site Background

The Rolling Knolls LF site (Rolling Knolls) is an inactive, unlined municipal landfill in Green Village, Morris County, New Jersey (Figure 1). The 80-ha (200-acre) site is bounded by the Great Swamp National Wildlife Refuge on the east, south, and southwest sides; by Loantaka Brook on the west, and by private residential property on the north and northwest sides (Figure 2) (Foster Wheeler 2000). On its south and east sides, the Rolling Knolls property extends into the Great Swamp National Wildlife Refuge. Loantaka Brook is approximately 0.3 km (0.2 mi) west of the facility. Loantaka Brook flows into Great Brook, which then converges with Black Brook. Both Great Brook and Black Brook are within 1.6 km (1 mi) of the property; each discharges into the Passaic River and ultimately to Newark Harbor (Figure 1).

From the early 1930s through 1968, the landfill received municipal solid waste, construction and demolition debris, residential septic tank waste, and industrial waste. Pesticides and herbicides were used at the landfill for rodent, insect, and weed control. Oil was applied to the landfill's roads to control dust.

Several environmental investigations are currently underway at the Rolling Knolls site: a remedial investigation/feasibility study (RI/FS) began in September 2005, and a removal assessment, which began in August 2004. The most recent environmental investigations completed at the Rolling Knolls site were a field investigation of soil and sediment samples,

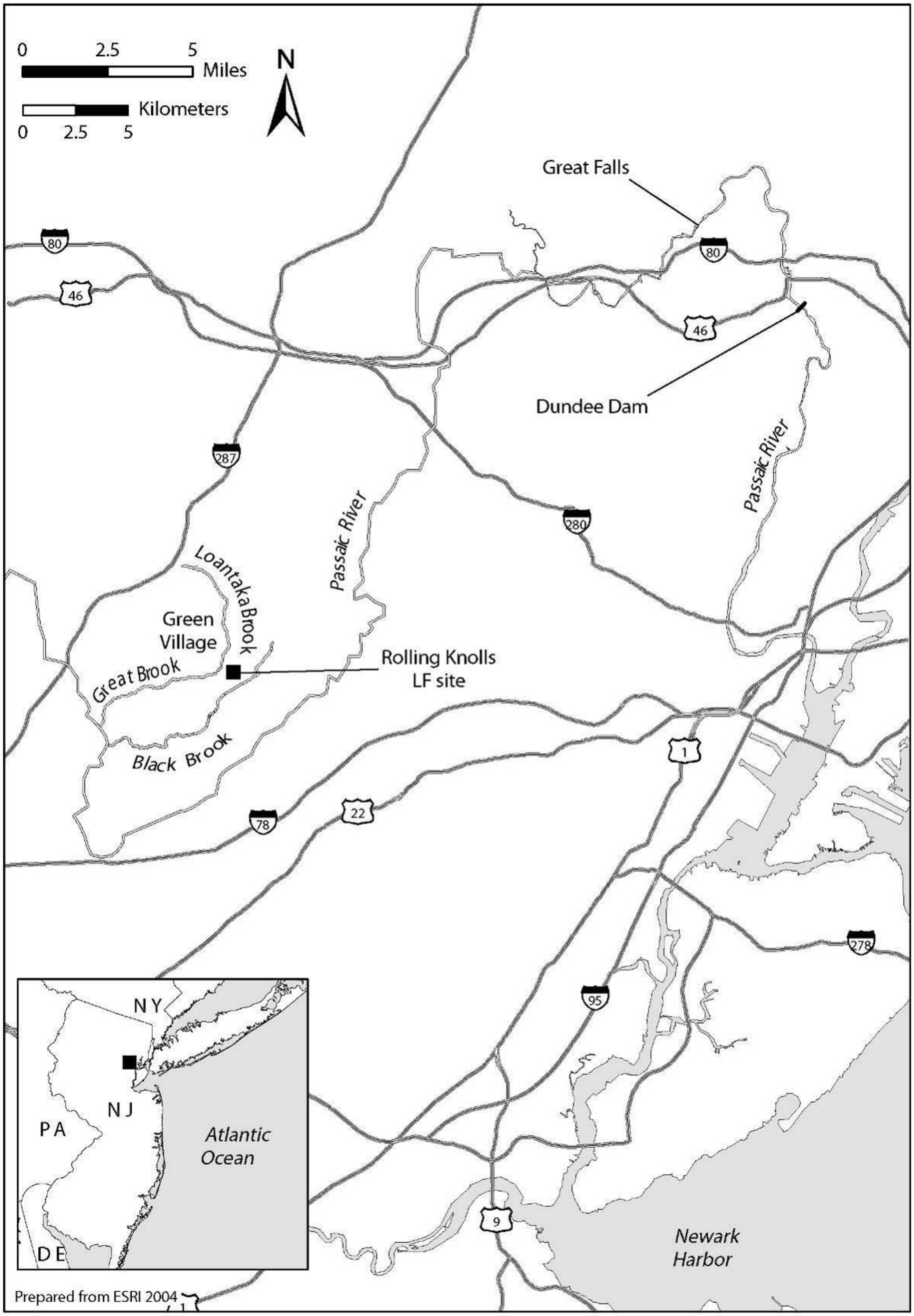

Figure 1. Location of the Rolling Knolls LF site in Green Village, New Jersey.

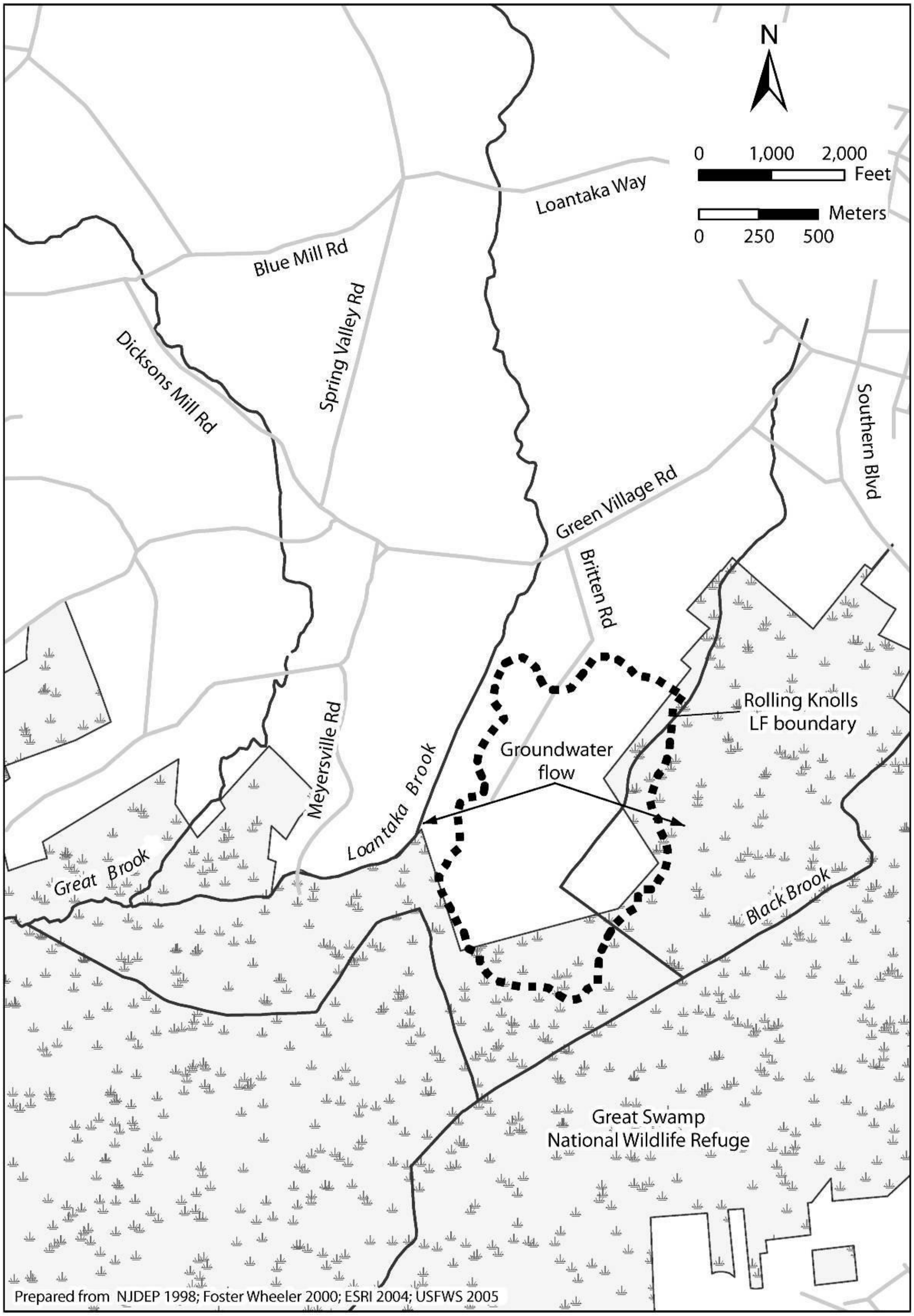

Figure 2. Detail of the Rolling Knolls LF property.

which was completed in April 2003, and an expanded site inspection was completed in 2000. The site was proposed to the National Priorities List (NPL) on April 30, 2003, and was placed on the NPL on September 29, 2003 (USEPA 2003).

Sediment, surface water runoff, and groundwater transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. Groundwater beneath the site is thought to flow from the eastern aspect of the landfill southeast to the Black Brook watershed, and from the western aspect of the landfill southwest to Loantaka Brook (Foster Wheeler 2000). Surface flow on the site is multidirectional and generally channeled by drainage ditches east and south of the Rolling Knolls property into Loantaka Brook and Black Brook (Figure 2). The soil beneath the landfill waste consists of stratified drift or swamp peat deposits underlain by glacial lake clay and silt (Foster Wheeler 2000).

NOAA Trust Resources

The habitats of primary concern to NOAA are Loantaka Brook, Great Brook, and Black Brook, which all flow through the Great Swamp National Wildlife Refuge, also a habitat of concern (Figures 1 and 2). Drainage from the site flows into Loantaka Brook, which in turn connects to Great Brook and Black Brook. These perennial streams ultimately discharge into the Passaic River and Newark Harbor (Figure 1).

The migration of anadromous and catadromous fish into the upper Passaic River is blocked by Great Falls, which is 24 m (79 ft) in height, and Dundee Dam, which is 6 m (20 ft) in height (Figure 1). No NOAA trust resources are able to migrate past the dam and falls. Although historical information indicates that American eel were once transported to the upper reaches of the Passaic River by fishermen, recent information shows that there are no American eel or other NOAA trust resources in the reach of the Passaic River near the site or in Loantaka, Great, or Black Brooks (Papson 2006). However, a fish passage project is planned for Dundee Dam (Harbor Estuary Program 2006). Adding fish passage to the dam will allow NOAA trust resources to migrate to the base of Great Falls, but further migration will be impeded by the falls.

Site-Related Contamination

Surface water, sediment, groundwater, and soil samples were collected from the Rolling Knolls site during a 1999 site investigation (Foster Wheeler 2000). The surface water samples were collected from a former swimming pool on the north end of the landfill property, as well as from Loantaka Brook and Black Brook. The sediment samples were collected from the landfill area, drainage ditches, Loantaka Brook, the Great Swamp National Wildlife Refuge, and Black Brook. The groundwater samples were collected from two monitoring wells and two residential wells on Meyersville Road (Figure 2). The soil samples were collected from throughout the site, including the Great Swamp National Wildlife Refuge. The primary contaminants of concern to NOAA are pesticides, polycyclic aromatic hydrocarbons (PAHs), and metals.

Table 1 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always used when appropriate. In the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC; USEPA 2006); the screening guidelines

Table 1. Maximum concentrations of contaminants of concern to NOAA at the Rolling Knolls LF site (Foster Wheeler 2000). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)	
Contaminant	Soil	ORNL-PRG[a]	Ground-water	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/ INORGANICS							
Arsenic	7.9	9.9	11	42	150	**30**	9.79
Cadmium	**37**	0.36[d]	**3.8**	ND	0.25[e]	**43**	0.99
Chromium[f]	**120**	0.4	**57**	**45**	11	**89**	43.4
Copper	9,100	60	**19**	**410**	9[e]	**1,600**	31.6
Lead	**2,900**	40.5	ND	**420**	2.5[e]	**1,400**	35.8
Mercury	**8.8**	0.00051	ND	**2.5**	0.77[g]	**6**	0.18
Nickel	**190**	30	**52**	**66**	52[e]	**80**	22.7
Selenium	**4.2**	0.21	ND	**29**	5.0[h]	6.6	NA
Silver	**6.9**	2	1.6	3	3.2[e,i]	**10**	4.5[j]
Zinc	**5,600**	8.5	55	**540**	120[e]	**1,600**	121
PAHs							
Acenaphthene	ND	20	ND	ND	520[k]	0.1	0.290[j]
Benz(a)anthracene	**0.2**	0.1[l]	ND	ND	NA	**2.6**	0.108
Benzo(a)pyrene	**0.1**	0.1[l]	ND	ND	NA	**2.4**	0.15
Benzo(b)fluoranthene	**0.2**	0.1[l]	ND	ND	NA	6	NA
Benzo(k)fluoranthene	0.06	0.1[l]	ND	ND	NA	1.8	13.4[j]
Chrysene	0.1	NA	ND	ND	NA	**3.5**	0.166
Dibenz(a,h)anthracene	ND	0.1[l]	ND	ND	NA	**0.7**	0.033
Fluoranthene	0.4	NA	ND	ND	NA	**6.2**	0.423
Fluorene	ND	NA	ND	ND	NA	**0.2**	0.0774
Indeno(1,2,3-cd)pyrene	**0.1**	0.1[l]	ND	ND	NA	**2.6**	0.330[j]
Phenanthrene	**0.2**	0.1[l]	ND	ND	NA	**3.8**	0.204
Pyrene	**0.2**	0.1[l]	ND	ND	NA	**5.3**	0.195
PESTICIDES/PCBs							
Aldrin	ND	NA	ND	0.007	3.0[i]	ND	0.040[j]
4,4'-DDD	0.1	NA	ND	ND	0.6[i,k]	**0.02**	0.00488
4,4'-DDE	0.03	NA	ND	ND	1050[i,k]	**0.02**	0.00316
4,4'-DDT	0.01	0.7[l]	**0.0022**	ND	0.001[m]	**0.02**	0.00416
Dieldrin	**0.02**	0.000032[d]	ND	0.01	0.056	**0.01**	0.0019
Endrin	ND	NA	ND	0.008	0.036	0.001	0.00222
Gamma-BHC (Lindane)	ND	0.1[l]	ND	0.006	0.95[i]	0.0004	0.00237
Heptachlor	ND	NA	ND	0.015	0.0038	0.0002	0.010[j]
Heptachlor Epoxide	ND	NA	ND	ND	0.0038	**0.004**	0.00247

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).

Table 1 continued on next page

Table 1, *cont.*

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Freshwater chronic criteria presented.
c: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
d: Ecological soil screening guidelines (USEPA 2008).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guidelines represent concentrations for Cr^{+6}.
g: Derived from inorganic, but applied to total mercury.
h: Criterion expressed as total recoverable metal.
i: Chronic criterion not available; acute criterion presented.
j: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
k: Lowest observable effects level (LOEL) (USEPA 1986).
l: Canadian Council of Ministers of the Environment (CCME) environmental quality guidelines for agricultural land uses (CCME 2006).
m: Expressed as total DDT.
NA: Screening guidelines not available.
ND: Not detected.

for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the Canadian Council of Ministers of the Environment (CCME) environmental quality guidelines for agricultural land uses (CCME 2006). Exceptions to these screening guidelines, if any, are noted on Table 1. Only maximum concentrations that meet or exceed the relevant screening guidelines, or for which there are no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided.

Surface Water

Seven metals were detected in surface water samples taken from the Rolling Knolls site at maximum concentrations that exceeded the AWQC (Table 1). The maximum concentrations of chromium, copper, lead, mercury, nickel, and selenium were detected in samples collected from the southwest corner of the property. The maximum concentration of lead exceeded the AWQC by two orders of magnitude. The maximum concentration of copper exceeded the AWQC by one order of magnitude. The maximum concentrations of selenium and chromium exceeded the AWQC by factors of six and four, respectively. The maximum concentration of mercury exceeded the AWQC by a factor of three, while the maximum concentration of nickel slightly exceeded the AWQC. The maximum concentration of zinc, which was detected in a sample collected from the west side of the property, exceeded the AWQC by a factor of 4.5.

Sediment

Nine metals were detected in sediment samples taken from the Rolling Knolls site at maximum concentrations that exceeded screening guidelines, and one metal was also detected for which no screening guideline is currently available (Table 1). The maximum concentrations of cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc were detected in samples collected from the east edge of the property bordering the Great Swamp National Wildlife Refuge. The maximum concentrations of cadmium, copper, lead, mercury, and zinc exceeded the TECs by one order of magnitude. The maximum concentration of nickel exceeded the TEC by a factor of 3.5, while the maximum concentrations of chromium and silver exceeded the TECs by a factor of two. The maximum concentrations of arsenic and selenium were detected in samples collected from the northeast edge of the Great Swamp National Wildlife Refuge, approximately 670 m (2,200 ft) from Southern Boulevard (Figure 2). The maximum concentration of arsenic exceeded the TEC by a factor of three. No screening guideline is currently available for comparison to the maximum concentration of selenium detected in the sediment samples.

Nine PAHs were detected in sediment samples taken from the Rolling Knolls site at maximum concentrations that exceeded screening guidelines, and one PAH was also detected for which no screening guideline is currently available (Table 1). The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were detected in a sample collected approximately 275 m (900 ft) southeast of Green Village Road (Figure 2). The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, phenanthrene, and pyrene exceeded the TECs by one order of magnitude. The maximum concentration of indeno(1,2,3-cd)pyrene exceeded the relevant screening guideline (see Table 1) by a factor of seven, while the maximum concentration of fluorene exceeded the TEC by a factor of 2.5. No screening guideline is currently available for comparison to the maximum concentration of benzo(b)fluoranthene detected in the sediment samples.

Five pesticides were detected in sediment samples taken from the Rolling Knolls site at maximum concentrations that exceeded TECs (Table 1). The maximum concentrations of 4,4'-DDT and dieldrin were detected in samples taken from the southeast portion of the property. The maximum concentration of dieldrin and 4,4'-DDT each exceeded the TEC by a factor of five. The maximum concentrations of 4,4'-DDD and 4,4'-DDE, which were detected in a sample taken from the northeast portion of the property, exceeded the TECs by factors of four and six, respectively. The maximum concentration of heptachlor epoxide, which was detected in a sample taken south of the property in the Great Swamp National Wildlife Refuge, exceeded the TEC by a factor of 1.5.

<u>Groundwater</u>

Four metals were detected in groundwater samples taken from the Rolling Knolls site at maximum concentrations that equaled or exceeded the AWQC (Table 1). The maximum concentration of cadmium, which was detected in a sample taken from the eastern edge of the property, exceeded the AWQC by one order of magnitude. The maximum concentrations of chromium and nickel were detected in samples taken from the north side of the property. The maximum concentration of chromium exceeded the AWQC by a factor of five, while the maximum concentration of nickel equaled the AWQC. The maximum concentration of copper, which was detected in a sample taken on Meyersville Road approximately 760 m (2,500 ft) south of Green Village Road (Figure 2), exceeded the AWQC by a factor of two.

One pesticide was detected in groundwater samples taken from the Rolling Knolls site at a maximum concentration that exceeded the AWQC (Table 1). The maximum concentration of 4,4'-DDT, which was detected in a sample collected on Meyersville Road approximately 760 m (2,500 ft) south of Green Village Road (Figure 2), exceeded the AWQC by a factor of two.

Soil

Nine metals were detected in soil samples collected from the Rolling Knolls site at maximum concentrations that exceeded screening guidelines (Table 1). The maximum concentrations of cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc were detected in samples collected from the east side of the property in the Great Swamp National Wildlife Refuge. The maximum concentration of mercury exceeded the ORNL-PRG by four orders of magnitude. The maximum concentrations of chromium, copper, lead, and zinc exceeded the ORNL-PRGs by two orders of magnitude, while the maximum concentration of cadmium exceeded the relevant screening guideline (see Table 1) by two orders of magnitude. The maximum concentration of selenium exceeded the ORNL-PRGs by one order of magnitude. The maximum concentrations of nickel and silver exceeded the ORNL-PRGs by factors of six and 3.5, respectively.

Six PAHs were detected in soil samples collected from the Rolling Knolls site at maximum concentrations that equaled or exceeded screening guidelines, and two PAHs were also detected for which no screening guidelines are currently available (Table 1). The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were detected in samples collected from the east side of the property in the Great Swamp National Wildlife Refuge. The maximum concentrations of benz(a)anthracene and benzo(b)fluoranthene exceeded the CCME soil guidelines by a factor of two. The maximum concentrations of benzo(a)pyrene and indeno(1,2,3-cd)pyrene equaled the CCME soil guidelines. The maximum concentrations of phenanthrene and pyrene, which were detected in samples collected from the southwest edge of the property, exceeded the CCME soil guidelines by a factor of two. The maximum concentrations of chrysene and fluoranthene were detected in samples collected from the east side of the property in the Great Swamp National Wildlife Refuge. No screening guidelines are currently available for comparison to the maximum concentrations of chrysene and fluoranthene detected in the soil samples.

One pesticide was detected in soil samples at a maximum concentration that exceeded the screening guideline, and two pesticides were also detected for which no screening guidelines are currently available (Table 1). The maximum concentration of dieldrin, which was detected in a sample collected from the west edge of the property, exceeded the relevant screening guideline (see Table 1) by three orders of magnitude. The maximum concentrations of 4,4'-DDD and 4,4'-DDE were detected in samples collected from the east side of the property in the Great Swamp National Wildlife Refuge. No screening guidelines are currently available for comparison to the maximum concentrations of 4,4'-DDD and 4,4'-DDE detected in the soil samples.

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Sherwin-Williams/Hilliards Creek

Gibbsboro, New Jersey
EPA Facility ID: NJD980417976
Basin: Lower Delaware
HUC: 02040202

Executive Summary

The Sherwin-Williams/Hilliards Creek site surrounds a former paint manufacturing plant in a residential and light industrial area of Gibbsboro, Camden County, New Jersey. The former plant encompassed an area of approximately 24 ha (60 acres) that is bisected by Hilliards Creek, a headwater tributary of the Cooper River. From the mid-1800s to the late 1970s, lead-based paints, varnishes, and lacquers were manufactured at the former plant. During the manufacturing process, white lead was ground at the facility. Spills and leaks occurred during the transfer, storing, and shipping of these materials and products. Wastes from the manufacturing process were disposed of in Hilliards Creek; in on-site, unlined wastewater lagoons; and in dump sites in the vicinity of the former plant. The primary contaminants of concern to NOAA are lead and PAHs. Surface water runoff, groundwater transport, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The primary NOAA trust resource near the site is the catadromous American eel and Hilliards Creek is the habitat of most concern to NOAA.

Site Background

The Sherwin-Williams/Hilliards Creek site surrounds a former paint manufacturing plant in a residential and light industrial area of Gibbsboro, Camden County, New Jersey (Figure 1). The former plant encompassed an area of approximately 24 ha (60 acres) and was bounded to the north by Silver Lake and to the south by Bridgewood Lake. Hilliards Creek bisects the property and flows through the Hilliards Creek Wildlife Refuge before discharging to the Cooper River approximately 2 km (1.25 mi) west of the former plant. The Cooper River is a tributary of the Delaware River. Two other waste sites, the Route 561 Dump and the United States Avenue Burn, are in the vicinity of the Sherwin-Williams/Hilliards Creek site. Both sites were landfills used as paint waste disposal areas.

From the mid-1800s to the late 1970s, lead-based paints, varnishes, and lacquers were manufactured at the former plant. During the manufacturing process, white lead was ground at the facility. Wastes from the manufacturing process were disposed of in Hilliards Creek; in on-site, unlined wastewater lagoons; and in dump sites in the vicinity of the former plant. Paint manufacturing materials and final products were stored in buildings, tank farms, and drum storage areas throughout the property. Raw materials and final products were shipped to and from the facility via railroad tanker cars, which were loaded and unloaded via a pipeline. Spills and leaks occurred during the transfer, storing, and shipping of these materials and products. In 1976, manufacturing at the plant was terminated and the entire facility was permanently closed in 1978. In the early 1980s, the land encompassing the former plant was redeveloped into a light industrial park. As part of the redevelopment, aboveground and underground storage tanks were removed and the unlined wastewater lagoons were backfilled (Tetra Tech 2006).

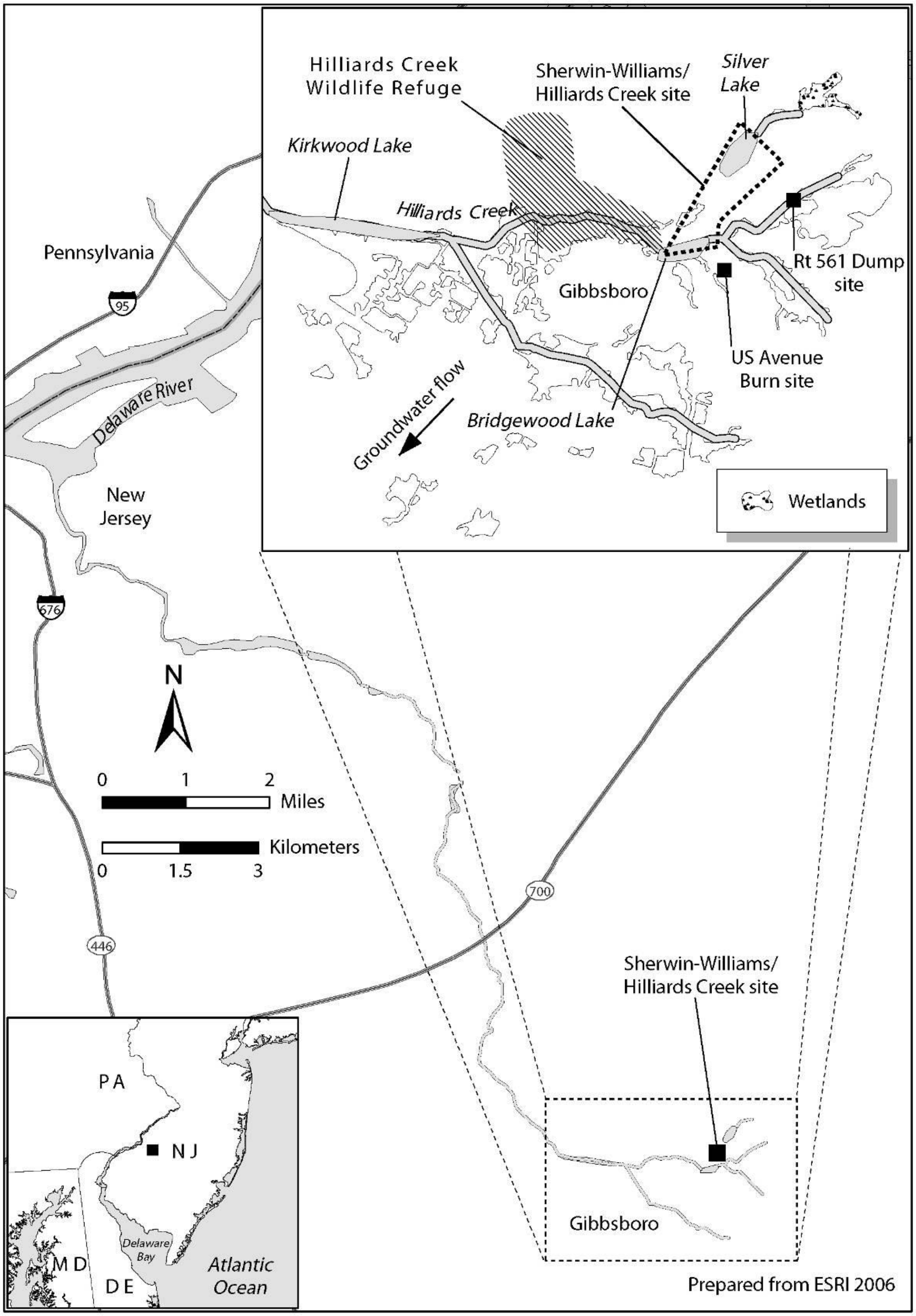

Figure 1. Location of the Sherwin-Williams/Hilliards Creek site, Gibbsboro, New Jersey.

Numerous investigations conducted at the site have detected elevated concentrations of metals, primarily lead; semivolatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs); and volatile organic compounds (VOCs) in surface water, sediment, groundwater, and soil samples collected from the site. Elevated concentrations of lead and PAHs were also been detected in surface water, sediment, and soil samples collected from Hilliards Creek and its associated wetlands and floodplain, and from nearby Kirkwood Lake (Tetra Tech 2006).

The U.S. Environmental Protection Agency (USEPA) completed a hazard ranking system (HRS) documentation package for the site in February 2006, and the site was proposed for placement on the USEPA's National Priorities List on April 19, 2006 (USEPA 2008). In September 1999, a remedial investigation and feasibility study was initiated at the site and is still underway (USEPA 2008); results from this work were not available at the time this report was prepared.

Surface water runoff, groundwater transport, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. Surface water runoff from the site discharges to Hilliards Creek and Silver Lake. Silver Lake discharges to Hilliards Creek via an underground culvert. Groundwater in the area is encountered approximately 0.3 to 5 m (1 to 16 ft) below ground surface and flows to the southwest toward Hilliards Creek (Tetra Tech 2006).

NOAA Trust Resources

Hilliards Creek, a headwater tributary of the Cooper River, is the habitat of primary concern to NOAA. Hilliards Creek is a small stream with silty to sandy substrates. The creek is generally less than 3 m (10 ft) wide and 1 m (3.3 ft) deep (Carberry 2000). Hilliards Creek bisects the property and flows through the Hilliards Creek Wildlife Refuge before discharging to the Cooper River approximately 2 km (1.25 mi) west of the former plant. The Cooper River flows to the northwest approximately 15 km (9 mi) before discharging to the lower Delaware River.

The primary NOAA trust resource in the vicinity of the site is the catadromous American eel. The Cooper River and its tributaries, including Hilliards Creek, provide adult rearing habitat for the American eel (Carberry 2000). Although American eel spawn in the Atlantic Ocean, juvenile and adult eel migrate throughout the Cooper River basin, using the area for rearing and feeding.

Although numerous dams on the Cooper River block the migration of anadromous fish species such as alewife and blueback herring, American eel are able to traverse these lowhead dams and are found throughout the basin (Carberry 2000). Numerous restoration projects that include fish passage facilities are under way on the Cooper River. These efforts to restore fish passage will provide anadromous alewife and blueback herring with access to spawning and rearing habitat in the upper Cooper River basin (USEPA 2002).

There is no commercial fishery near the site. The Cooper River basin is not managed or stocked for recreational fishing and recreational fishing in the area is limited as a result (Carberry 2000).

A statewide fish consumption advisory is in effect for the freshwater rivers of New Jersey because of dioxin, mercury, and polychlorinated biphenyl (PCB) contamination (NJDEP 2006); the advisory recommends:

- The general public limit consumption of chain pickerel, largemouth bass, and smallmouth bass to one meal per week.
- High-risk individuals limit consumption of chain pickerel, largemouth bass, smallmouth bass, sunfish, and yellow bullhead to one meal per month.
- High-risk individuals limit consumption of brown bullhead to one meal per week.

A fish consumption advisory is also in effect for the Cooper River because of dioxin, mercury, and PCB contamination. The advisory recommends:

- The general public limit consumption of brown bullhead and common carp to one meal per month.
- The general public limit consumption of bluegill sunfish to one meal per week.
- High-risk individuals consume no common carp.
- High-risk individuals limit consumption of bluegill sunfish to one meal per month.
- High-risk individuals limit consumption of brown bullhead to four meals per year.

Site-Related Contamination

Numerous surface water, sediment, groundwater, and soil samples were collected at the Sherwin-Williams/Hilliards Creek site during multiple sampling events between 1990 and 2004 (Tetra Tech 2006). The samples were analyzed for metals, SVOCs (including PAHs), phenols, and VOCs. With the exception of groundwater, the contaminant concentrations discussed in this report were reported in the HRS documentation package (Tetra Tech 2006) and represent analytical results for samples collected downstream of the former plant in the floodplain of Hilliards Creek; groundwater samples discussed here were collected from monitoring wells on the [site?] property. The HRS provides a limited summary of the data and analytical results for numerous potential contaminants were not available for review at the time this report was prepared. The primary contaminants of concern to NOAA are lead and PAHs.

Table 1 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for surface water are the USEPA ambient water quality criteria (AWQC; USEPA 2006); the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000), and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997). Exceptions to these screening guidelines, if any, are noted on Table 1. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided.

Surface Water

One metal was detected in a surface water sample collected from Hilliards Creek downstream of the site at a maximum concentration that exceeded the screening guideline (Table 1). The maximum concentration of lead exceeded the AWQC by one order of magnitude.

Sediment

Two metals were detected in sediment samples collected from downstream of the site in the floodplain of Hilliards Creek at maximum concentrations that exceeded screening guidelines (Table 1). The maximum concentrations of arsenic and lead exceeded the TECs by two orders of magnitude.

Six PAHs were detected in sediment samples collected from downstream of the site in the floodplain of Hilliards Creek at maximum concentrations that exceeded screening guidelines, and one PAH was also detected for which no screening guideline is currently available (Table 1). The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, and pyrene exceeded the TECs by one order of magnitude. No screening guideline is currently available for comparison to the maximum concentration of benzo(b)fluoranthene detected in the sediment samples.

Groundwater

One metal was detected in a groundwater sample collected from a monitoring well at the site at a maximum concentration that exceeded the screening guideline (Table 1). The maximum concentration of lead exceeded the AWQC by one order of magnitude.

Pentachlorophenol was detected in a groundwater sample collected from a monitoring well at the site at a maximum concentration that exceeded the AWQC by two orders of magnitude.

Benzene, a VOC, was detected in a groundwater sample collected from a monitoring well at the site at a maximum concentration that slightly exceeded the screening guideline.

Soil

One metal was detected in a soil sample collected from a residential yard downstream of the site in the floodplain of Hilliards Creek at a maximum concentration that exceeded the screening guideline (Table 1). The maximum concentration of lead exceeded the ORNL-PRG by two orders of magnitude.

Table 1. Maximum concentrations of contaminants of concern to NOAA at the Sherwin-Williams/Hilliards Creek site (Tetra Tech 2006). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)	
Contaminant	Soil	ORNL-PRG[a]	Ground-water	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/INORGANICS							
Arsenic	NA	9.9	NA	30	150	**1,100**	9.79
Lead	**39,000**	40.5	**240**	**29**	2.5[d]	**9,100**	35.8
PAHs							
Benz(a)anthracene	NA	0.1[e]	NA	NA	NA	**2.6**	0.108
Benzo(a)pyrene	NA	0.1[e]	NA	NA	NA	**3.4**	0.15
Benzo(b)fluoranthene	NA	0.1[e]	NA	NA	NA	7.5	NA
Benzo(k)fluoranthene	NA	0.1[e]	NA	NA	NA	1.9	13.4[f]
Chrysene	NA	NA	NA	NA	NA	**3.6**	0.166
Fluoranthene	NA	NA	NA	NA	NA	**7.1**	0.423
Phenanthrene	NA	0.1[e]	NA	NA	NA	**3.1**	0.204
Pyrene	NA	0.1[e]	NA	NA	NA	**7.3**	0.195
PHENOLS							
Pentachlorophenol	NA	3	**1,900**	NA	15[g]	NA	NA
VOCs							
Benzene	NA	0.1[e]	**5,500**	NA	5,300[h,i]	NA	NA
Ethylbenzene	NA	0.1[e]	2,700	NA	32,000[h,i]	NA	NA

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Freshwater chronic criteria presented.
c: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
d: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
e: Canadian Council of Ministers of the Environment (CCME) soil quality guidelines for the protection of environmental and human health (CCME 2006).
f: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
g: Chronic criterion is pH dependent; concentration shown above corresponds to pH of 7.8.
h: Chronic criterion not available; acute criterion presented.
i: Lowest observable effects level (LOEL) (USEPA 1986).
NA: Screening guideline or analytical result not available.

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Standard Chlorine

Kearny, New Jersey
EPA Facility ID: NJD002175057
Basin: Hackensack-Passaic
HUC: 02030103

Executive Summary

The Standard Chlorine site in Kearny, Hudson County, New Jersey, is bordered by the Hackensack River. From the early 1900s to the 1990s, the site was used by multiple owners to manufacture naphthalene products, creosote-based disinfectants, batteries, rubber products, solvents, chlorobenzene-based mothballs, and other chemical products. The primary contaminants of concern to NOAA are metals, dioxins, PAHs, and chlorobenzenes. The habitats of primary concern to NOAA are the lower Hackensack River and Newark Bay. NOAA trust resources found near the site in the lower Hackensack River include anadromous, catadromous and estuarine fish, and invertebrates. The primary pathways for the migration of contaminants from the site to NOAA trust resources are surface water transport via a buried drainage pipe and a drainage ditch on the site, which discharge to the Hackensack River, and surface water runoff into the Hackensack River. Groundwater is a secondary pathway for migration of contaminants to NOAA trust resources.

Site Background

The Standard Chlorine site (Standard Chlorine) in Kearny, Hudson County, New Jersey (Figure 1) was used by multiple owners from the early 1900s to the 1990s for chemical manufacturing and processing. The Standard Chlorine property, which encompasses approximately 10 ha (25 acres), is bordered to the east by the Hackensack River, to the west by the Belleville Turnpike, to the north by the former Diamond Shamrock Corp Superfund site, and to the south by the Koppers Co Inc/Seaboard Plant hazardous waste site, where cleanup is being lead by the state of New Jersey.

The Standard Chlorine property has been used for producing naphthalene products, creosote-based disinfectants, batteries, rubber products, solvents, chlorobenzene-based mothballs, and other chemical products. The general layout of the property is shown on Figure 2. Several buildings, two waste lagoons, a drainage ditch, and a buried drainage pipe are still present on the site property. When the Standard Chlorine facility was active, waste from the chemical manufacturing process was disposed of in the two waste lagoons (USEPA 2003). The drainage ditch and drainage pipe discharge into the Hackensack River via the south and north outfalls, respectively.

Environmental investigations have been conducted at the Standard Chlorine site since the 1980s (USEPA 2008a); the most recent investigation was an expanded site inspection, which was completed in April 2003. The site was placed on the U.S. Environmental Protection Agency's (USEPA) National Priorities List on September 19, 2007 (USEPA 2008a). The site is currently included in a remedial investigation of the Hackensack River Study Area (BBL 2005), which also includes the former Diamond Shamrock Corp Superfund site and the Koppers Co Inc/Seaboard Plant state-lead hazardous waste site.

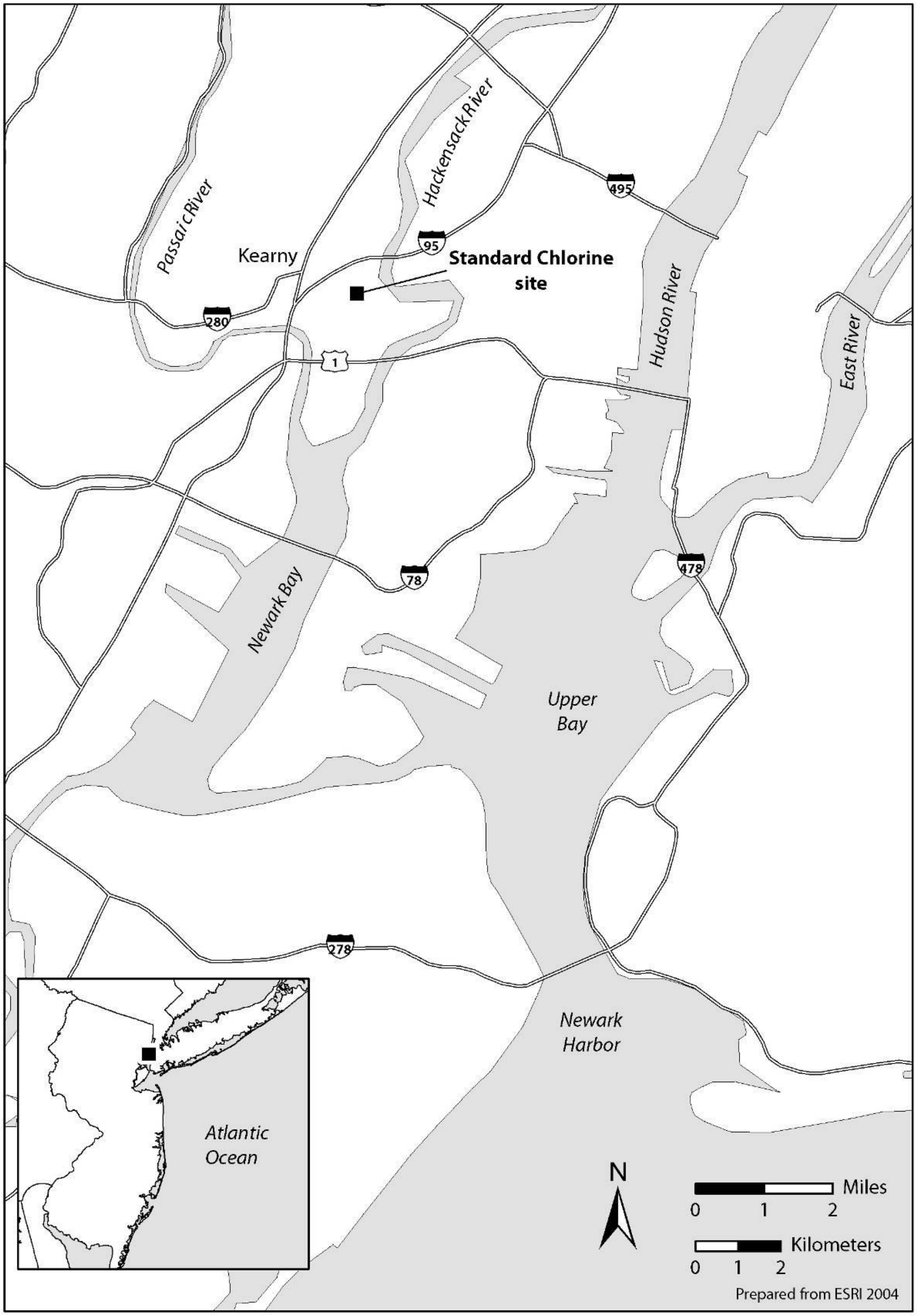

Figure 1. Location of the Standard Chlorine site, Kearny, New Jersey.

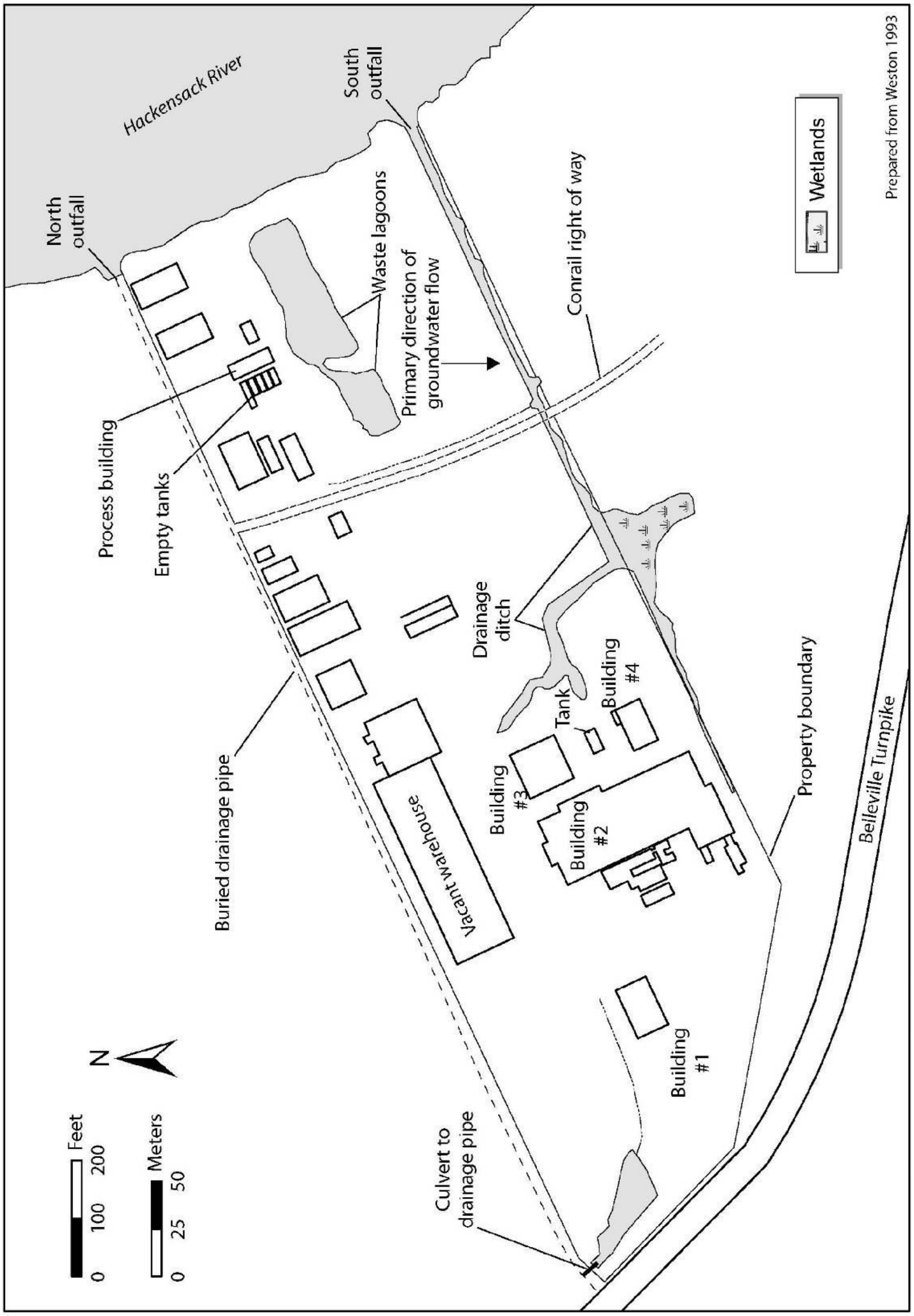

Figure 2. Detail of the Standard Chlorine property.

The primary pathways for the migration of contaminants from the Standard Chlorine site to NOAA trust resources are surface water transport to the Hackensack River via the drainage pipe and drainage ditch, and surface water runoff into the Hackensack River. Groundwater is a secondary pathway for migration of contaminants to NOAA trust resources. Surface water runoff from most of the property is collected in the drainage ditch at the southeast side of the property (Figure 2). The ditch also receives runoff from the adjacent property to the south, drainage ditches along the Belleville Turnpike, and other areas. Surface water runoff from the northwest section of the property flows through a culvert into the buried drainage pipe and is then discharged to the Hackensack River via the north outfall (USEPA 2003). Groundwater at the site is encountered within a few feet of the surface and flows mostly to the south (Weston 1993). Soil at the site consists of a layer of fill 2.4 to 3 m (8 to 10 ft) in thickness; the fill is composed of slag and silty sand (Weston 1993).

NOAA Trust Resources

The habitats of primary concern to NOAA are the lower Hackensack River, which is adjacent to the site, and Newark Bay, which is approximately 6 km (4 mi) south of the site. The site drains to the lower Hackensack River, which flows into Newark Bay (Figure 1).

The Standard Chlorine site is located within the Hackensack Meadowlands, a U.S. Fish and Wildlife Service (USFWS) Significant Habitat Complex. The lower Hackensack River is identified as Essential Fish Habitat for 14 species by the National Marine Fisheries Service, and the Hackensack Meadowlands has been designated an Aquatic Resource of National Importance by the USEPA and other federal agencies (USFWS 2006).

Table 1 lists some of the NOAA trust resources commonly found in the lower Hackensack River, which provides spawning, nursery, and adult habitat for numerous estuarine and anadromous fish species, including alewife, Atlantic silverside, Atlantic tomcod, mummichog, striped bass, striped killifish, and white perch. The lower Hackensack River is brackish, due in part to the Oradell Dam, located upstream of the site, which reduces freshwater flow to the tidal portion of the river. The dam presents a barrier to anadromous fish species accessing their freshwater spawning grounds (Bragin et al. 2005). The dominant fish in the lower Hackensack River are resident estuarine fish tolerant of fluctuations in salinity and water quality. The lower Hackensack River contains contaminated sediments, and dissolved oxygen concentrations in the river are low during the summer months (USFWS 1997).

Striped bass are fished recreationally in the lower Hackensack River (Papson 2006). There are no commercial fisheries in the lower Hackensack River and crabbing is illegal. A fish consumption advisory is in effect for American eel, blue crab, striped bass, white catfish, and white perch in the tidal Hackensack River and the Newark Bay complex because of polychlorinated biphenyls (PCBs), dioxins, and mercury. The advisory recommends limited consumption of striped bass and white catfish and no consumption of American eel, blue crab, and white perch for the general public (NJDEP 2006).

Table 1. NOAA trust resources present in the lower Hackensack River near the Standard Chlorine Chemical Company, Inc. site (USFWS 1997, Kiviat and MacDonald 2004, Bragin et al. 2005, Papson 2006).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*	♦	♦	♦		
American shad	*Alosa sapidissima*			♦		
Blueback herring	*Alosa aestivalis*			♦		
Gizzard shad	*Dorosoma cepedianum*			♦		
Striped bass	*Morone saxatilis*	♦	♦	♦		♦
White perch	*Morone americana*	♦	♦	♦		
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		
MARINE/ESTUARINE FISH						
Atlantic menhaden	*Brevoortia tyrannus*	♦	♦	♦		
Atlantic silverside	*Menidia menidia*	♦	♦	♦		
Atlantic tomcod	*Microgadus tomcod*	♦	♦	♦		
Bluefish	*Pomatomus saltatrix*	♦	♦	♦		
Inland silverside	*Menidia beryllina*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Striped killifish	*Fundulus majalis*	♦	♦	♦		
INVERTEBRATES						
Blue crab	*Callinectes sapidus*	♦	♦	♦		
Grass shrimp	*Palaemonetes pugio*	♦	♦	♦		
Mysid shrimp	*Neomysis americana*	♦	♦	♦		
Sevenspine bay shrimp	*Crangon septemspinosa*	♦	♦	♦		
Estuarine mud crab	*Rhithropanopeus harrisii*	♦	♦	♦		

Site-Related Contamination

Surface water, sediment, groundwater, and soil samples were collected from the Standard Chlorine site during multiple investigations (Weston 1993, ERM 1997, Key 1999, Brown and Caldwell 2001, Salkie 2002, BBL 2005). Surface water and sediment samples were collected from the Hackensack River, the drainage ditch on the property, and wetlands south of the property. Groundwater samples were collected from monitoring wells throughout the property, and soil samples were also collected throughout the property. Based on the results of laboratory analyses of these samples, the primary contaminants of concern to NOAA are metals, polycyclic aromatic hydrocarbons (PAHs), chlorobenzenes, and dioxins, specifically 2,3,7,8-TCDD.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available.

In the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC; USEPA 2006); the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000); the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008b). Exceptions to these screening guidelines, if any, are noted in Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Standard Chlorine Chemical Company, Inc. site (Weston 1993, ERM 1997, Key 1999, Brown and Caldwell 2001, Salkie 2002, BBL 2005). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)	
Contaminant	Soil	ORNL-PRG[a]	Groundwater	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/INORGANICS							
Arsenic	**42**	9.9	**250**	73	150	**120**	9.79
Cadmium	**4.2**	0.36[d]	**170**	**9.3**	0.25[e]	**3.3**	0.99
Chromium	**35,000**	0.4	**100,000**	**8,600**	11[f]	**14,000**	43.4
Copper	**340**	60	**570**	**460**	9[e]	**1,300**	31.6
Lead	**650**	40.5	**21,000**	**12,000**	2.5[e]	**740**	35.8
Mercury	**0.5**	0.00051	**140**	**8.8**	0.77[g]	**9.1**	0.18
Nickel	**52**	30	**6,700**	**200**	52[e]	**310**	22.7
Selenium	ND	0.21	**25**	ND	5.0[h]	2.0	NA
Silver	ND	2	**10**	**8.1**	3.2[e,i]	2.8	4.5[j]
Zinc	**3,700**	8.5	**12,000**	**1,100**	120[e]	**610**	121
PAHs							
Acenaphthene	0.5	20	**2,900**	38	520[k]	**25**	0.290[j]
Acenaphthylene	0.1	NA	190	3	NA	**50**	0.160[j]
Anthracene	0.6	NA	69	4	NA	**130**	0.0572
Benz(a)anthracene	1.6	NA	ND	7.6	NA	**300**	0.108
Benzo(a)pyrene	0.4	NA	ND	9.1	NA	**280**	0.15
Benzo(b)fluoranthene	0.7	NA	ND	12	NA	390	NA
Benzo(k)fluoranthene	0.2	NA	ND	4.3	NA	**130**	13.4[j]
Chrysene	1.6	NA	ND	8.6	NA	**260**	0.166
Dibenz(a,h)anthracene	0.5	NA	ND	ND	NA	**61**	0.033
Fluoranthene	3.5	NA	30	16	NA	**740**	0.423
Fluorene	0.2	NA	300	9	NA	**46**	0.0774
Indeno(1,2,3-cd)pyrene	0.9	NA	ND	6.5	NA	**190**	0.330[j]
2-Methylnaphthalene	ND	NA	ND	80	NA	190	NA

Table 2 continued on next page

Table 2, *cont.*

Contaminant	Soil (mg/kg) Soil	Soil (mg/kg) ORNL-PRG[a]	Water (µg/L) Ground-water	Water (µg/L) Surface Water	Water (µg/L) AWQC[b]	Sediment (mg/kg) Sediment	Sediment (mg/kg) TEC[c]
Naphthalene	2,400,000	NA	**58,000**	260	620[k]	**4,600**	0.176
Phenanthrene	2.4	NA	290	7.8	NA	**520**	0.204
Pyrene	6.9	NA	22	19	NA	**580**	0.195
CHLOROBENZENES							
1,2-Dichlorobenzene	9,200	NA	**30,000**	450	763[k]	5,300	NA
1,3-Dichlorobenzene	1,700	NA	27,000	430	NA	3,900	NA
1,4-Dichlorobenzene	4,800	NA	**29,000**	610	763[k]	6,000	NA
1,2,4-Trichlorobenzene	100,000	NA	**26,000**	**200**	50[k]	2,900	NA
PESTICIDES/PCBs							
4,4'-DDE	ND	NA	ND	ND	1,050[i,k]	**0.03**	0.00316
4,4'-DDT	ND	NA	ND	ND	0.001[l]	**0.04**	0.00416
Dieldrin	ND	0.000032[d]	ND	ND	0.056	**0.07**	0.0019
Endrin	ND	NA	ND	ND	0.036	**0.09**	0.00222
Heptachlor	ND	NA	ND	ND	0.0038	**0.11**	0.010[j]
Heptachlor Epoxide	ND	NA	ND	ND	0.0038	**0.56**	0.00247
Total PCBs	0.3	0.371	ND	ND	0.014	**0.21**	0.0598
DIOXINs/FURANs							
TEQ (Toxic Equivalent Value)[m]	**0.3**	3.15×10^{-6}	ND	NA	1.0×10^{-8}[k]	**9.6×10^{-5}**	3.18×10^{-6}[n]

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Freshwater chronic criteria presented.
c: Threshold effects concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
d: Ecological soil screening guidelines (USEPA 2008b).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guidelines represent concentrations for $Cr.^{+6}$
g: Derived from inorganic, but applied to total mercury.
h: Criterion expressed as total recoverable metal.
i: Chronic criterion not available; acute criterion presented.
j: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
k: Lowest observable effects level (LOEL) (USEPA 1986).
l: Expressed as total DDT.
m: Maximum toxic equivalent (TEQ) value is provided. Each dioxin/furan is assigned a toxic equivalency factor (TEF) relative to 2,3,7,8-tetrachlorodibenzodioxin, which is the most toxic in this group of compounds. In order to determine the toxicity of a mixture of dioxin/furan compounds, the measured concentration of the individual dioxins/furans is multiplied by the assigned TEF. The results are summed to produce a TEQ.
n: Regional-specific biota-sediment accumulation factor (BSAF; Wintermyer and Cooper 2003).
NA: Screening guidelines not available.
ND: Not detected.

Surface Water

Eight metals were detected in surface water samples collected from the Standard Chlorine site at maximum concentrations that exceeded screening guidelines (Table 2). The maximum concentration of lead, which was detected in a sample taken from the wetlands south of the property (Figure 2), exceeded the AWQC by three orders of magnitude. The maximum concentration of chromium, which was detected in a sample collected from the western portion of the drainage ditch, exceeded the AWQC by two orders of magnitude. The maximum concentrations of cadmium, copper, mercury, nickel, silver, and zinc were detected in samples collected from the Hackensack River adjacent to the Standard Chlorine site. The maximum concentrations of cadmium, copper, and mercury exceeded the AWQC by one order of magnitude. The maximum concentrations of silver, nickel, and zinc exceeded the AWQC by factors of 2.5, four, and nine, respectively.

Thirteen PAHs were detected in surface water samples collected from the Standard Chlorine site (Table 2). The maximum concentrations of acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene were detected in samples taken from the Hackensack River adjacent to the site. The maximum concentrations of fluorene and phenanthrene were detected in samples taken from the eastern portion of the drainage ditch. The maximum concentration of 2-methylnaphthalene was detected in a sample taken from the western portion of the drainage ditch. Screening guidelines are not currently available for comparison to the maximum concentrations of any of the PAHs that were detected in the surface water samples.

One chlorobenzene was detected at a maximum concentration that exceeded the relevant screening guideline, and a second chlorobenzene was also detected for which no screening guideline is currently available (Table 2). The maximum concentrations of 1,2,4-trichlorobenzene and 1,3-dichlorobenzene were detected in surface water samples collected from the drainage ditch (Figure 2). The maximum concentration of 1,2,4-trichlorobenzene exceeded the AWQC by a factor of four. No screening guideline is currently available for comparison to the maximum concentration of 1,3-dichlorobenzene detected in the surface water samples.

Sediment

Eight metals were detected in sediment samples taken from the Standard Chlorine site at maximum concentrations that exceeded the TECs, and one metal was also detected for which no screening guideline is currently available (Table 2). The maximum concentrations of cadmium, chromium, and nickel were detected in samples collected from the Hackensack River adjacent to the Standard Chlorine property. The maximum concentration of chromium and nickel exceeded the TEC by two orders of magnitude and one order of magnitude, respectively. The maximum concentration of cadmium exceeded the TEC by a factor of three. The maximum concentrations of copper, lead, selenium, and zinc were detected in samples collected from the Hackensack River upstream of the property. The maximum concentrations of copper and lead exceeded the TECs by one order of magnitude. The maximum concentration of zinc exceeded the TEC by a factor of five. No screening guideline is currently available for comparison to the maximum concentration of selenium detected in the sediment samples. The maximum concentrations of arsenic and mercury were detected in a sample collected from the Hackensack River downstream of the site and both exceeded the TECs by one order of magnitude.

Fourteen PAHs were detected in sediment samples taken from the Standard Chlorine site at maximum concentrations that exceeded the TECs, and two PAHs were also detected for which no screening guidelines are currently available (Table 2). The maximum concentrations of acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene were detected in samples collected from the Hackensack River adjacent to the southwest end of the property. The maximum concentration of naphthalene exceeded the TEC by four orders of magnitude. The maximum concentrations of anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, phenanthrene, and pyrene exceeded the TECs by three orders of magnitude. The maximum concentrations of acenaphthylene, fluorene, and indeno(1,2,3-cd)pyrene exceeded the TECs by two orders of magnitude. The maximum concentration of benzo(k)fluoranthene exceeded the TEC by one order of magnitude. No screening guideline is currently available for comparison to the maximum concentration of benzo(b)fluoranthene detected in the sediment samples. The maximum concentrations of acenaphthene and 2-methylnaphthalene were detected at in a sample collected from the Hackensack River downstream of the property. The maximum concentration of acenaphthene exceeded the TEC by one order of magnitude. No screening guideline is currently available for comparison to the maximum concentration of 2-methylnaphthalene detected in the sediment samples.

Four chlorobenzenes were detected at maximum concentrations in sediment samples collected from the drainage ditch (Figure 2). No screening guidelines are currently available for comparison to the maximum concentrations of 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene detected in the sediment samples.

Six pesticides and PCBs were detected in sediment samples collected from the Standard Chlorine site at maximum concentrations that exceeded the TECs (Table 2). The maximum concentrations of the pesticides 4,4'-DDE, 4,4'-DDT, dieldrin, and endrin, which were detected in samples collected from the wetlands south of the property (Figure 2), exceeded the TECs by approximately one order of magnitude. The pesticides heptachlor and heptachlor epoxide, and total PCBs were detected at maximum concentrations in samples collected from the Hackensack River approximately 300 m (1,000 ft) downstream of the property. The maximum concentration of heptachlor epoxide exceeded the TEC by two orders of magnitude; heptachlor exceeded the TEC by one order of magnitude. The maximum concentration of total PCBs exceeded the TEC by a factor of 3.5.

The maximum concentrations of dioxins were detected in sediment samples collected from the Hackensack River adjacent to the Standard Chlorine property. The maximum toxic equivalent value (TEQ) calculated for dioxins exceeded the region-specific biota-sediment accumulation factor (BSAF) by one order of magnitude (.

<u>Groundwater</u>

Ten metals were detected in groundwater samples collected from monitoring wells on the Standard Chlorine site at maximum concentrations that exceeded the AWQC (Table 2). The maximum concentrations of cadmium, lead, mercury, and selenium were detected in samples taken near the waste lagoons (Figure 2). The maximum concentration of lead exceeded the AWQC by three orders of magnitude; cadmium and mercury exceeded the AWQC by two orders of magnitude. The maximum concentration of selenium exceeded the AWQC by a factor of five. The maximum concentration of chromium, which was detected in a sample collected from the northeast portion of the site, exceeded the AWQC by three orders of magnitude. The maximum concentrations of arsenic, copper, nickel, and zinc were detected in samples collected from the southeast corner of the site. The maximum concentrations of nickel and zinc exceeded the AWQC by two orders of magnitude. The maximum concentration of copper exceeded the AWQC by one order of magnitude. The maximum concentration of arsenic exceeded the AWQC by a factor of approximately 1.5. The maximum concentration of silver, which was detected in several samples from different locations, exceeded the AWQC by a factor of three.

Two PAHs were detected in groundwater samples collected from the Standard Chlorine site at maximum concentrations that exceeded the AWQC, and six PAHs were also detected for which no screening guidelines are currently available. The maximum concentrations of naphthalene and acenaphthene, which were detected in samples taken from the southeast portion of the site, exceeded the AWQCs by one order of magnitude and a factor of 5.5, respectively. The maximum concentrations of acenaphthylene and phenanthrene were detected in samples collected near the waste lagoons (Figure 2). The maximum concentrations of anthracene, fluoranthene, fluorene, and pyrene were detected in samples collected from the northeast portion of the site. No screening guidelines are currently available for comparison to the maximum concentrations of acenaphthylene, anthracene, fluoranthene, fluorene, phenanthrene, and pyrene detected in the groundwater samples.

Three chlorobenzenes were detected in groundwater at the site at maximum concentrations that exceeded the AWQCs, and a fourth chlorobenzene was also detected for which no screening guideline is currently available (Table 2). The maximum concentration of 1,2-dichlorobenzene, which was detected in a sample collected south of Building 2 (Figure 2), exceeded the AWQC by one order of magnitude. The maximum concentrations of 1,3-dichlorobenzene and 1,4-dichlorobenzene were detected in a sample collected near the wetlands south of the property. The maximum concentration of 1,4-dichlorobenzene exceeded the AWQC by one order of magnitude. No screening guideline is currently available for comparison to the maximum concentration of 1,3-dichlorobenzene detected in the groundwater samples. The maximum concentration of 1,2,4-trichlorobenzene, which was detected in a sample collected near the waste lagoons, exceeded the AWQC by two orders of magnitude.

<u>Soil</u>

Eight metals were detected in soil samples collected from the Standard Chlorine site at maximum concentrations that exceeded screening guidelines (Table 2). Chromium was detected in a sample collected from the north side of the site at a maximum concentration that exceeded the ORNL-PRG by four orders of magnitude. The maximum concentrations of arsenic, cadmium, copper, lead, mercury, nickel, and zinc were detected in samples collected from the southwest portion of the site. The maximum concentration of mercury exceeded the ORNL-PRG by nearly three orders of magnitude; zinc exceeded the ORNL-PRG by two orders of magnitude, and lead exceeded the ORNL-PRG by one order of magnitude. The maximum concentration of cadmium exceeded the USEPA's ecological soil screening guideline by one order of magnitude. The maximum concentrations of nickel, arsenic, and copper exceeded the ORNL-PRGs by factors of approximately two, four, and five, respectively.

Fourteen PAHs for which no screening guidelines are currently available, were detected in soil samples collected from the Standard Chlorine site (Table 2). The maximum concentrations of benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene were detected in samples collected from the western portion of the site. The maximum concentrations of acenaphthylene, anthracene, benz(a)anthracene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were all detected in a sample collected northwest of Building 1 (Figure 2). The maximum concentration of naphthalene was detected in a sample collected adjacent to the empty tanks.

Four chlorobenzenes for which no screening guidelines are currently available, were detected in soil samples collected from the site (Table 2). The maximum concentration of 1,2-dichlorobenzene was detected in a sample collected west of Building 2 (Figure 2). The maximum concentration of 1,3-dichlorobenzene was detected in a sample collected near the waste lagoons. The maximum concentrations of 1,4-dichlorobenzene and 1,2,4-trichlorobenzene were detected in a sample collected adjacent to the empty tanks.

The maximum dioxin TEQ was calculated for a soil sample collected near the waste lagoons. The maximum TEQ calculated for dioxins exceeded the ORNL-PRG by nearly five orders of magnitude.

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White Swan Laundry and Cleaner Inc.

Wall Township, New Jersey
EPA Facility ID: NJSFN0204241
Basin: Mullica-Toms Watershed
HUC: 02040301

Executive Summary

The White Swan Laundry and Cleaner Inc. site (White Swan) consists of two overlapping, contaminated groundwater plumes in Wall Township, Monmouth County, New Jersey. The sources of the plumes are two former dry-cleaning facilities: White Swan and Sun Cleaners. Contaminants associated with dry-cleaning operations, including the volatile organic compounds PCE and TCE, have been detected in soil and groundwater at the White Swan Laundry and Cleaners property and the Sun Cleaners property, and in surface water down-gradient of these properties. VOCs are the primary contaminants of concern to NOAA. The habitat of primary concern to NOAA is Wreck Pond, where PCE has been detected. Wreck Pond, which is connected to the Atlantic Ocean, is located northeast of the two dry-cleaning facilities. Nearby Wreck Pond Brook, Watson Creek, Glimmer Glass Lake, Stockton Lake, the Manasquan River estuary, and Judas Creek, an intermittent stream adjacent to the Sun Cleaners property where PCE was detected, are secondary habitats of concern. The surface waters near the site are used by many NOAA trust resources as a nursery and spawning area and as adult habitat. Groundwater transport is the primary pathway for the migration of contaminants to NOAA trust resources

Site Background

The White Swan Laundry and Cleaner Inc. site (White Swan) is in a commercial/residential area of Wall Township, Monmouth County, New Jersey (Figure 1). The site consists of two overlapping, contaminated groundwater plumes, one emanating from the former White Swan Laundry and Cleaner property (White Swan property), and the other emanating from the former Sun Cleaners property (USEPA 2004). Volatile organic compounds (VOCs) associated with dry-cleaning operations, including tetrachloroethylene (PCE) and trichloroethylene (TCE), have been detected in soil, surface water, and groundwater samples collected from the White Swan site. The two former dry-cleaning facilities are located southwest of Wreck Pond, a 19-ha (48-acre) pond that connects to the Atlantic Ocean via a large pipe (NJDEP 2004); PCE has been detected in surface water samples from Wreck Pond and Judas Creek. The White Swan property is approximately 270 m (900 ft) from Watson Creek and the Sun Cleaners property is just south of Watson Creek. Watson Creek, Stockton Lake, Glimmer Glass Lake, and the Manasquan River estuary all ultimately discharge to the Atlantic Ocean (Figure 1).

<u>White Swan Property</u>

A dry-cleaning facility was operated on the White Swan property from approximately 1964 through 1986. Waste from the dry cleaning was discharged into a septic tank connected to a seepage pit until the early 1980s, when the property was connected to the public sewer system (Weston 2003). The seepage pit is a covered pit with a perforated lining through which discharge from the septic tank can infiltrate into the surrounding soil. Both the septic

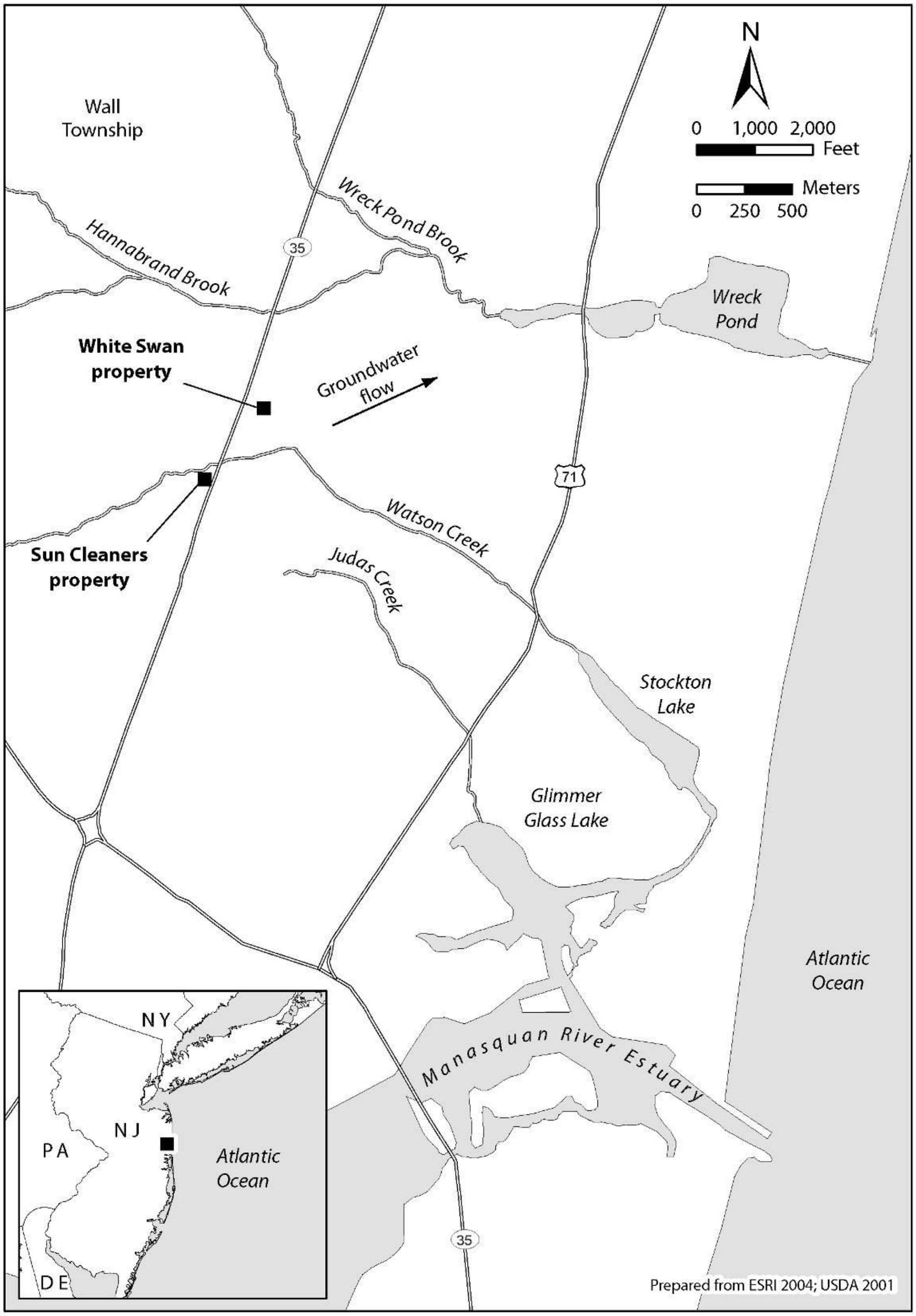

Figure 1. Location of the White Swan Laundry and Cleaner Inc. site , Wall Township, New Jersey.

tank and the seepage pit were located on the White Swan property. Contaminants associated with dry-cleaning chemicals, including the VOCs PCE and TCE, were detected at the White Swan property during investigations conducted from 2000 to 2003 (Weston 2003).

Sun Cleaners Property

Dry cleaning operations were conducted at the Sun Cleaners property from about 1960 until 1991. During investigations conducted at the Sun Cleaners property from 1995 to 1996, a discharge pipe from the dry-cleaning building was observed; the discharge pipe connected to equipment that had been used to separate dry-cleaning solvent from water used in the dry-cleaning process. No containment structure was documented below the discharge pipe (Weston 2003). Contaminants associated with dry-cleaning chemicals: VOCs, including TCE and PCE, have been detected at the Sun Cleaners property (Weston 2003).

The White Swan site was placed on the National Priorities List on September 23, 2004. A remedial investigation/feasibility study of the site began on September 2, 2006 and activities are still underway; no results from that investigation were available at the time of this report (USEPA 2004, 2008).

Groundwater transport is the primary pathway for the migration of contaminants from the site to NOAA trust resources. Groundwater flow in the vicinity of the site is generally to the east-northeast. Groundwater is encountered beneath the site at 0.9 to 6.7 m (3 to 22 ft) below the ground surface (Weston 2003).

NOAA Trust Resources

The habitat of primary concern to NOAA is Wreck Pond (Figure 1), where PCE has been detected. Wreck Pond is connected to the Atlantic Ocean via a large pipe (NJDEP 2004). Other habitats that are potentially impacted by the site are Wreck Pond Brook, Judas Creek, Watson Creek, Stockton Lake, Glimmer Glass Lake, and the Manasquan River estuary (Figure 1). Watson Creek empties into Stockton Lake, which connects to Glimmer Glass Lake. Judas Creek, an intermittent stream adjacent to the Sun Cleaners property, also empties into Glimmer Glass Lake. Glimmer Glass Lake is connected to the Manasquan River estuary, which is in turn connected to the Atlantic Ocean. The White Swan and Sun Cleaners properties are approximately 4 km (2.5 mi) from the estuary.

Table 1 summarizes the NOAA trust resources present in the Manasquan River estuary, Wreck Pond, and the nearshore Atlantic Ocean in the vicinity of the site. Anadromous alewife and blueback herring migrate through Wreck Pond to spawn in its tributaries, including Wreck Pond Brook and Hannabrand Brook (Figure 1) (Smith 2006; NJDEP 2005a). Anadromous striped bass are present in the neashore marine waters adjacent to Wreck Pond but are not likely to migrate into its tributaries to spawn because of the water's shallowness and rate of slow flow. The nearshore Atlantic Ocean adjacent to Wreck Pond provides habitat to many marine species, including bluefish, northern searobin, striped mullet, summer flounder, tautog, and weakfish (Burlas et al. 2001). In addition, blue crab, mummichog, river herring (blueback herring and alewife), silversides, summer flounder, and white perch may be present in the tidally influenced creek and streams adjacent to the site. Shellfish present in the nearshore areas of the Atlantic Ocean adjacent to Wreck Pond include Atlantic sand crab, Atlantic surf clam, blue mussel, and lady crab (NJDEP 1999).

Table 1. NOAA trust resources present in the Manasquan River estuary, Wreck Pond, and the nearshore Atlantic Ocean near the White Swan Laundry and Cleaners Inc. site (MWMG 1999; Burlas et al. 2001; NJDEP 2005a; Smith 2006; Rossman 2006).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*		♦	♦		
Blueback herring	*Alosa aestivalis*		♦	♦		
Gizzard shad	*Dorosoma cepedianum*		♦	♦		
Striped bass	*Morone saxatilis*			♦		♦
White perch	*Morone americana*			♦		
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		
MARINE/ ESTUARINE FISH						
American sand lance	*Ammodytes americanus*	♦	♦	♦		
Atlantic croaker	*Micropogonias undulatus*	♦	♦	♦		
Atlantic herring	*Clupea harengus*	♦	♦	♦		
Atlantic mackerel	*Scomber scombrus*		♦	♦	♦	
Atlantic menhaden	*Brevoortia tyrannus*	♦	♦	♦		
Atlantic needlefish	*Strongylura marina*	♦	♦	♦		
Atlantic silverside	*Menidia menidia*	♦	♦	♦		
Bay anchovy	*Anchoa mitchilli*	♦	♦	♦		
Black drum	*Pogonias cromis*					
Black sea bass	*Centropristis striata*	♦	♦	♦	♦	♦
Bluefish	*Pomatomus saltatrix*		♦	♦	♦	♦
Butterfish	*Peprilus triacanthus*	♦	♦	♦	♦	
Crevalle jack	*Caranx hippos*	♦	♦	♦		
Cunner	*Tautogolabrus adspersus*	♦	♦	♦		♦
Florida pompano	*Trachinotus carolinus*		♦	♦		
Inland silverside	*Menidia beryllina*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Northern kingfish	*Menticirrhus saxatilis*	♦	♦	♦	♦	♦
Northern pipefish	*Syngnathus fuscus*	♦	♦	♦		
Northern puffer	*Sphoeroides maculatus*	♦	♦	♦		
Northern searobin	*Prionotus carolinus*	♦	♦	♦		♦
Permit	*Trachinotus falcatus*		♦	♦		
Red hake	*Urophycis chuss*	♦	♦	♦		
Sheepshead minnow	*Cyprinodon variegatus*	♦	♦	♦		
Silver perch	*Bairdiella chrysoura*	♦	♦	♦		
Silversides	*Menidia spp.*	♦	♦	♦		
Spot	*Leiostomus xanthurus*	♦	♦	♦		

Table 1 continued on next page

Table 1, *cont*.

Species	**Habitat Use**	**Fisheries**				
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
MARINE/ ESTUARINE FISH						
Spotted hake	*Urophycis regia*	♦	♦	♦		
Summer flounder	*Paralichthys dentatus*	♦	♦	♦	♦	♦
Tautog	*Tautoga onitis*	♦	♦	♦	♦	♦
Weakfish	*Cynoscion regalis*	♦	♦	♦	♦	♦
White mullet	*Mugil curema*	♦	♦	♦		
Windowpane	*Scophthalmus aquosus*	♦	♦	♦		
Winter flounder	*Pseudopleuronectes americanus*	♦	♦	♦	♦	♦
INVERTEBRATES						
Atlantic surfclam	*Spisula solidissima*	♦	♦	♦	♦	
Blue crab	*Callinectes sapidus*	♦	♦	♦	♦	♦
Blue mussel	*Mytilus edulis*	♦	♦	♦		
Eastern oyster	*Crassostrea virginica*	♦	♦	♦		
Lady crab	*Ovalipes ocellatus*	♦	♦	♦		
Northern quahog	*Mercenaria mercenaria*	♦	♦	♦	♦	♦

The Manasquan River estuary is used by many fish and shellfish species as a nursery and spawning area and as adult habitat. NOAA trust resources in the Manasquan River estuary in the vicinity of the site include alewife, American eel, Atlantic croaker, Atlantic herring, Atlantic menhaden, black drum, black sea bass, blueback herring, gizzard shad, red hake, northern pipefish, spotted seatrout, striped bass, summer and winter flounder (MWMG 1999). Shellfish, including blue crab, blue mussel, Eastern oyster, and northern quahog, are also found in the Manasquan River estuary (MWMG 2000).

Commercial fisheries in the Atlantic Ocean near the site include Atlantic mackerel, black sea bass, bluefish, butterfish, northern kingfish, summer flounder, tautog, weakfish, and winter flounder (NJDEP 2006a). Recreational fishers commonly target black sea bass, bluefish, winter cunner, northern kingfish, northern searobin, striped bass, summer flounder, tautog, weakfish, and winter flounder in the vicinity of the site (Burlas et al. 2001).

Shellfish species that are commercially harvested in the vicinity of the site are Atlantic surf clam, blue crab, and northern quahog (NJDEP 2006a). Blue crab and northern quahog are also harvested recreationally (NJDEP 2006b). The harvesting of shellfish is prohibited within approximately 0.8 km (0.5 mi) of land in the section of the Atlantic Ocean adjacent to Wreck Pond (NJDEP 2005b). Shellfish can be harvested in the Manasquan River estuary only by special permit; the shellfish must be processed in a depuration plant (where pollutants are purged from shellfish) or held in clean estuarine waters before they can be eaten (NJDEP 2005b).

No regional fish consumption advisories specific to the Manasquan River estuary or Wreck Pond and its tributaries are in effect. In 2006, the New Jersey Department of Environmental Protection (NJDEP) issued a statewide fish consumption advisory for estuarine and marine waters due to contamination by PCBs and dioxin (NJDEP 2006c). The advisory recommends:

- The general public reduce consumption of American eel, bluefish, and striped bass and that high-risk individuals avoid consuming these species.
- All individuals avoid consumption of the hepatopancreas of American lobster.

Site-Related Contamination

During several site investigations conducted between 1995 and 2003, groundwater and soil samples were collected from the White Swan and Sun Cleaners properties (GES 2000, 2001; Weston 2003), and surface water samples were collected from Wreck Pond and Watson Creek. All of the samples were analyzed for VOCs, which are the primary contaminants of concern to NOAA.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC; USEPA 2006), and the screening guidelines for soil are the Canadian Council of Ministers of the Environment (CCME) soil guidelines for agricultural land uses (CCME 2006). Exceptions to these screening guidelines, if any, are noted in Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the White Swan Laundry and Cleaner Inc. site (GES 2000, 2001; Weston 2003). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)			**Water (µg/L)**			
Contaminant	White Swan Laundry and Cleaners Soil	Sun Cleaners Soil	CCME Soil Guidelines[a]	White Swan Laundry and Cleaners Groundwater	Sun Cleaners Ground-water	Surface Water	AWQC[b]
VOCs							
Trichloroethylene (TCE)	ND	ND	0.01	760	28	ND	21,900[c]
Tetrachloroethylene (PCE)	**15,000**	**7,400**	0.1	**120,000**	**200,000**	**1,000**	840[c]
Cis-1,2-dichloroethene (cis-DCE)	ND	ND	NA	210	ND	ND	11,600[c,d]

a: Canadian Council of Ministers of the Environment (CCME) soil quality guidelines for the protection of environmental and human health, agricultural uses (CCME 2006).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Marine chronic criteria presented.
c: Chronic criterion not available; acute criterion presented.
d: Lowest Observable Effect Level (LOEL) (USEPA 1986).
NA: Screening guidelines not available.
ND: Not detected.

Surface Water

One VOC was detected in surface water samples collected from the site at a maximum concentration that exceeded the screening guideline. The maximum concentration of PCE, which was detected in a sample collected from Wreck Pond slightly exceeded the AWQC.

Groundwater

One VOC was detected in groundwater samples collected from both the White Swan and Sun Cleaners properties at maximum concentrations that exceeded the screening guideline. The maximum concentrations of PCE in monitoring well samples from both the White Swan and Sun Cleaners properties exceeded the AWQC by two orders of magnitude.

Soil

One VOC was detected in soil samples collected from both the White Swan and Sun Cleaners properties at maximum concentrations that exceeded the screening guideline. The maximum concentration of PCE detected at the White Swan property exceeded the CCME environmental quality guideline for agricultural land uses by five orders of magnitude. The maximum concentration of PCE detected at the Sun Cleaners property exceeded the CCME soil guideline by four orders of magnitude.

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Franklin Slag Pile (MDC)

Philadelphia, Pennsylvania
EPA Facility ID: PASFN0305549
Basin: Lower Delaware
HUC: 02040202

Executive Summary

The Franklin Slag Pile site encompasses approximately a 1.6-ha (4-acre) lot in Philadelphia, Pennsylvania, that contains approximately 52,000 m^3 (68,000 cy) of copper slag. While the site was active, slag material was observed in areas outside the property boundaries, including storm drains that discharge to the Delaware River and into a nearby lagoon and wetland area. Lead and copper are the primary contaminants of concern to NOAA. Surface water runoff is the primary pathway for the migration of contaminants from the site to NOAA trust resources. The habitat of primary concern to NOAA is the Delaware River, which is less than 0.4 km (0.25 mi) southeast of the site and provides habitat for NOAA trust resources, including anadromous, catadromous, and marine fish species.

Site Background

The Franklin Slag Pile (MDC) site, referred to here as the Franklin site, encompasses approximately a 1.6-ha (4-acre) lot in the Port Richmond section of northeast Philadelphia, Pennsylvania (Figure 1). The Franklin site is bordered to the northeast and and northwest by a lagoon and wetland area that belong to the Philadelphia Water Department (PWD) (Figure 2). The Delaware River is less than 0.4 km (0.25 mi) southeast of the site (USEPA 2006a).

The Franklin site consists of a waste pile that contains approximately 52,000 m^3 (68,000 cy) of copper slag. The slag, a byproduct of copper smelting at the adjacent Franklin Smelting and Refining Corporation, was purchased by a company called MDC and stored at the site until it could be physically treated and resold for use as a sandblast material or in asphalt roofing materials. MDC ceased operations and abandoned the site in 1999 (USEPA 2008).

While MDC was operating, slag was observed in areas outside of the property boundaries, including slag in storm drains along Castor and Delaware Avenues, which empty directly into the Delaware River, and in the adjacent lagoon and wetland area owned by the PWD (Tetra Tech 2001). Before its operations ceased at the site, MDC was cited by the U.S. Environmental Protection Agency (USEPA) Region III Water Protection Division for releasing lead into stormwater runoff (USEPA 2006a). Surface water runoff is the primary pathway for the migration of contaminants from the site to NOAA trust resources.

In 2000, an emergency response action led by the USEPA was initiated at the site. During the response action, a thick plastic cover was placed over the slag pile; equipment stored in the slag pile was decontaminated, and visible slag contamination that had migrated outside the property boundaries was removed (USEPA 2006a).

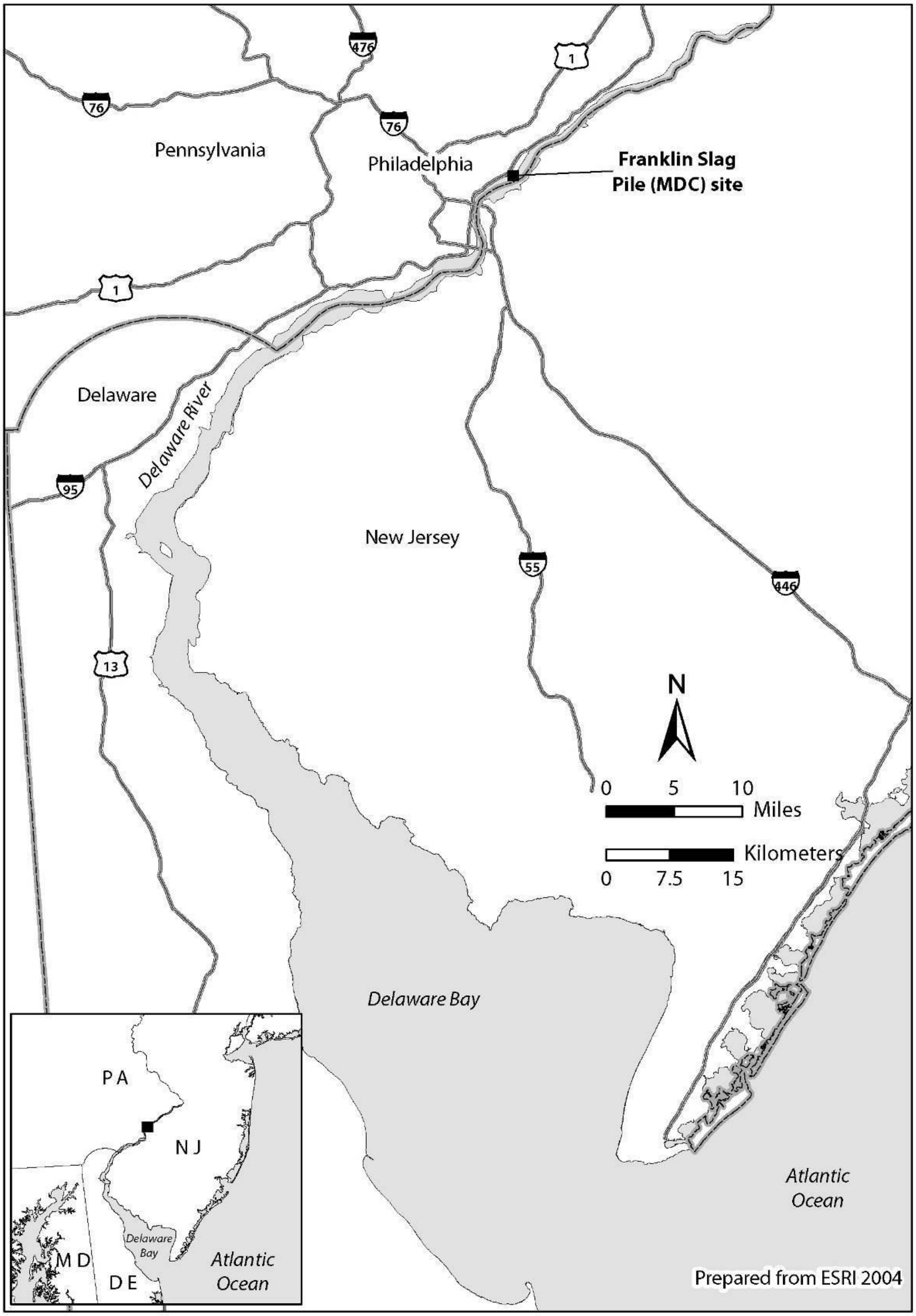

Figure 1. Location of the Franklin Slag Pile (MDC) site in Philadelphia, Pennsylvania.

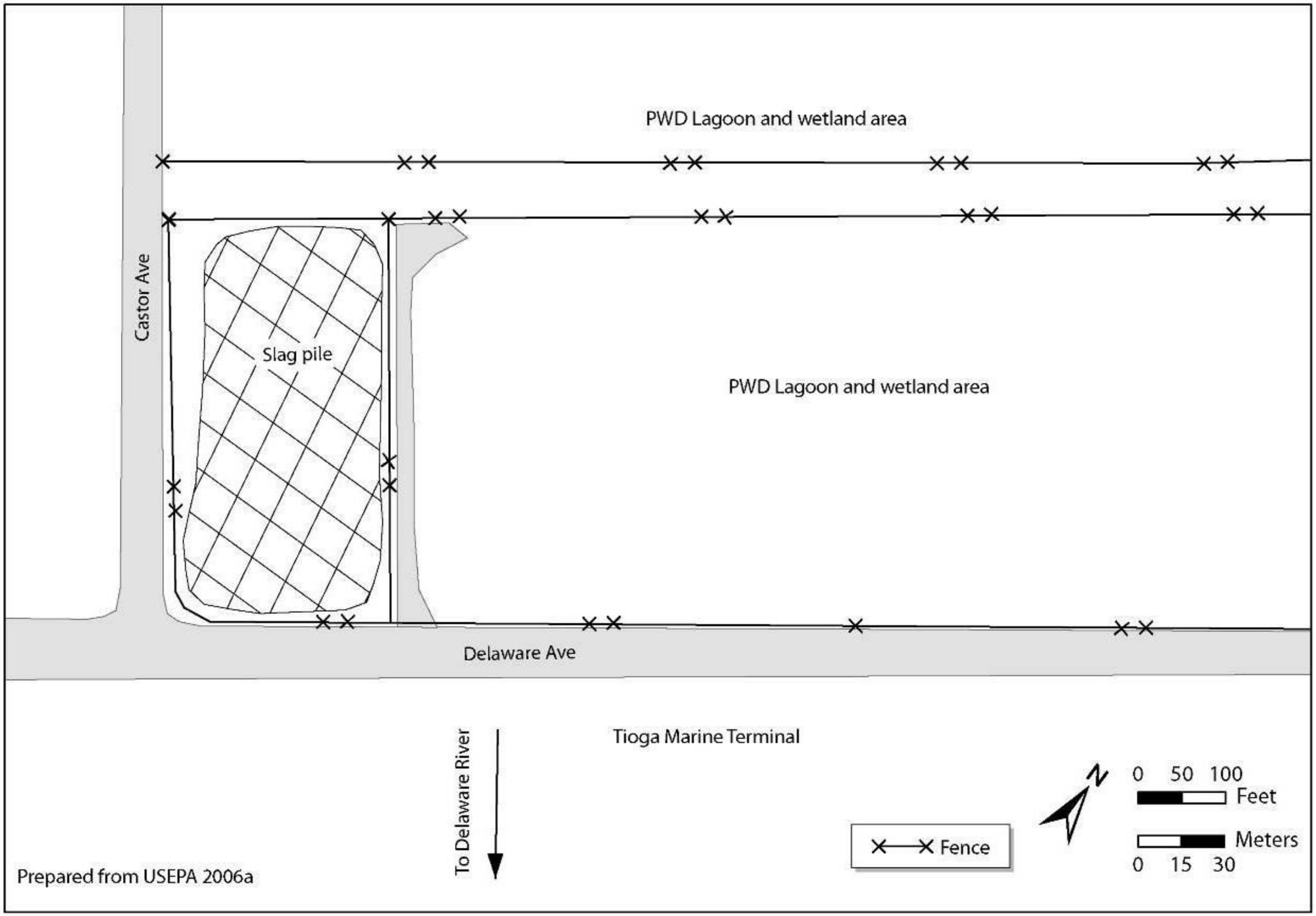

Figure 2. Detail of the Franklin Slag Pile (MDC) property.

The Franklin Slag Pile (MDC) site was placed on the USEPA's National Priorities List in 2002. The USEPA began a remedial investigation/feasibility study at the site in May 2002, and these activities are still underway; results from this investigation were not available at the time this report was prepared (USEPA 2007, 2008).

NOAA Trust Resources

The Delaware River is the habitat of primary concern to NOAA. The section of the Delaware River near Philadelphia is tidally influenced fresh water. Salinity concentrations in this area are nearly zero, and there are moderate amounts of suspended sediment (Sutton et al. 1996).

The Delaware River provides spawning, nursery, and adult habitat to several NOAA trust resources, including anadromous, catadromous, and marine fish species (Table 1). Alewife, American eel, American shad, blueback herring, and striped bass are commonly present in the Delaware River near the site (Kaufmann 2001). Atlantic menhaden are occasionally found in the area (Kaufmann 2001), and Atlantic sturgeon, a state endangered species in Pennsylvania, use habitat in the Delaware River near the site (PFBC 2007). There are no dams on the Delaware River that block the movement of anadromous or catadromous species near the site.

Table 1. NOAA trust resources present in the Delaware River near the Franklin Slag Pile site (O'Herron et al. 1994; Dove and Nyman 1995; Sutton et al. 1996; Kaufmann 2001).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*	♦	♦	♦		
American shad	*Alosa sapidissima*		♦	♦		♦
Atlantic sturgeon	*Acipenser oxyrinchus*	♦	♦	♦		
Blueback herring	*Alosa aestivalis*	♦	♦	♦		
Striped bass	*Morone saxatilis*	♦	♦	♦		♦
White perch	*Morone americana*	♦	♦	♦		♦
CATADROMOUS FISH						
American eel	*Anguilla rostrata*		♦	♦		
MARINE/ESTUARINE FISH						
Atlantic menhaden	*Brevoortia tyrannus*		♦	♦		
Bay anchovy	*Anchoa mitchilli*		♦	♦		
Hogchoker	*Trinectes maculatus*		♦	♦		
Inland silverside	*Menidia beryllina*		♦	♦		
INVERTEBRATES						
Blue crab	*Callinectes sapidus*		♦	♦		♦

Atlantic sturgeon and striped bass spawn approximately 32 km (20 mi) downstream of the site across the Delaware state line (Dove and Nyman 1995; Sutton et al. 1996). Alewife, blueback herring, and white perch spawn in the freshwater Delaware River near the site (O'Herron et al. 1994; Sutton et al. 1996). American eel spawn in the Atlantic Ocean, and juvenile and adult eel then migrate throughout the Delaware River basin. Atlantic menhaden spawn in salt water and migrate into the tidal freshwater Delaware River as juveniles (Sutton et al. 1996). Bay anchovy, hogchoker, and inland silverside spawn downstream of the site in Delaware Bay; as juveniles, these species mature in areas of lower salinity such as those near the site (Dove and Nyman 1995). Blue crab also spawn downstream of the site in Delaware Bay, and adult and juvenile blue crab are found throughout the tidally influenced portion of the Delaware River (Dove and Nyman 1995).

There are no commercial fisheries near the site, although commercial fishing occurs downstream in Delaware Bay. Recreational fishing for American shad, blue crab, striped bass, and white perch occurs on the Delaware River (Dove and Nyman 1995).

A fish consumption advisory is in effect for the tidally influenced portion of the Delaware River because of polychlorinated biphenyl (PCB) contamination (PADEP 2007). The advisory recommends that consumption of channel catfish, flathead catfish, striped bass, and white perch be limited to one meal per month. The advisory also recommends no human consumption of American eel and carp.

Site-Related Contamination

Samples of surface water runoff (i.e., stormwater), soil, and waste slag were collected at the Franklin site during multiple sampling events between 1994 and 2000 (USEPA 1994; Weston 2000). The samples were analyzed for selected metals. The primary contaminants of concern to NOAA are lead and copper.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for surface water are the USEPA ambient water quality criteria (AWQC; USEPA 2006b), and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; (Efroymson et al. 1997). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, discussed below. When known, the general sampling locations are also provided (refer to Figure 2).

Surface Water

Lead was detected in surface water samples collected from the Franklin site at a maximum concentration that exceeded the AWQC by three orders of magnitude (Table 2). The maximum concentration of lead was detected in a sample of stormwater runoff collected adjacent to the slag pile.

Soil

Three metals were detected in soil samples collected from the Franklin site at maximum concentrations that exceeded the ORNL-PRGs (Table 2). The maximum concentrations of beryllium, copper, and lead were detected in samples collected from around the perimeter of the slag pile. Maximum concentrations of copper and lead exceeded the ORNL-PRGs by two orders of magnitude, and beryllium exceeded the ORNL-PRG by one order of magnitude.

Slag

Beryllium, copper, and lead were detected in samples collected from the slag pile. No screening guidelines are available for comparison to the maximum concentrations of these metals detected in this type of material.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Franklin Slag Pile (MDC) site (USEPA 1994; Weston 2000). Contaminant values in bold exceed or are equal to screening guidelines.

	Waste Material (mg/kg)	**Soil (mg/kg)**		**Water (µg/L)**	
Contaminant	Slag	Soil	ORNL-PRG[a]	Surface Water	AWQC[b]
METALS/INORGANICS					
Beryllium	130	**110**	10	ND	NA
Copper	17,000	**24,000**	60	ND	9[c]
Lead	9,100	**6,700**	40.5	**7,000**	2.5[c]

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006b). Freshwater chronic criteria presented.
c: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
NA: Screening guidelines not available.
ND: Not detected.

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Price Battery

Hamburg, Pennsylvania
EPA Facility ID: PAN000305679
Basin: Schuylkill
HUC: 02040203

Executive Summary

The Price Battery site is a former lead battery manufacturing and recycling plant in Hamburg, Berks County, Pennsylvania. During the recycling process, a lead smelter was used to melt the lead plates from batteries and separate the lead from other components in the plates. Price Battery disposed of battery casings and wastes as fill material at numerous locations throughout the county, including along the banks of Kaercher Creek, which flows through the site and is a tributary to the Schuylkill River, and along the banks of the Schuylkill River. The primary contaminant of concern to NOAA is lead. The habitats of concern to NOAA are the Schuylkill River and Kaercher Creek. There are currently ten dams on the Schuylkill River that impede migratory fish from reaching the river in the vicinity of the site. However, a program to restore access for migratory fish is in progress. When fish passage to the upper reaches of the Schuylkill River is restored, anadromous alewife, American shad, blueback herring, and striped bass, and the catadromous American eel are expected to use the habitat near the site. Particulate deposition, surface water runoff, and direct discharge from battery casings are the primary pathways for the migration of contaminants to NOAA trust resources.

Site Background

The Price Battery site is a former lead battery manufacturing and recycling plant in a residential area of Hamburg, Berks County, Pennsylvania (Figure 1). From the 1940s to 1971, lead batteries were manufactured and recycled at the 3-ha (8-acre) site. Three manufacturing buildings, referred to as the East Building, the West Building, and the Oxide Department, and one large warehouse are present on the Price Battery property (Tetra Tech 2002). The general layout of the property is shown on Figure 2. Kaercher Creek, a tributary to the Schuylkill River, passes under the Price Battery property in a culvert (Figure 2) and then flows southwest before emptying into the Schuylkill River approximately 1 km (0.6 mi) west of the site.

During the recycling process, a lead smelter was used to melt the lead plates from batteries and separate the lead from other components in the plates. The lead smelter emitted particles containing lead into the air (USEPA 2004). In addition, Price Battery disposed of battery casings and wastes as fill material at numerous locations throughout the county, including along the banks of Kaercher Creek and the Schuylkill River, and allowed citizens to pick up old battery casings for use as fill material as well. Emissions from the smelter and the burial of old battery casings have contributed to elevated concentrations of lead in soil throughout Hamburg.

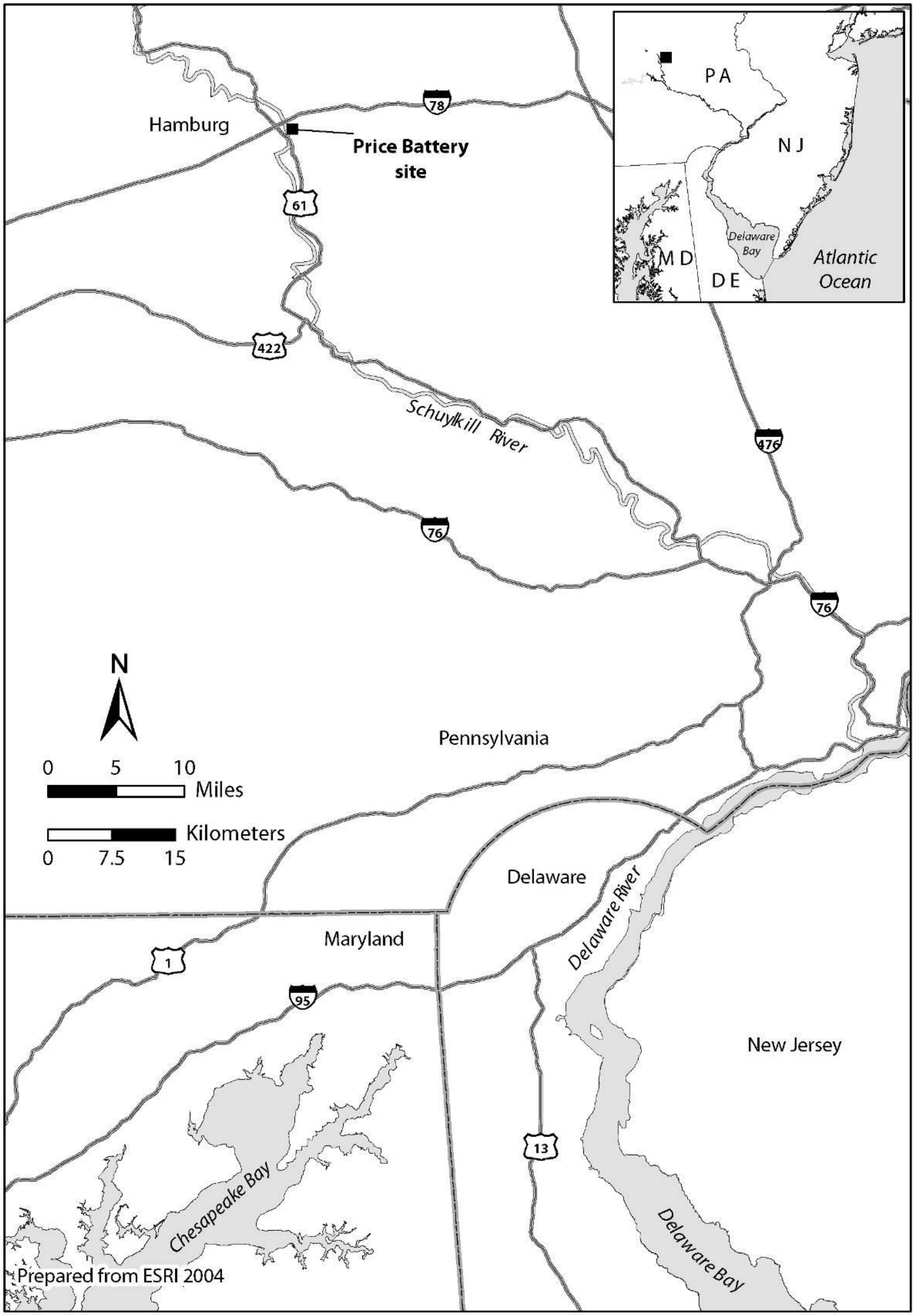

Figure 1. Location of the Price Battery site, Hamburg, Pennsylvania.

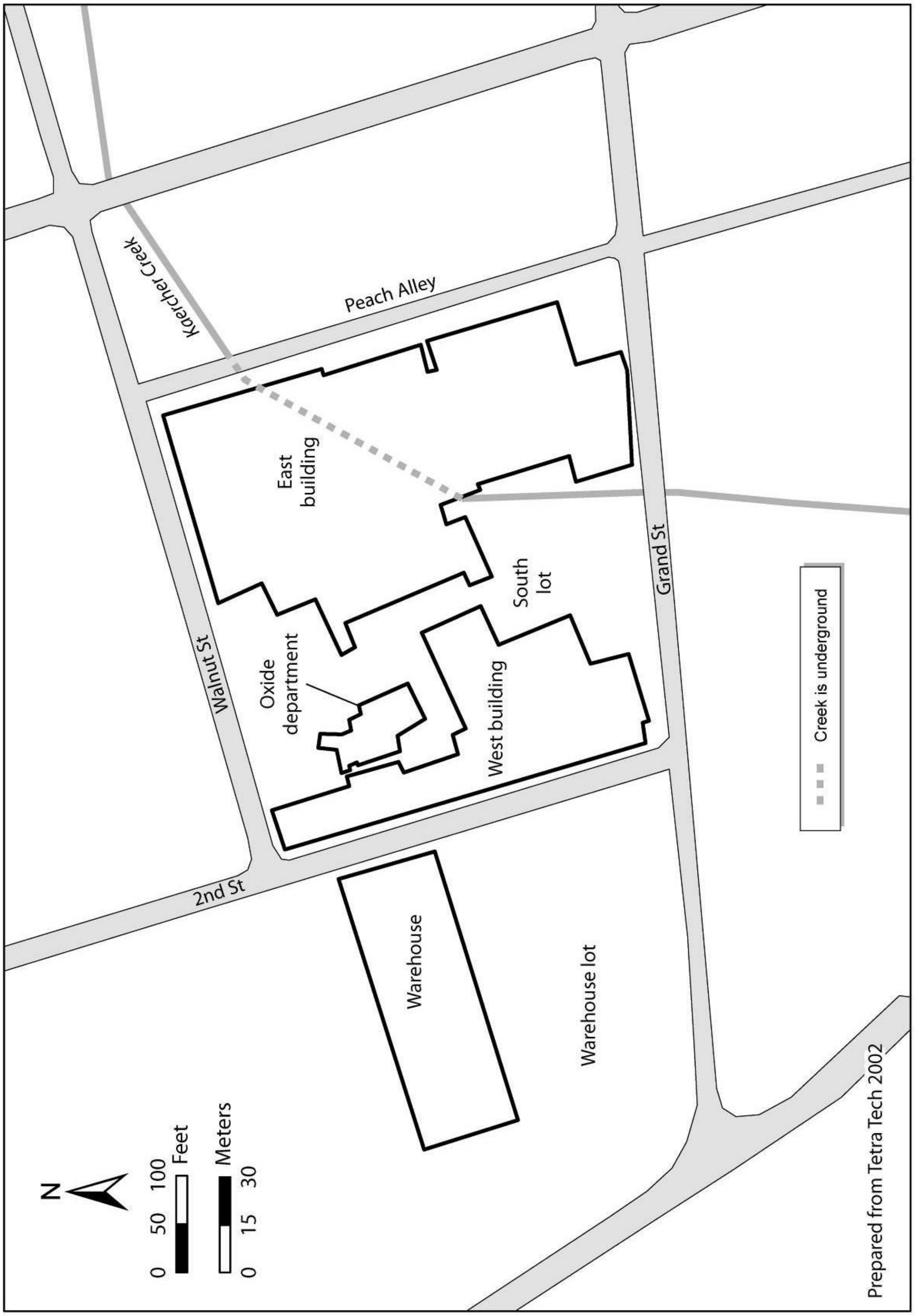

Figure 2. Detail of the Price Battery property.

Investigations conducted by and for the U.S. Environmental Protection Agency (USEPA) have detected elevated concentrations of lead and other metals in samples of soil, sediment, groundwater, and surface water. The Price Battery site was placed on the National Priorities List on April 27, 2005 (USEPA 2006a).

Pathways for the migration of contaminants from the site to NOAA trust resources are (1) deposition of particulate air emissions to Kaercher Creek and the SchuylkillRiver, and the site property (2) surface water runoff from contaminated soil at the property, and (3) direct discharge from battery casings that were disposed of in and adjacent to, Kaercher Creek and the Schuylkill River. Information regarding groundwater transport of contaminants, the depth of groundwater below the site, and the direction of groundwater flow was not available in the documents reviewed for this report.

NOAA Trust Resources

The habitats of concern to NOAA are the Schuylkill River and Kaercher Creek. Kaercher Creek flows under the site in a culvert and then flows southwest before emptying into the Schuylkill River approximately 1 km (0.6 mi) west of the site. Before entering the Schuylkill River, Kaercher Creek flows through areas, both upgradient and downgradient of the property, where old battery casings were used as fill. The creek is 0.9 to 3 m (3 to 10 ft) in width and 0.3 to 0.9 m (1 to 3 ft) in depth; sections of the creek are channelized by concrete walls.

Currently, there are ten dams on the Schuylkill River that impede the passage of migratory fish; seven of these dams are downstream of the site. However, a program to restore access for migratory fish is in progress. Plans call for breaching, removing, or adding fish passage to the seven dams downstream of the site, which would allow fish access to historical spawning reaches (Snyder 2004). As of 2008, fish passage facilities have been added to three dams; construction of a fish passage facility is currently in progress on another dam; two of the dams have been breached; and one dam is in the process of being breached (PFBC 2008a). The lower Schuylkill River provides habitat for anadromous alewife, American shad, blueback herring, and striped bass, and the catadromous American eel. Historically, these fish species were abundant throughout most of the Schuylkill River (Fairchild et al. 1998). When fish passage is restored to the upper reaches of the Schuylkill River, these species are expected to use habitat near the site for spawning, nursery, and adult habitat (Kaufmann 1992). Table 1 lists NOAA trust resources that will have access to habitat near the site after impediments to migratory fish passage are removed or modified.

The Pennsylvania Fish and Boat Commission regularly stocks juvenile American shad in the Schuylkill River as part of the Schuylkill River American Shad Restoration Program. In 2008, American shad were stocked in the Schuylkill River in the reach nearest the site (PFBC 2008b). The goal of the stocking to create a self-sustaining population of American shad that is not dependent on stocking (PFBC 2008a). Kaercher Creek does not provide suitable habitat for American Shad, which rarely enter small streams and are typically found in rivers (Steiner 2000).

Table 1. NOAA trust resources present in the Schuylkill River downstream of the Price Battery site (Kauffman 1992; Snyder 2004).

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
American shad[a]	*Alosa sapidissima*	♦	♦	♦		♦
Alewife[b]	*Alosa pseudoharengus*	♦	♦	♦		
Blueback herring[b]	*Alosa aestivalis*	♦	♦	♦		
Striped bass[b]	*Morone saxatilis*	♦	♦	♦		♦
CATADROMOUS FISH						
American eel[b]	*Anguilla rostrata*			♦		

a: Although American shad are present near the site because of stocking, not through natural migration, the goal of the stocking program is to create a self-migrating population.

b: Species is not currently present near the site but would likely be present after impediments to fish passage in lower sections of the Schuylkill River are removed or modified.

NOAA trust resources are not fished commercially on the Schuylkill River or its tributaries. American shad and striped bass are targeted by recreational fishers throughout the Schuylkill River (PFBC 2006b).

A 2006 fish consumption advisory is in effect for the section of the Schuylkill River adjacent to the site because of contamination with polychlorinated biphenyls (PCBs) (PDEP 2007). The advisory recommends that people reduce their consumption of bluegill, brown bullhead, brown trout, and rainbow trout and that they avoid consuming brook trout from reaches of the Schuylkill River near the site. No fish consumption advisories are in effect for Kaercher Creek.

Site-Related Contamination

During investigations conducted in 1994, 2000, and 2002, a total of 78 sediment and 33 surface water samples were collected from Kaercher Creek and the Schuylkill River downstream of and adjacent to, the Price Battery property. Approximately 50 percent of the surface water and sediment samples were analyzed for metals; the remaining 50 percent were analyzed only for lead (USEPA 1994; Weston 2000; Tetra Tech 2002).

In 2002, four groundwater samples were collected from monitoring wells at the Price Battery property and analyzed for lead (Tetra Tech 2002). Also in 2002, 48 soil samples were collected from the Price Battery property (Tetra Tech 2002). Eleven of these soil samples were analyzed for volatile organic compounds, semivolatile organic compounds, pesticides, PCBs, metals, and cyanide, and 37 of the samples were analyzed only for lead. In addition, 74 soil samples were collected from the banks of Kaercher Creek and two soil samples were collected from the banks of the Schuylkill River in 2002; these samples were analyzed for lead (Tetra Tech 2002). The primary contaminant of concern to NOAA is lead.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC; USEPA 2006b), and the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000). The screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008). Exceptions to these screening guidelines, if any, are noted in Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided (refer to Figures 1 and 2).

Surface Water

Three metals were detected in surface water samples collected from the site at maximum concentrations that exceeded the AWQC (Table 2). The maximum concentration of lead, which was detected in a sample collected from Kaercher Creek where it flows beneath the site (Figure 2), exceeded the AWQC by one order of magnitude. Maximum concentrations of copper and silver were detected in a sample collected from Kaercher Creek approximately 150 m (500 ft) upstream of the Price Battery property. The maximum concentration of silver exceeded the AWQC by a factor of 7.5; copper exceeded the AWQC by a factor of approximately 3.5.

Sediment

Seven metals were detected in sediment samples collected from Kaercher Creek at maximum concentrations that exceeded the TECs (Table 2). The maximum concentration of lead, which was detected in a sample collected approximately 550 m (1,800 ft) downstream of the Price Battery property, exceeded the TEC by three orders of magnitude. Maximum concentrations of arsenic, copper, and mercury were detected in samples collected approximately 430 m (1,400 ft) upstream of the Price Battery property. The maximum concentration of mercury exceeded the TEC by one order of magnitude; arsenic and copper exceeded the TECs by factors of two and three, respectively. The maximum concentrations of nickel and zinc were detected in samples collected from the Schuylkill River just upstream of its confluence with Kaercher Creek. The maximum concentration of nickel exceeded the TEC by a factor of 7.5, and zinc exceeded the TEC by a factor of five. The maximum concentration of silver, which was detected in a sample collected approximately 150 m (500 ft) upstream of the Price Battery property, exceeded the TEC by a factor of two.

Groundwater

The maximum concentration of lead, which was detected in a groundwater sample collected from a monitoring well in the west side of the south lot (Figure 2), exceeded the AWQC by a factor of approximately 7.5.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Price Battery site (USEPA 1994; Weston 2000; Tetra Tech 2002). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)	
Contaminant	Soil	ORNL-PRG[a]	Ground-water	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/INORGANICS							
Arsenic	**320**	9.9	N/A	11	150	**20**	9.79
Cadmium	**11**	0.36[d]	N/A	ND	0.25[e]	ND	0.99
Chromium	**25**	0.4	N/A	ND	11[f]	27	43.4
Copper	**440**	60	N/A	**33**	9[e]	**99**	31.6
Lead	**160,000**	40.5	**19**	**86**	2.5[e]	**62,000**	35.8
Mercury	**0.45**	0.00051	N/A	ND	0.77[g]	**2.8**	0.18
Nickel	27	30	N/A	4.4	52[e]	**170**	22.7
Selenium	**4.0**	0.21	N/A	ND	5.0[h]	ND	NA
Silver	**4.4**	2	N/A	**24**	3.2[e,i]	**11**	4.5[j]
Zinc	**280**	8.5	N/A	40	120[e]	**600**	121
PCBs							
Aroclor 1260[k]	**0.98**	0.371	N/A	N/A	0.014	N/A	0.0598

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goal (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria (AWQC) for the protection of aquatic organisms (USEPA 2006b). Freshwater chronic criteria presented.
c: Threshold effects concentration (TEC), the concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
d: Ecological soil screening guidelines (USEPA 2008).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guidelines represent concentrations for Cr^{+6}
g: Derived from inorganic, but applied to total mercury.
h: Criterion expressed as total recoverable metal.
i: Chronic criterion not available; acute criterion presented.
j: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
k: Screening guidelines are for Total PCBs
NA: Screening guideline not available.
N/A: Contaminant not analyzed for.
ND: Not detected.

Soil

Eight metals and selenium were detected in soil samples from the Price Battery property at maximum concentrations that exceeded screening guidelines (Table 2). The maximum concentrations of arsenic, cadmium, chromium, copper, lead, mercury, and silver were all detected in samples collected from the south lot (Figure 2). The maximum concentration of lead exceeded the ORNL-PRG by three orders of magnitude; mercury exceeded the ORNL-

PRG by two orders of magnitude, and arsenic and chromium exceeded the ORNL-PRGs by one order of magnitude. The maximum concentration of cadmium exceeded the USEPA ecological soil screening guideline by one order of magnitude. The maximum concentration of copper exceeded the ORNL-PRG by a factor of seven, and silver exceeded the ORNL-PRG by a factor of two. The maximum concentrations of selenium and zinc, which were detected in samples collected from the warehouse lot (Figure 2), exceeded the ORNL-PRGs by one order of magnitude.

The maximum concentration of PCB Aroclor 1260, which was detected in a soil sample collected from the north side of the property, exceeded the ORNL-PRG by a factor of approximately 2.5.

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Brewer Gold Mine

Jefferson, South Carolina
EPA Facility ID: SCD987577913
Basin: Lynches
HUC: 03040202

Executive Summary

The Brewer Gold Mine site is an abandoned gold mine encompassing approximately 400 ha (1,000 acres) in a forested rural area of Jefferson, Chesterfield County, South Carolina. The Brewer Gold Mine property is on a ridge that divides the Little Fork Creek and Lynches River basins. Small-scale pit mining, a process that used mercury, began at the site around 1828. Large-scale open pit mining, a process that used a cyanide solution, was conducted from 1987 to 1993. The primary contaminants of concern to NOAA are cyanide and selenium and metals, including arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc. Surface water runoff, direct discharge, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources; groundwater transport is a secondary pathway. NOAA trust resources that use Little Fork Creek, Fork Creek, and the Lynches River for spawning, nursery, or adult habitat are the anadromous American shad and striped bass, and the catadromous American eel.

Site Background

The Brewer Gold Mine site is an abandoned gold mine encompassing approximately 400 ha (1,000 acres) in a forested rural area of Jefferson, Chesterfield County, South Carolina (Figure 1). The Brewer Gold Mine property is on a ridge that divides the Little Fork Creek and Lynches River basins. East of the ridge, Little Fork Creek forms the eastern border of the property (Figure 2). The Lynches River is to the west of the ridge. The majority of the property is in the Little Fork Creek watershed (USEPA 2003).

Small-scale pit mining began at the site around 1828. In this process, mercury was used to isolate gold particles from crushed rock, forming an amalgam. The amalgam was heated in a furnace to extract the gold from the mercury. The mercury was then reclaimed, and the waste was discarded in a tailings pile located between the Brewer Pit and Sediment Control Pond (Figure 2) ((USEPA 2003).

From 1987 to 1993, large-scale open pit mining also occurred at the site. In this process, a cyanide solution was sprayed over piles of crushed ore to dissolve gold into solution. Some of the leftover solution was recharged with cyanide and reused. Waste solutions that were not recycled were treated with calcium hypochlorite to reduce cyanide and copper concentrations before they were discharged into Little Fork Creek. Waste rock was disposed of on site(Black & Veatch 2004; USEPA 2003, 2005).

In 1990, a dam failed at the Pad 6 Pond, which held a solution of sodium-cyanide, resulting in a fish kill along 79 km (49 mi) of the Lynches River. The dam failure also resulted in severe impacts to macroinvertebrate communities in Little Fork Creek, Fork Creek, and the Lynches River (Black & Veatch 2004; USEPA 2003, 2005).

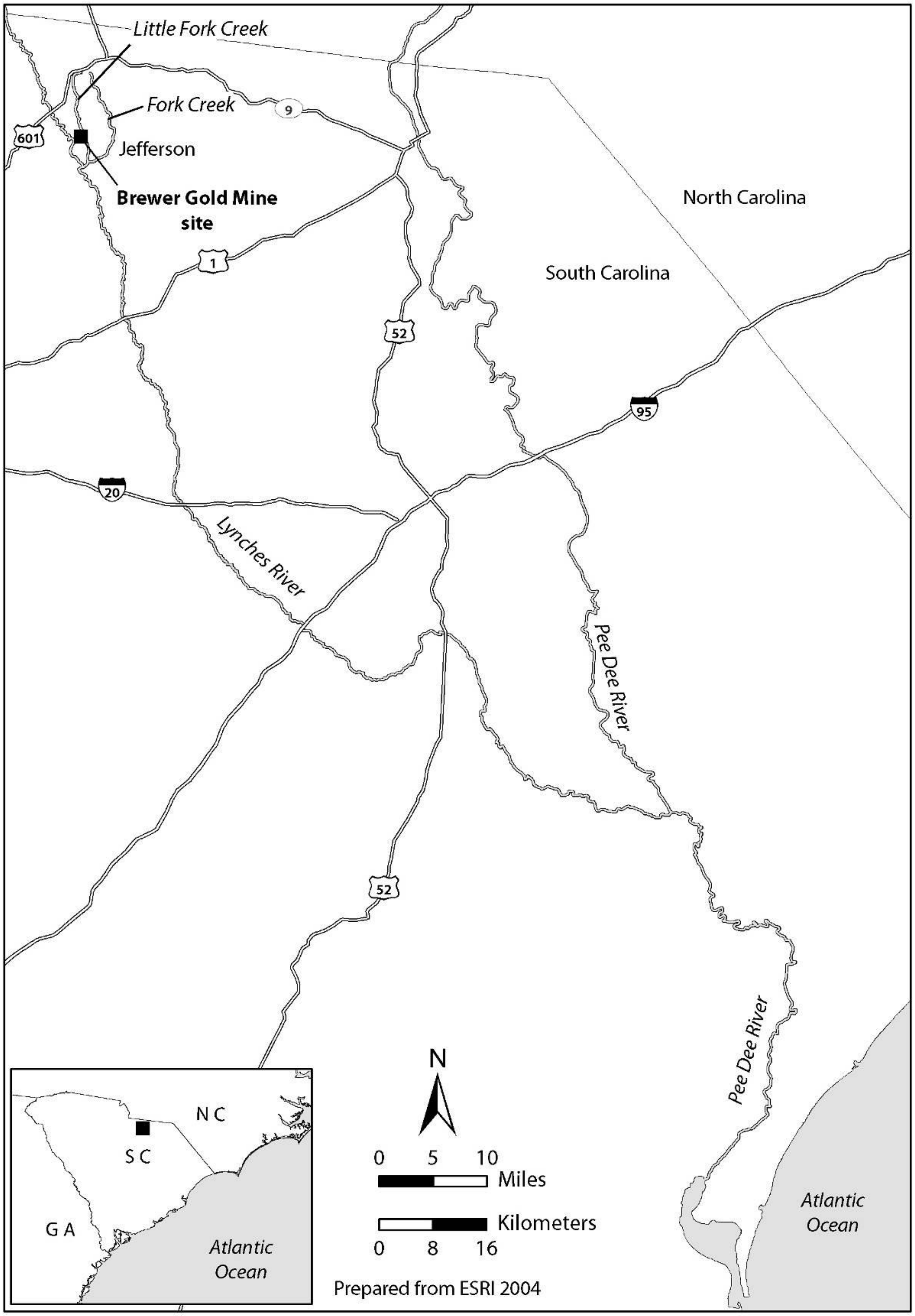
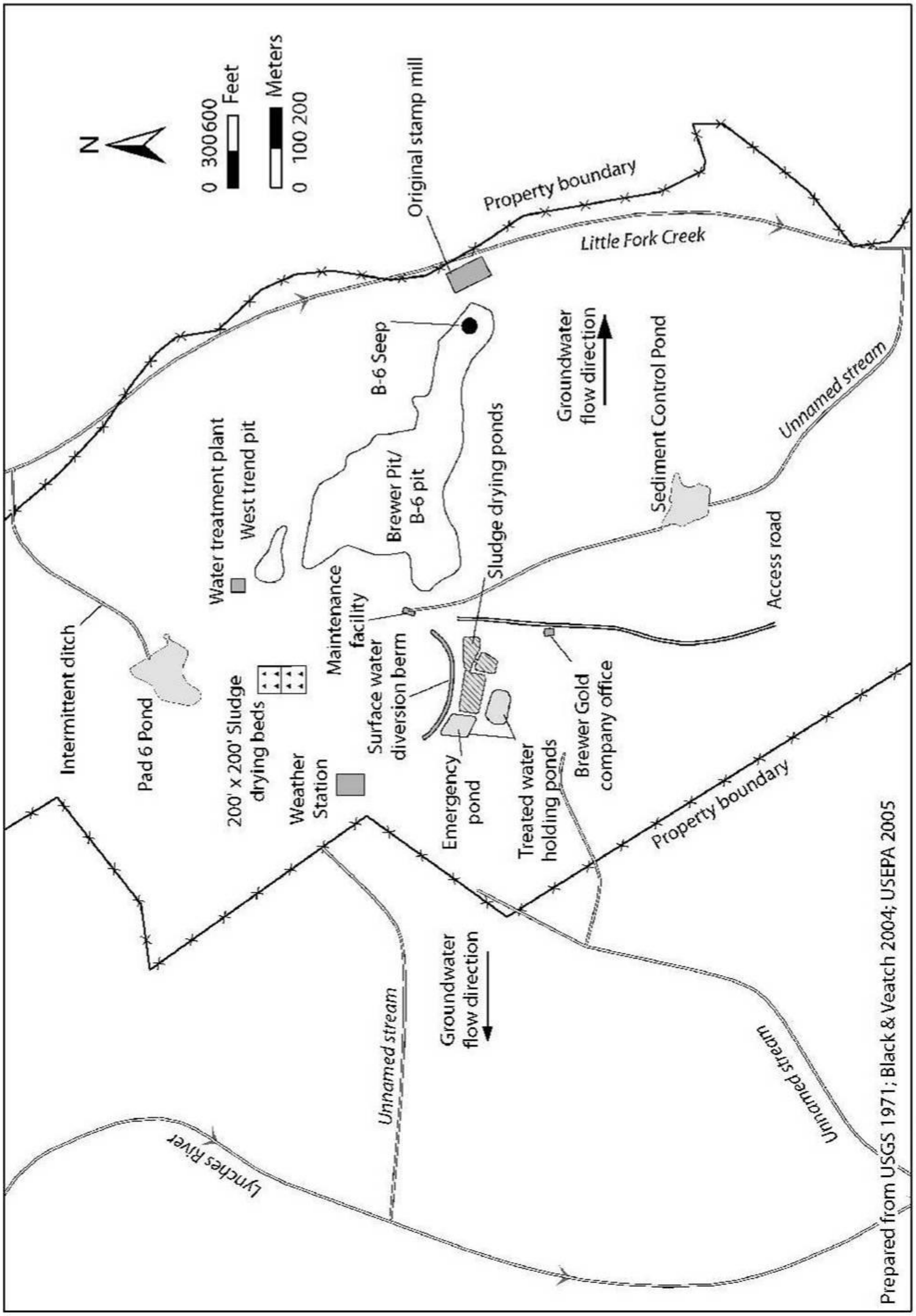


Figure 1. Location of the Brewer Gold Mine site, Jefferson, South Carolina.



Prepared from USGS 1971; Black & Veatch 2004; USEPA 2005

Figure 2. Detail of the Brewer Gold Mine property.

Elevated levels of metals and cyanide were detected in surface water, groundwater, sediment, and soil during numerous investigations conducted by state and federal agencies. In 1995, the open pits were backfilled with treated and untreated mine wastes and capped with a clay liner, low-permeability soil, and topsoil (Black & Veatch 2004; USEPA 2003, 2005).

Surface water runoff, direct discharge, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources; groundwater transport is a secondary pathway. Surface water and stormwater runoff from the eastern portion of the Brewer Gold Mine site discharges directly to Little Fork Creek. Stormwater and treated water from the Sediment Control Pond were directed into Little Fork Creek under a National Pollutant Discharge Elimination System (NPDES) permit. Groundwater underlying the site is encountered approximately 3 to 12 m (10 to 40 ft) below ground surface (Black & Veatch 2004; USEPA 2005). Most groundwater beneath the site flows to the east and discharges to Little Fork Creek, however some groundwater flows to the west and discharges to intermittent unnamed streams that are tributaries of the Lynches River. Treated acidic groundwater continues to be discharged into Little Fork Creek under an NPDES permit (USEPA 2005).

A hazard ranking system package was completed by the U.S. Environmental Protection Agency (USEPA) for the Brewer Gold Mine site in March 2002. The site was placed on the USEPA's National Priorities List in April 2005 (USEPA 2008). Two cleanup activities are still underway for Operable Unit 1 at the site. These include an RI/FS to determine a long-term solution, which began in September 2003, and a remedial action initiated by the USEPA, which began in September 2006 (USEPA 2008). All cleanup activities that have been completed to date at the site are described in USEPA (2008).

NOAA Trust Resources

The habitats of primary concern to NOAA are Little Fork Creek, Fork Creek, and the Lynches River (Figure 1). Little Fork Creek flows approximately 3.7 km (2.3 mi) before discharging into Fork Creek, which flows approximately 1.2 km (0.75 mi) before entering the Lynches River. The Lynches River flows approximately 160 km (100 mi) before discharging into the Pee Dee River. Little Fork Creek and Fork Creek range from approximately 1.5 to 5 m (5 to 15 ft) in width and are approximately 0.2 to 0.6 m (0.5 to 2 ft) deep. Substrates in the creeks consist of silt, sand, gravel, and cobbles. The habitat is characterized by sand bars, gravel bars, and rocky areas. The banks are scoured and highly eroded in places. The Lynches River is approximately 9 to 12 m (30 to 40 ft) in width and ranges from approximately 0.3 to 0.9 m (1 to 3 ft) in depth, with shallow bars and deeper pools present (USEPA 2005).

The Pee Dee River basin provides spawning, nursery, and adult habitat to numerous anadromous species, such as American shad, Atlantic sturgeon, blueback herring, shortnose sturgeon, striped bass, and striped mullet, as well as the catadromous American eel (Dorsey et al. 2004). NOAA trust resources that use Little Fork Creek, Fork Creek, or the Lynches River for spawning, nursery, or adult habitat are the anadromous American shad and striped bass and the catadromous American eel (Table 1).

American shad and American eel have been documented in the Lynches River in the vicinity of the site, and American eel have been documented in Little Fork Creek (USEPA 2005). It is also possible that striped bass use habitat in the vicinity of the site (Crochet 2004; Osier

2007). No dams or other impediments block fish from entering Fork Creek near its confluence with the Lynches River, so it is likely that American shad and striped bass are also present in Fork Creek and Little Fork Creek. However, it is highly unlikely that Atlantic sturgeon, blueback herring, shortnose sturgeon, or striped mullet are found this far upstream in the system (Crochet 2004).

Recreational fishing for warm-water species such as bluegill, catfish, largemouth bass, and sunfish occurs on the Lynches Rivers and its tributaries. American eel are not targeted but may be incidentally caught in the vicinity of the site and consumed by fishers (Osier 2007). There is no commercial fishery in the vicinity of the site.

The South Carolina Department of Health and Environmental Control has issued a fish consumption advisory for the Lynches River due to mercury contamination (SCDHEC 2007). The advisory recommends that consumption of redear sunfish be limited to one meal per week and consumption of largemouth bass and chain pickerel be limited to one meal per month. The advisory recommends against consuming channel catfish or bowfin (mudfish). Little Fork Creek and Fork Creek are not included in the advisory.

Table 1. NOAA trust resources present in Little Fork Creek, Fork Creek, and the Lynches River near the Brewer Gold Mine site (Crochet 2004; USEPA 2005; Osier 2007).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
American shad	*Alosa sapidissima*	♦	♦			
Striped bass	*Morone saxatilus*	♦				
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		♦

Site-Related Contamination

Large numbers of surface water, sediment, groundwater, and soil samples have been collected over the course of numerous environmental investigations conducted at the Brewer Gold Mine site and analyzed for metals and cyanide (Black & Veatch 2004; USEPA 2003, 2005). The primary contaminants of concern to NOAA are cyanide and selenium and metals, including arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In this case, the screening guidelines for sediment in a freshwater environment are the ecological screening values recommended by USEPA Region 4 (USEPA 2001) and the threshold effects concentrations (TECs; MacDonald et al. 2000). The screening guidelines for surface water, groundwater, and soil are the ecological screening values recommended by USEPA Region 4 (USEPA 2001). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided (refer to Figure 2).

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Brewer Gold Mine site (USEPA 2003; Black & Veatch 2004; USEPA 2005). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)		
Contaminant	Soil	USEPA Region 4[a]	Ground-water	Surface Water	USEPA Region 4[b]	Sediment	TEC[c]	USEPA Region 4[d]
METALS/INORGANICS								
Arsenic	7.7	10	32	180	190	**24**	9.79	7.24
Chromium	**8.6**	0.4	**22**	<10	11[e]	20	43.4	52.3
Copper	**120**	40	**40,000**	**110**	6.54[f]	**140**	31.6	18.7
Cyanide	**3.6**	0.9	**62**	**11**	5.2	1.3	NA	NA
Lead	28	50	**4.9**	<10	1.32[f]	**35**	35.8	30.2
Mercury	**0.22**	0.00051[g]	**10**	**2**	0.012	**0.75**	0.18	0.13
Nickel	2.4	30	**200**	ND	87.71[f]	6.4	22.7	15.9
Selenium	**5**	0.81	**140**	ND	5	6.4	NA	NA
Silver	1.2	2	**10**	ND	0.012	1.3	4.5[h]	2
Zinc	15	50	**170**	36	58.91[f]	28	121	124

a: USEPA Region 4 recommended ecological screening values for soil (USEPA 2001).

b: USEPA Region 4 recommended ecological screening values for freshwater surface water (USEPA 2001).

c: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).

d: USEPA Region 4 recommended ecological screening values for sediment (USEPA 2001).

e: Screening guidelines represent concentrations for $Cr.^{+6}$

f: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 50 mg/L $CaCO_3$.

g: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).

h: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.

NA: Screening guideline not available.

ND: Not detected.

Surface Water

Two metals and cyanide were detected in surface water samples collected from the Brewer Gold Mine site at maximum concentrations that exceeded the USEPA Region 4 ecological screening values (Table 2). The maximum concentrations of copper, cyanide, and lead were detected in samples collected from Little Fork Creek. The maximum concentration of mercury exceeded the USEPA Region 4 ecological screening value by two orders of magnitude; copper exceeded screening value by one order of magnitude. The maximum concentration of cyanide exceeded the USEPA Region 4 ecological screening value by a factor of approximately two. The maximum concentration of lead in surface water cannot be evaluated because the analytical detection limit exceeded the USEPA Region 4 ecological screening value.

<u>Sediment</u>

Four metals were detected in sediment samples collected from the Brewer Gold Mine site at maximum concentrations that exceeded screening guidelines; cyanide and selenium were also detected however no screening guidelines are currently available for comparison (Table 2). The maximum concentrations of arsenic, copper, lead, and mercury were detected in samples collected from Little Fork Creek. The maximum concentrations of copper, mercury, and arsenic exceeded the USEPA Region 4 ecological screening values by factors of approximately seven, six, and three, respectively. The maximum concentrations of copper and mercury exceeded the TECs by a factor of approximately four, while arsenic exceeded the TEC by a factor of approximately two. The maximum concentration of lead slightly exceeded the USEPA Region 4 ecological screening value and did not exceed the TEC.

The maximum concentrations of cyanide and selenium were detected in a sample collected from an intermittent ditch that drains the Pad 6 Pond to Little Fork Creek. No screening guidelines are currently available for comparison to the maximum concentrations of cyanide and selenium detected in sediment samples.

<u>Groundwater</u>

Seven metals and cyanide and selenium were detected in groundwater samples collected from the Brewer Gold Mine site at maximum concentrations that exceeded the USEPA Region 4 ecological screening values (Table 2). The maximum concentrations of chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, and zinc were detected in samples taken from the B-6 Seep. The maximum concentration of copper exceeded the USEPA Region 4 ecological screening value by three orders of magnitude; mercury and silver exceeded the screening values by two orders of magnitude, and cyanide and selenium exceeded the screening values by one order of magnitude. The maximum concentrations of lead and zinc exceeded the USEPA Region 4 ecological screening values by factors of approximately four and nearly three, respectively. The maximum concentrations of chromium and nickel exceeded the USEPA Region 4 ecological screening values by a factor of approximately two.

<u>Soil</u>

Three metals and cyanide and selenium were detected in soil samples collected from the Brewer Gold Mine at maximum concentrations that exceeded screening guidelines (Table 2). The maximum concentration of selenium, which was detected in a sample taken in the vicinity of the Pad 6 Pond, exceeded the USEPA Region 4 ecological screening value by a factor of six. The maximum concentrations of chromium, copper, cyanide, and mercury were detected in samples taken from the area of the original stamp mill. The maximum concentration of mercury exceeded the Oak Ridge National Laboratory final preliminary remediation goal for soil by two orders of magnitude. The maximum concentration of chromium exceeded the USEPA Region 4 ecological screening value by one order of magnitude. The maximum concentrations of cyanide and copper exceeded the USEPA Region 4 ecological screening values by factors of four and three, respectively.

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San Jacinto River Waste Pits

Channelview, Texas
EPA Facility ID: TXN000606611
Basin: Buffalo-San Jacinto
HUC: 12040104

Executive Summary

The San Jacinto River Waste Pits site is in Channelview, Harris County, Texas. The site is composed of former waste pits that were used to store sludge from a nearby paper mill. The waste pits are currently inundated by the San Jacinto River, which flows into Galveston Bay downstream of the site. Direct discharge to surface water and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The tidal portions of the San Jacinto River and Galveston Bay provide rearing, spawning, and adult habitat for numerous NOAA trust resources including marine and estuarine fish, invertebrates, and sea turtles. The primary contaminants of concern to NOAA at the site are dioxins and furans.

Site Background

The San Jacinto River Waste Pits site is located just east of Houston in Channelview, Harris County, Texas (Figure 1 and 2). The site encompasses approximately 8-ha (20 acres) on the western bank of the San Jacinto River. The site is bounded to the north, west, and east by a tidally influenced reach of the San Jacinto River. The site is composed of three former waste pits. From 1964 to 1973, the pits were used to store waste sludge from a nearby paper mill. The waste pits are currently inundated by the San Jacinto River. There is no containment barrier to prevent contaminants from discharging from the impoundments directly into the San Jacinto River. During investigations conducted at the site, dioxins were detected at elevated concentrations in sediment, surface water, and aquatic biota samples.

Direct discharge to surface water and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The site is inundated by the San Jacinto River, which connects to Galveston Bay approximately 19 km (12 mi) downstream of the site.

A site investigation was conducted by the Texas Commission on Environmental Quality in 2005. The site was placed on the United States Environmental Protection Agency's (USEPA's) National Priorities List in March 2008 (USEPA 2008). The USEPA is currently in the process of investigating parties who may be liable for the costs of cleaning up the site (USEPA 2008).

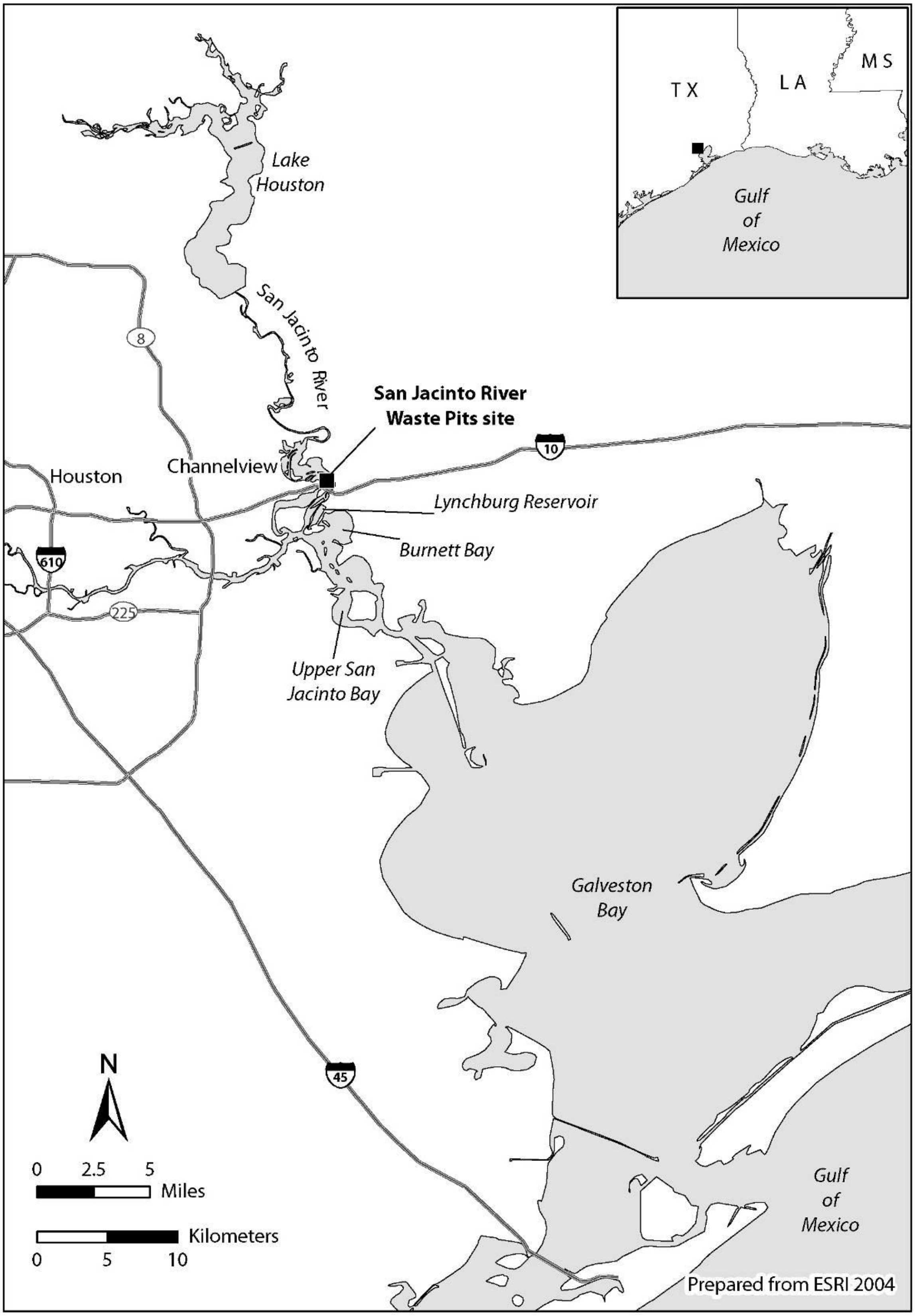

Figure 1. Location of the San Jacinto River Waste Pits site, Channelview, Texas.

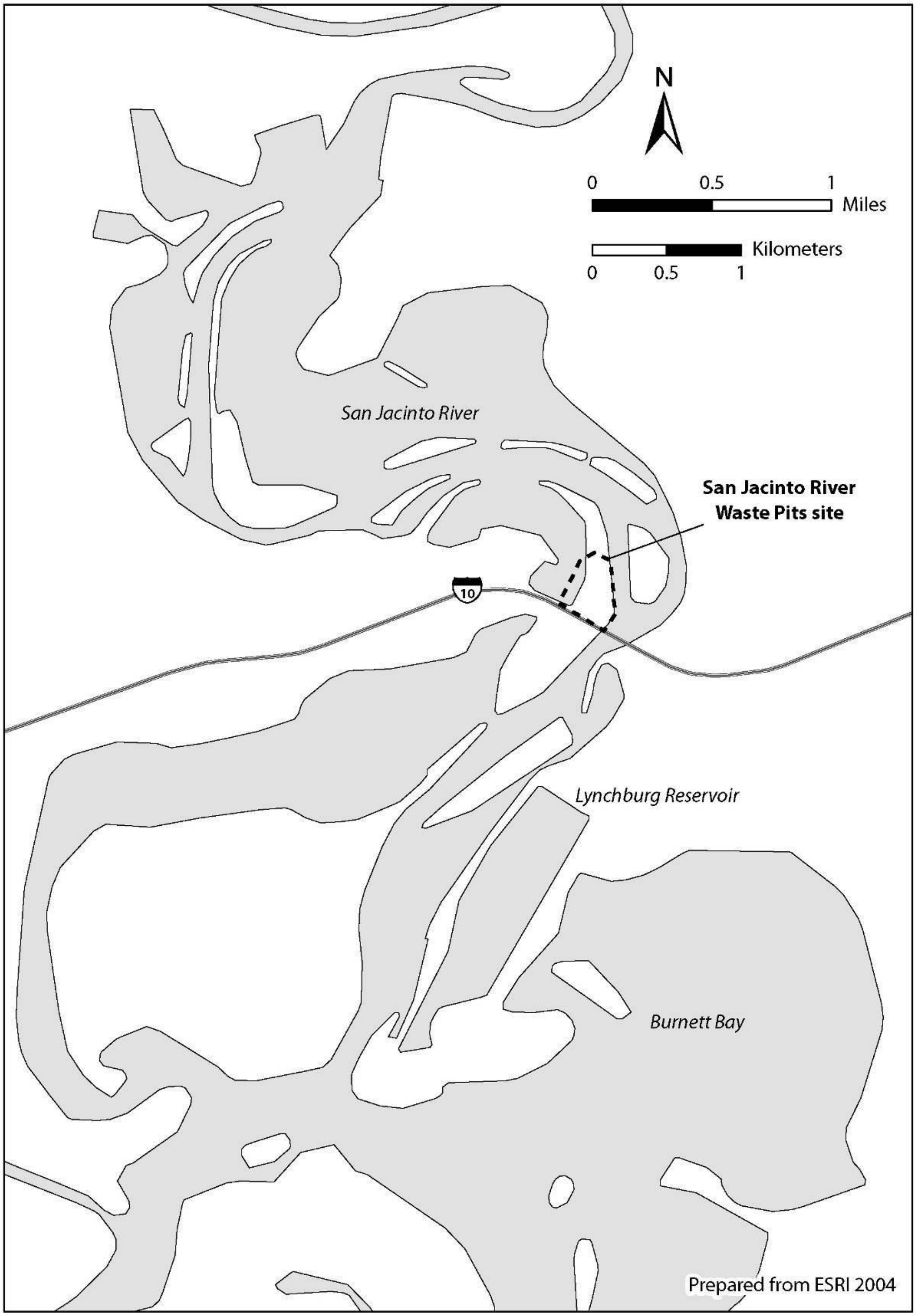

Figure 2. Detail of the San Jacinto River Waste Pits site.

NOAA Trust Resources

The habitats of primary concern to NOAA are the tidally influenced and estuarine portions of the San Jacinto River and Galveston Bay; the San Jacinto River is tidally influenced in the vicinity of the site. Approximately 28 percent of the freshwater entering Galveston Bay is from the San Jacinto River. Galveston Bay is generally shallow with depths ranging from approximately 2 to 4 m (6 to 12 ft). Salinity in the bay is influenced by freshwater input from rivers and ranges from approximately 2 to 20 parts per thousand. Substrates in the bay generally consist of mud, silt, and sand. Habitat types found in the estuary and bay include estuarine and freshwater marshes, mudflats, seagrass beds, oyster reefs, and open water (GBIC 2008).

The tidal portions of the San Jacinto River and Galveston Bay provide rearing, spawning, and adult habitat for numerous marine and estuarine fish and invertebrate species including blue crab, drum, flounder, oysters, spotted sea trout, and shrimp. Sea turtles, including the federally listed green, hawksbill, Kemp's Ridley, leatherback, and loggerhead turtles occasionally enter Galveston Bay to nest and feed (GBIC 2008).

Commercial and recreational fisheries occur in the vicinity of, and downstream of the San Jacinto River Waste Pits site. Table 1 identifies the species targeted in these fisheries.

A fish consumption advisory is in effect for the San Jacinto River below the U.S. Highway 90 bridge and Galveston Bay due to elevated levels of dioxins and PCBs in fish tissue (TDSHS 2008). The advisory recommends:

- people limit their consumption of blue crab, catfish, and spotted seatrout to no more than one meal per month
- no consumption of blue crab, catfish, and spotted seatrout by children and women who are pregnant, nursing, or who may become pregnant

Site-Related Contamination

During the most recent investigation of the site completed in 2005, sediment samples were collected at the San Jacinto River Waste Pits site and analyzed for dioxins (TCEQ 2007). Based on the results of this investigation, the primary contaminants of concern to NOAA are dioxins and furans.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. The screening guidelines used for comparison to sediment results detected at this site are the freshwater upper effects threshold (UET) for bioassays as reported in Buchman (1999). Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided (refer to Figure 1 and Figure 2).

Sediment

Dioxins and furans were detected in sediment samples collected from the San Jacinto River Waste Pit site. Each dioxin and furan is assigned a toxic equivalency factor (TEF) relative to 2,3,7,8 tetrachlorodibenzodioxin, which is the most toxic in this group of compounds. In order to determine the toxicity of a mixture of dioxin and furan compounds, the measured concentration of the individual dioxin and furan is multiplied by its assigned TEF. The results are summed to produce a toxic equivalent value (TEQ). The maximum TEQ at the site was detected in a sediment sample collected from the middle of the site. The TEQ at this sample location exceeded the UET by three orders of magnitude (Table 2). No screening guidelines are currently available for the individual dioxins and furans detected during the site investigations (Table 2).

Table 1. NOAA trust resources found in the estuarine portion of the San Jacinto River and Galveston Bay (Nelson 1992; GBIC 2008).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm. Fishery	Rec. Fishery
MARINE/ESTUARINE FISH						
Atlantic croaker	*Micropogonias undulates*	♦	♦	♦	♦	♦
Atlantic menhaden	*Brevoortia tyrannus*	♦	♦			
Bay anchovy	*Anchoa mitchilli*	♦	♦	♦		
Bay squid	*Lolliguncula brevis*	♦	♦	♦	♦	
Black drum	*Pogonias cromis*		♦	♦	♦	♦
Gizzard shad	*Dorosoma cepedianum*			♦		
Hardhead catfish	*Arius felis*	♦	♦	♦		
Red drum	*Sciaenops ocellatus*	♦	♦	♦		♦
Sand seatrout	*Cynoscion arenarius*	♦	♦	♦		♦
Sheepshead	*Archosargus probatocephalus*	♦	♦	♦	♦	♦
Silversides	*Menidia species*		♦	♦		
Southern flounder	*Paralichthys lethostigma*		♦	♦	♦	♦
Spot	*Leiostomus xanthurus*		♦	♦	♦	
Spotted seatrout	*Cynoscion nebulosus*	♦	♦	♦		♦
Striped mullet	*Mugil cephalus*		♦	♦	♦	♦
INVERTEBRATES						
Blue crab	*Callinectes sapidus*		♦	♦	♦	♦
Brown shrimp	*Farfantepenaeus aztecus*		♦	♦	♦	♦
Eastern oyster	*Crassostrea virginica*	♦	♦	♦	♦	♦
Grass shrimp	*Palaemonetes pugio*	♦	♦	♦		
Gulf stone crab	*Menippe adina*	♦	♦	♦	♦	♦
Hard clam	*Mercenaria species*	♦	♦	♦		
White shrimp	*Litopenaeus setiferus*		♦	♦	♦	♦
SEA TURTLES						
Green sea turtle	*Chelonia mydas*		♦	♦		
Hawksbill sea turtle	*Eretmochelys imbricata*		♦	♦		
Kemp's Ridleys sea turtle	*Lepidochelys kempii*		♦	♦		
Leatherback sea turtle	*Dermochelys coriacea*		♦	♦		
Loggerhead sea turtle	Caretta caretta		♦	♦		

Table 2. Maximum concentrations of contaminants of concern to NOAA at the San Jacinto River Waste Pits site (TCEQ 2007). Contaminant values in bold exceed screening guidelines.

	Sediment (mg/kg)	
Contaminant	Sediment	UET [a]
DIOXINs/FURANs		
2,3,7,8-Tetrachlorodibenzodioxin	0.019	NA
1,2,3,7,8-Pentachlorodibenzodioxin	0.00018	NA
1,2,3,4,7,8-Hexachlorodibenzodioxin	0.0000036	NA
1,2,3,6,7,8-Hexachlorodibenzodioxin	0.000011	NA
1,2,3,7,8,9-Hexachlorodibenzodioxin	0.0000057	NA
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	0.00019	NA
2,3,7,8-Tetrachlorodibenzofuran	0.041	NA
1,2,3,7,8-Pentachlorodibenzofuran	0.0019	NA
2,3,4,7,8-Pentachlorodibenzofuran	0.0013	NA
1,2,3,4,7,8-Hexachlorodibenzofuran	0.0056	NA
1,2,3,6,7,8-Hexachlorodibenzofuran	0.0014	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.00022	NA
1,2,3,7,8,9-Hexachlorodibenzofuran	0.00044	NA
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.00096	NA
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.00035	NA
TEQ (Toxic Equivalent Value)[b]	**0.022**	0.0000088

a: Freshwater upper effects threshold (UET) for bioassays as reported in Buchman (1999). The UET represents the concentration above which adverse biological impacts would be expected.

b: Maximum toxic equivalant value (TEQ) is provided. Each dioxin/furan is assigned a toxic equivalency factor (TEF) relative to 2,3,7,8 tetrachlorodibenzodioxin, which is the most toxic in this group of compounds. In order to determine the toxicity of a mixture of dioxin/furan compounds the measured concentration of the individual dioxin/furans is multiplied by its assigned TEF. The results are summed to produce a TEQ.

NA: Screening guidelines not available.

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Halaco Engineering Company

Oxnard, California
EPA Facility ID: CAD009688052
Basin: Calleguas
HUC: 18070103

Executive Summary

The Halaco Engineering Company site is an active metal recycling plant in Oxnard, California. Non-ferrous scrap metal is produced into aluminum and magnesium ingots at the Halaco Engineering Company site. Wastewater from the smelting process is pumped into settling ponds to allow suspended solids to settle out. The primary contaminants of concern detected in environmental media at the site are aluminum, copper, lead, magnesium, and zinc. The NOAA trust habitats of concern are the surface waters of the Ormond Beach Lagoon and Ormond Beach Wetlands and the nearshore waters adjacent to Ormond Beach. NOAA trust resources including federally endangered Chinook salmon and nearshore marine species, use a variety of habitats near the site.

Site Background

The Halaco Engineering Company (Halaco) site is an inactive metal recycling plant in Oxnard, Ventura County, California (Figure 1). The site occupies approximately 17 hectares (43 acres) and is adjacent to the coastal sand dunes and estuarine wetlands of Ormond Beach, which includes Ormond Beach Lagoon (CRWQCB 2002a). The Oxnard Industrial Drain (OID) flows through the site and discharges into the Ormond Beach Lagoon southwest of the site. The OID was originally constructed as a flood control channel. The OID drains agricultural storm water runoff from fields and surrounding areas in the Oxnard Plain. The Oxnard plain is one of ten subbasins within the coastal valleys and plains of the Santa Clara-Calleguas basin in Ventura County. The OID divides the site into two sections: the smelting facility and the waste management unit (Figure 2). The waste management unit consists of three settling ponds and a waste disposal area. The ponds are surrounded by a berm constructed of solid wastes from periodic dredging of the ponds (CRWQCB 2002b).

The primary pathways for the migration of contaminants from the facility toward NOAA trust resources are groundwater and surface water. The near surface groundwater body beneath the facility is approximately 15 m (50 ft) thick and flows south toward the Pacific Ocean. The depth to groundwater has been measured at approximately three feet below ground surface and may be influenced by tidal fluctuations (Padre 2002). The site and the Ormond Beach Lagoon are situated immediately landward of a coastal sand dune (CRWQCB 2002b). During the winter, when storms create greater wave action, sand dunes are eroded (Scripps 2003). The winter erosion of the Ormond Beach sand dune likely leads to seasonal flow of lagoon water onto Ormond Beach and into the ocean.

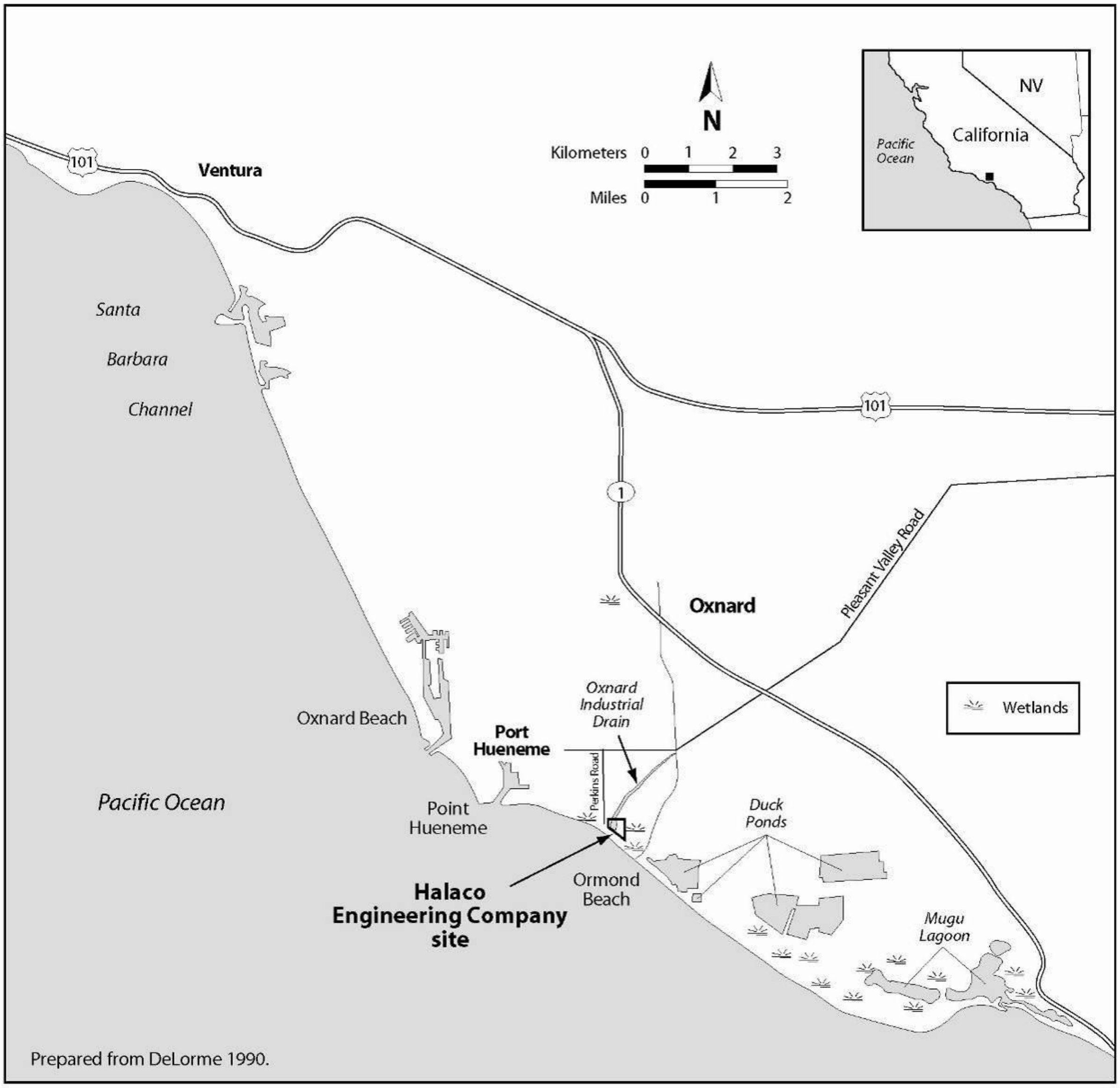

Figure 1. Location of the Halaco Engineering Company site, Oxnard, California.

Non-ferrous scrap metal was produced into aluminum and magnesium ingots at the Halaco smelting facility. When scrap metal was received at the site, it was washed with water from the OID to remove dirt and other impurities from the surface. The scrap metal was then smelted in a large furnace. Magnesium, sodium, and potassium chlorides were added to the scrap metal during the smelting process to separate the metals from metal oxides and other impurities. The slag, which was a byproduct of the smelting process, was then washed to recover additional aluminum and magnesium (CRWQCB 2002b).

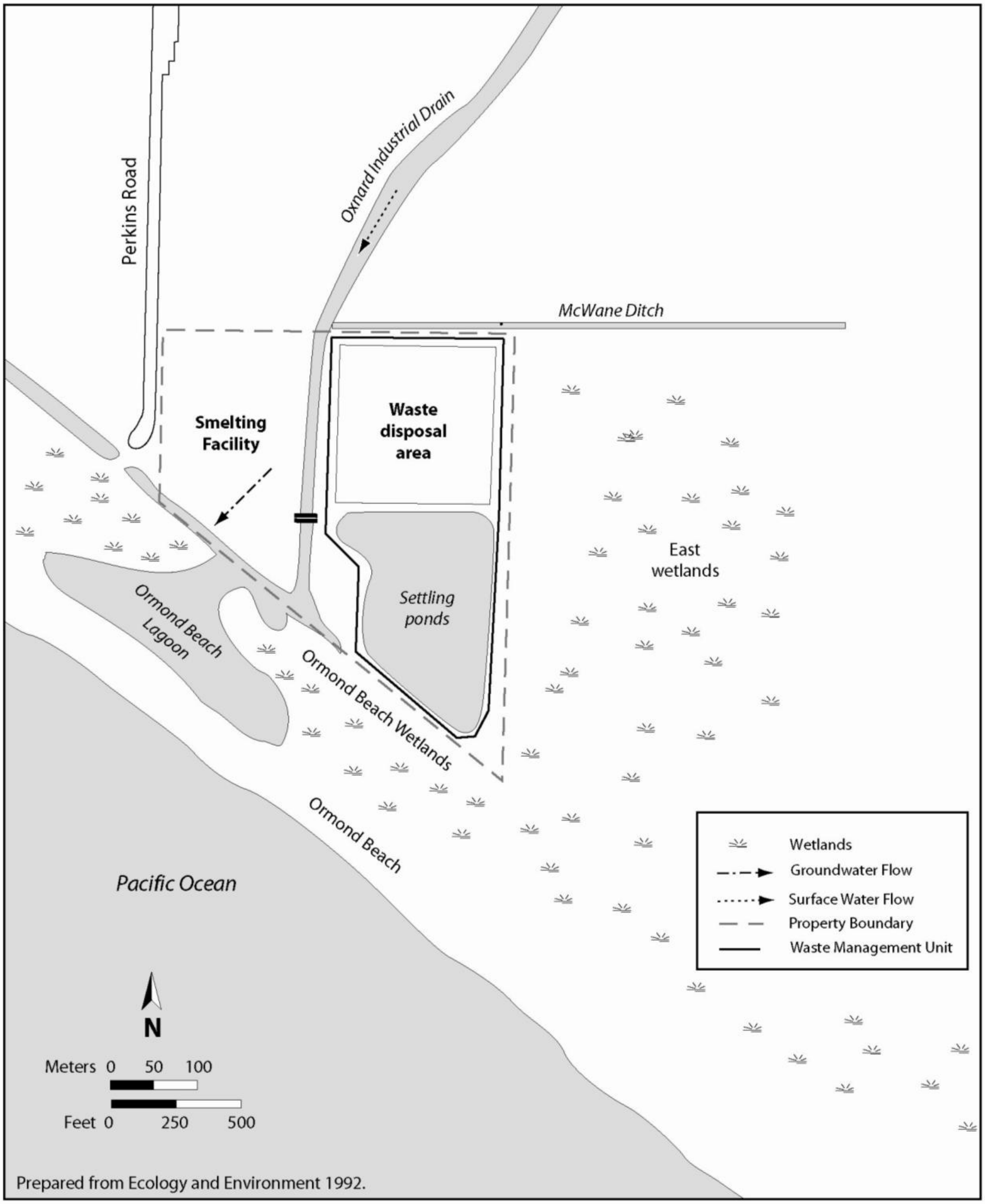

Figure 2. Detail of the Halaco Engineering Company site.

Approximately 1.8 million L (472,000 gal) of wastewater were produced at the site per month. Wastewater was generated when the scrap metal was rinsed, before and after the scrap metal was smelted, and when the system that controls air pollution at the smelting facility was cleaned. The wastewater, which contained metals, salts, ammonia, undissolved metal oxides, dirt, and other impurities, was pumped into the settling ponds to allow suspended solids to settle out. The solids were then periodically dredged from the settling ponds and placed in the waste disposal area and on the berms surrounding the settling ponds (CRWQCB 2002b). The California Regional Water Quality Control Board has estimated that the contaminated sediments in the waste disposal area are 6 to 12 m (20 to 40 ft) in thickness and 330,000 m^3 (430,000 yd^3) in volume (CRWQCB 2002b).

In 1992, consultants for the U.S. Environmental Protection Agency (USEPA) conducted an expanded site inspection (ESI) at the Halaco site. The results of the ESI indicated that hazardous substances were present in the Halaco waste management unit and were migrating to the wetlands east of the site (Ecology and Environment 1992) In 2002, the California Regional Water Quality Control Board issued a Cease and Desist Order (CDO) to the Halaco Engineering Company for violating waste discharge requirements (CRWQCB 2002b). In order to comply with the CDO, the Halaco Engineering Company was required to modify its waste management procedures and monitor contaminant levels in groundwater and surface water at the site. The waste management procedure modifications included operation of a filter press to dewater waste; discharge of the filter press wastewater to a local sanitary sewer; discontinued disposal of wastes to the waste management unit; recycling of the solids from the filter press; and eventual capping of the waste management unit (CRWQCB 2002b). Halaco Engineering Company filed bankruptcy in 2002, and ceased operating at the site in 2004. In 2006, the USEPA conducted an integrated assessment at the Halaco site to determine if it was eligible for placement on the USEPA's National Priorities List (NPL). The Halaco site was proposed to the NPL on March 7, 2007 (USEPA 2007).

NOAA Trust Resources

The NOAA trust habitats of concern are the surface waters of the Ormond Beach Lagoon and Ormond Beach Wetlands and the nearshore waters adjacent to Ormond Beach. Ormond Beach Lagoon and Ormond Beach Wetlands receive water from the OID, which drains agricultural, industrial, and storm water runoff from the Oxnard Plain. The OID flows into the Ormond Beach Lagoon, which is connected to the Ormond Beach Wetlands via a small drainage channel (CRWQCB 2002b).

In the 1800s, extensive estuarine wetlands extended from Mugu Lagoon to Port Hueneme (UCSB 2001). Since that time, upstream creeks have been dammed and diverted for agricultural and industrial development and infrastructure controls have been placed on the tidal flow of Mugu Lagoon. These changes have caused a loss of wetland acreage and reduced the connectivity of the wetland complex (UCSB 2001). Although the wetlands have been altered and no longer connect to Mugu Lagoon and Port Hueneme, they continue to provide habitat for many nearshore marine species.

In 1999, The California Coastal Conservancy purchased approximately 264 hectares (660 acres) of wetlands at the southern end of Ormond Beach for habitat restoration. This restoration may include hydrologic reconnection of Ormond Beach Lagoon and Mugu Lagoon (UCSB 2001).

The Ormond Beach Lagoon and Ormond Beach Wetlands provide critical spawning, nursery, and adult habitat for many marine species. These species include California killifish, deepbody anchovy, diamond turbot, jacksmelt, Pacific staghorn sculpin, threespine stickleback, and topsmelt. The tidewater goby, which is on the federal endangered species list, is present in the wetlands (Love 2003; Ono 2003; USFWS 2007).

The nearshore waters of Ormond Beach provide nursery and adult habitat for many marine species. Chinook salmon, a federally and state listed endangered species, migrate through the nearshore waters (CDFG 2003; USFWS 2007). The California grunion uses the high intertidal zone of Ormond Beach to deposit their eggs for incubation (Dugan 2000). Other species in the nearshore area include bass, California halibut, California lizardfish, flounder, sanddab, skate, smelt, and surfperch. Table 1 provides a summary of the NOAA trust resources found in the nearshore waters of Ormond Beach, Ormond Beach Lagoon, and the Ormond Beach Wetlands (Dugan 2000; Love 2003; Ono 2003).

Commercial fishing occurs in the nearshore waters of Ormond Beach. Commercially important fish species near the site are California halibut, Chinook salmon, California market squid, northern anchovy, Pacific barracuda, slender sole, white croaker, white seabass, and white seaperch. California market squid and northern anchovy are important bait fisheries in this area. The fish most often caught by recreational fishers include barred surfperch, California corbina, California grunion, California halibut, Chinook salmon, jacksmelt, and walleye surfperch (Ono 2003).

No fish consumption advisories were in effect for the nearshore waters of Ormond Beach at the time of this report (COEHHA 2003).

Table 1. NOAA trust resources present near the Halaco Engineering site (Dugan 2000, Love 2003, Ono 2003).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Chinook salmon	*Oncorhynchus tshawytscha*			♦	♦	♦
MARINE/ESTUARINE FISH						
Bat ray	*Myliobatis californica*	♦	♦	♦	♦	♦
Barred sand bass	*Paralabrax nebulifer*	♦	♦	♦		♦
Barred surfperch	*Amphistichus argenteus*	♦	♦	♦		♦
Black perch	*Embiotoca jacksoni*	♦	♦	♦	♦	♦
Brown smoothhound	*Mustelus henlei*	♦	♦	♦	♦	♦
California corbina	*Menticirrhus undulatus*	♦	♦	♦		♦
California grunion	*Leuresthes tenuis*	♦	♦	♦		♦
California halibut	*Paralichthys californicus*	♦	♦	♦	♦	♦
California killifish	*Fundulus parvipinnis*	♦	♦	♦		
California lizardfish	*Synodus lucioceps*	♦	♦	♦	♦	♦
California tonguefish	*Symphurus atricauda*	♦	♦	♦	♦	
Chub (Pacific) mackerel	*Scomber japonicus*	♦	♦	♦	♦	♦
Deepbody anchovy	*Anchoa compressa*	♦	♦	♦		
Diamond turbot	*Hypsopsetta guttulata*	♦	♦	♦	♦	♦

Table 1 continued on next page.

Table 1, *cont.*

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
Fantail sole	*Xystreurys liolepis*	♦	♦	♦	♦	♦
Giant sea bass	*Stereolepis gigas*		♦		♦	
Gray smoothhound	*Mustelus californicus*	♦	♦	♦	♦	♦
Jack mackerel	*Trachurus symmetricus*	♦	♦	♦	♦	♦
Jacksmelt	*Atherinopsis californiensis*	♦	♦	♦	♦	♦
Kelp bass	*Paralabrax clathratus*	♦	♦	♦		♦
Leopard shark	*Triakis semifasciata*	♦	♦	♦	♦	♦
Longfin sanddab	*Citharichthys xanthostigma*	♦	♦	♦	♦	♦
Longspine combfish	*Zaniolepis latipinnis*	♦	♦	♦	♦	
Northern anchovy	*Engraulis mordax*	♦	♦	♦	♦	♦
Pacific barracuda	*Sphyraena argentea*	♦	♦	♦	♦	♦
Pacific electric ray	*Torpedo californica*	♦	♦	♦	♦	
Pacific sanddab	*Citharichthys sordidus*	♦	♦	♦	♦	♦
Pacific sardine	*Sardinops sagax*	♦	♦	♦	♦	♦
Pacific staghorn sculpin	*Leptocottus armatus*	♦	♦	♦		♦
Plainfin midshipman	*Porichthys notatus*	♦	♦	♦	♦	
Queenfish	*Seriphus politus*	♦	♦	♦	♦	♦
Round stingray	*Urolophus halleri*	♦	♦	♦		♦
Shiner perch	*Cymatogaster aggregata*	♦	♦	♦		♦
Shovelnose guitarfish	*Rhinobatos productus*	♦	♦	♦	♦	♦
Slender sole	*Lyopsetta exilis*	♦	♦	♦	♦	
Speckled sanddab	*Citharichthys stigmaeus*	♦	♦	♦	♦	♦
Striped mullet	*Mugil cephalus*	♦	♦	♦		
Thornback skate	*Platyrhinoides triseriata*	♦	♦	♦		♦
Threespine stickleback	*Gasterosteus aculeatus*	♦	♦	♦		
Tidewater goby	*Eucyclogobius newberryi*	♦	♦	♦		
Topsmelt	*Atherinops affinis*	♦	♦	♦	♦	♦
Walleye surfperch	*Hyperprosopon argenteum*	♦	♦	♦	♦	♦
White croaker	*Genyonemus lineatus*	♦	♦	♦	♦	♦
White seabass	*Atractoscion nobilis*	♦	♦	♦	♦	♦
White seaperch	*Phanerodon furcatus*	♦	♦	♦	♦	♦
Yellowchin sculpin	*Icelinus quadriseriatus*	♦	♦	♦		
INVERTEBRATES						
California market squid	*Loligo opalescens*	♦	♦	♦	♦	♦
California sand star[a]	*Astropecten verrilli*	♦	♦	♦		
Gould beanclam	*Donax gouldii*	♦	♦	♦		♦
Gray sandstar[a]	*Luidia foliolata*	♦	♦	♦		
Pacific sand crab	*Emerita analoga*	♦	♦	♦	♦	♦
Pismo clam	*Tivela stultorum*	♦	♦	♦		♦
Ridgeback rock shrimp	*Sicyonia ingentis*	♦	♦	♦	♦	
Sand dollar[a]	*Dendraster excentricus*	♦	♦	♦		
Sea pansy[a]	*Renilla koellikeri*	♦	♦	♦		
Spiny mole crab	*Blepharipoda occidentalis*	♦	♦	♦		
Warty sea cucumber[a]	*Parastichopus parvimensis*	♦	♦	♦	♦	
White sand crab[a]	*Lepidopa myops*	♦	♦	♦		

a: Ono 2003.

Site-Related Contamination

The primary contaminants of concern to NOAA detected in environmental media at the site are metals. During the 1992 ESI, 52 waste samples (two water samples and four sediment samples from the settling ponds and 46 sediment samples from the waste disposal area), seven surface water samples, and 25 sediment samples were collected from the site and analyzed for metals, including selenium (Ecology and Environment 1992). In 1992, to comply with the Cease and Desist Order, consultants for the Halaco Engineering Company collected five surface water samples from the Ormond Beach Lagoon and the Oxnard Industrial Ditch. These samples were analyzed for metals, including selenium and thorium isotopes (Brash Industries 2002). In 1997, two sediment samples and two soil samples were collected from property adjacent to the Halaco site and analyzed for metals, including selenium (CRWQCB 2002b). In February 2003, two groundwater samples were collected by a consultant for the Halaco Engineering Company. During an integrated assessment conducted by USEPA in 2006, 118 soil, sediment, and slag samples; 10 surface water samples; and 14 groundwater samples were collected and analyzed for metals, volatile organic compounds (VOCs) and radioisotopes (Weston 2007).

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always used when available. In the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC) (USEPA 2006); the screening guidelines for sediment in a saltwater environment are the effects range-low (ERL) concentrations (Long et al. 1998); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs) (Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008). Exceptions to these screening guidelines, if any, are noted in Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which there are no screening guidelines are discussed below. When known, the general sampling locations are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines.

<u>Groundwater</u>

Eleven metals were detected in groundwater from monitoring wells at the site. The maximum concentrations of aluminum, arsenic, chromium, copper, nickel, and silver were detected in a sample collected from the north end of the settling ponds. The maximum copper concentration exceeded the AWQC by four orders of magnitude. Nickel and silver concentrations exceeded the AWQC by two orders of magnitude and chromium concentrations exceeded by one order of magnitude. The maximum arsenic concentration was more than a factor of seven greater than the AWQC. Screening guidelines were not available for comparison to aluminum concentrations.

Maximum concentrations of cadmium, lead, magnesium, and zinc were detected in a sample collected from a monitoring well in the middle of the settling ponds. Zinc concentrations exceeded the AWQC by three orders of magnitude. Maximum concentrations of lead and cadmium exceeded the AWQC by two and one orders of magnitude, respectively. Screening guidelines were not available for comparison to magnesium concentrations.

The maximum concentration of barium was detected in a sample collected from a monitoring well in the south end of the smelter facility. Screening guidelines were not available for comparison to barium concentrations.

Four radioisotopes were detected in groundwater at the site. The maximum concentrations of potassium-40, thorium-228, thorium-230, and thorium-232 were all detected in monitoring wells in the south end of the smelter facility. Screening guidelines are not available for comparison to the radioisotope concentrations.

Surface Water

Maximum concentrations reported for aluminum, barium, cadmium, copper, silver, and zinc were found in surface water samples collected from the east wetland near the settling ponds. The maximum concentrations of copper and silver exceeded the AWQC by two orders of magnitude. Cadmium and zinc were detected at concentrations that exceeded the AWQC screening guidelines by one order of magnitude. AWQCs are not available for comparison to the reported concentrations of aluminum or barium.

The maximum concentration reported for magnesium in surface water was from the surf line of Ormond Beach. AWQCs are not available for comparison to the reported concentrations of magnesium.

Potassium-40, which was the only radioisotope detected in surface waters at the Halaco site, was detected in a sample collected from the wetlands adjacent to the south end of the settling ponds. A screening guideline is not available for comparison to detected concentrations of potassium-40.

Sediment

Metals, including selenium were detected at concentrations greater than the screening guidelines in sediment samples collected at the site. The maximum concentrations reported for aluminum, arsenic, barium, magnesium, and silver were detected in samples from the east wetland within 27 m (90 ft) of the berm surrounding the settling ponds. Barium and silver concentrations exceeded the screening guidelines by two and one orders of magnitude, respectively. The maximum concentration of arsenic exceeded the ERL by a factor of more than three. Screening guidelines are not available for comparison to the reported concentrations of aluminum and magnesium.

Maximum concentrations of cadmium, chromium, copper, lead, nickel, and zinc were detected in a sample collected from the wetlands near the southwest corner of the settling ponds. The maximum concentration of copper exceeded the ERL by two orders of magnitude. Concentrations of cadmium, lead, nickel, and zinc exceeded the ERL by one order of magnitude. The maximum chromium concentration was approximately six times greater than the ERL.

Selenium was detected at a maximum concentration in a sample from McWane Ditch located north of the waste disposal area; this concentration exceeded the apparent effects threshold (AET) by one order of magnitude.

Five radioisotopes were detected in sediment at the site. Maximum concentrations of cesium-137, thorium-228, and thorium-232 were detected in samples collected from Ormond Beach. The maximum concentration of potassium-40 was detected in sediment from the wetlands adjacent to the south end of the settling ponds. The maximum concentration of thorium-230 was detected in a sediment sample from the OID near the Ormond Beach Lagoon. Screening guidelines are not available for comparison to the reported concentrations of radioisotopes.

<u>Soil</u>

Twelve metals were detected in soil at the site. Maximum concentrations of aluminum, chromium, copper, magnesium, nickel, and selenium were detected in samples collected from the Nature Conservancy Land to the east of the property. Chromium and selenium concentrations exceeded the ORNL-PRGs by two orders of magnitude. The maximum concentration of copper exceeded the ORNL-PRG by one order of magnitude. Nickel concentrations exceeded the ERL by a factor of more than six. No screening guidelines were available for comparison to reported concentrations of aluminum or magnesium.

Maximum concentrations of arsenic, cadmium, lead, silver, and zinc were detected in samples from the smelter facility. Zinc and lead concentrations exceeded the ORNL-PRG by three and two orders of magnitude, respectively. The maximum cadmium concentration exceeded the USEPA ecological soil screening guideline by one order of magnitude. Silver and arsenic concentrations exceeded the ORNL-PRG by a factor of seven and two, respectively.

The maximum barium concentration was detected in a sample northwest of the settling ponds. A screening guideline was not available for comparison to detected barium concentrations.

Five radioisotopes were detected in soil at the Halaco site. The maximum concentrations of cesium-137, potassium-40, thorium-228, thorium-230, and thorium-232 were detected in samples collected from the smelter facility. Screening guidelines are not available for comparison to the detected concentrations of radioisotopes.

<u>Waste Samples</u>

Elevated concentrations of metals, including selenium were detected in waste samples collected from the settling ponds and the waste disposal area. The maximum concentrations reported for aluminum, copper, and magnesium were found in the middle of the settling ponds; arsenic, barium, lead, selenium, and zinc concentrations were found in the northwest corner of the settling ponds. The maximum concentrations of cadmium, chromium, nickel, and silver were found in the southeast corner of the waste disposal area. No screening guidelines are available for comparison to the metals detected in the waste samples.

Five radioisotopes were detected in waste samples collected at the site. The maximum concentration of cesium-137 and potassium-40 were found in the northwest and northeast section of the settling ponds, respectively. The maximum concentrations of thorium-228, 230, and 232 were detected in the southeast corner of the waste disposal area. Screening guidelines are not available for comparison to the detected concentrations of radioisotopes.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Halaco Engineering Company site (Ecology and Environment 1992; CRWQCB 2002b; Brash Industries 2002; Weston 2007). Contaminant values in bold exceed or are equal to screening guidelines.

	Waste Samples (mg/kg)		**Soil (mg/kg)**		**Water (µg/L)**			**Sediment (mg/kg)**	
Contaminant	Waste Disposal Area	Settling Ponds	Soil	ORNL-PRG[a]	Ground-water	Surface Water	AWQC[b]	Sediment	ERL[c]
METALS/ INORGANICS									
Aluminum	140,000	290,000	170,000	NA	2,900,000	23,000	NA	120,000	NA
Arsenic	11	28	**20**	9.9	**270**	6.9	36	**30**	8.2
Barium	1,200	22,000	6,900	NA	1,600,000	1,200	NA	**6,300**	48[d]
Cadmium	26	15	**15**	0.36[e]	**400**	**720**	8.8	**17**	1.2
Chromium	1,700	770	**360**	0.4	**3,800**	ND	50[f]	**500**	81
Copper	3,100	8,700	**3,800**	60	**78,000**	**1,400**	3.1	**6,000**	34
Lead	300	1,100	**7,300**	40.5	**4,400**	ND	8.1	**740**	46.7
Magnesium	140,000	240,000	110,000	NA	11,000,000	2,200,000	NA	110,000	NA
Nickel	610	570	**200**	30	**1,600**	ND	8.2	**240**	20.9
Selenium	20	24	**42**	0.21	ND	ND	71	**54**	1.0[d]
Silver	62	28	**14**	2	**570**	**210**	1.9[g]	**13**	1
Zinc	2,500	6,800	**23,000**	8.5	**90,000**	**1,100**	81	**5,200**	150
RADIOISOTOPES									
Cesium-137	ND	0.079	0.25	NA	ND	ND	NA	0.092	NA
Potassium-40	9.0	55	24	NA	20,000	260	NA	37	NA
Thorium-228	19	4.5	12	NA	110	ND	NA	2.7	NA
Thorium-230	8.7	5.2	24	NA	1.0	ND	NA	2.4	NA
Thorium-232	20	4.8	12	NA	0.87	ND	NA	3.7	NA

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Marine chronic criteria presented.

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

d: Marine apparent effects threshold (AET) for amphipod bioassay. The AET represents the concentration above which adverse biological impacts would be expected.

e: Ecological soil screening guidelines (USEPA 2008).

f: Screening guidelines represent concentrations for Cr^{+6}.

g: Chronic criterion not available; acute criterion presented.

NA: Screening guidelines not available.

ND: Not detected.

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Formosa Mine

Riddle, Oregon
EPA Facility ID: ORN001002616
Basin: South Umpqua
HUC: 17100302

Executive Summary

The Formosa Mine site is an inactive mine encompassing approximately 20 ha (50 acres) on Silver Butte, south of Riddle, Oregon. Four tributaries of the South Umpqua River have their headwaters in the vicinity of the mine. Beginning in the early 1900s, the site was intermittently mined for copper, gold, silver, and zinc; the mine was closed in 1993. The primary contaminants of concern to NOAA are metals, including arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. Groundwater transport, surface water runoff, stormwater discharge, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The habitats of primary concern to NOAA are Middle Creek, South Fork Middle Creek, and Cow Creek, which all provide habitat for coho salmon, Pacific lamprey, and steelhead trout. Oregon Coast coho salmon are listed as a federally threatened species under the Endangered Species Act, and this population of steelhead trout is also listed as a federal species of concern. Cow Creek also provides habitat for Chinook salmon.

Site Background

The Formosa Mine site is an inactive mine encompassing approximately 20 ha (50 acres) on Silver Butte, south of Riddle, Oregon. Four tributaries of the South Umpqua River—Middle Creek, South Fork Middle Creek, Russell Creek, and West Fork Canyon Creek—have their headwaters in the vicinity of the mine (Figure 1). When the mine was active, contaminated stormwater runoff was discharged directly to Middle Creek. Previous sampling investigations conducted in the vicinity of the site by the Bureau of Land Management found no detectable impacts to Russell Creek or West Fork Canyon Creek (Hart Crowser 2004a, 2004b).

Beginning in the early 1900s, the site was intermittently mined for copper, gold, silver, and zinc. From 1990 to 1993, the mine produced approximately 320 to 360 metric tons (350 to 400 tons) of copper and zinc per day. Mining ceased in 1993 after the Oregon Department of Geology and Mineral Industries issued a Closure Order and the Oregon Department of Environmental Quality (ODEQ) issued a Notice of Noncompliance (USEPA 2007).

In 1994, the Oregon Department of Geology and Mineral Industries ordered the operators of the Formosa Mine to reclaim the site. As part of the reclamation, mine workings were backfilled with high-grade ore, all mine entrances (adits) were sealed, and a drainage system was constructed. The tailings and water storage pond was also backfilled and capped; the area is now referred to as the encapsulation mound (Figure 2).

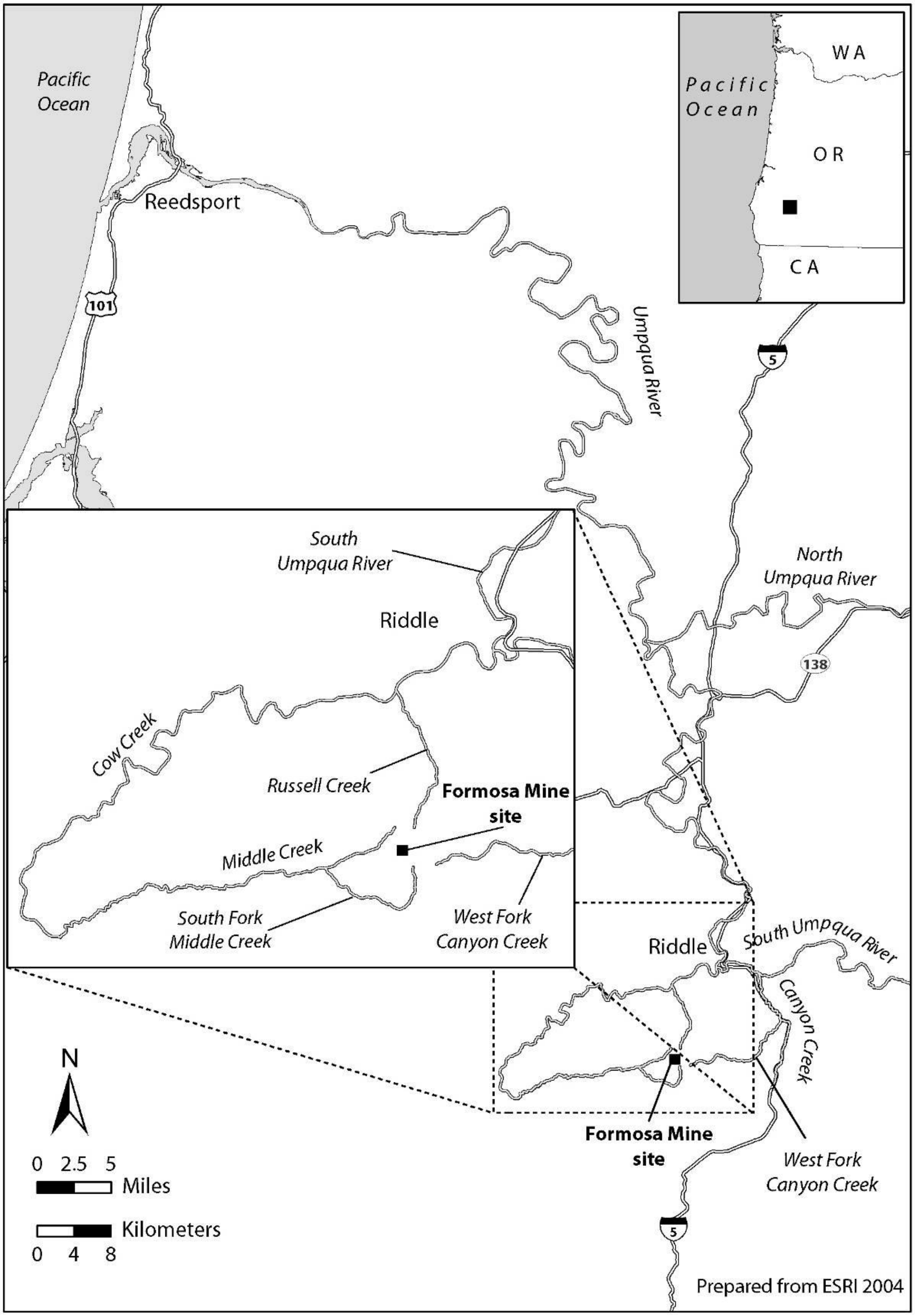

Figure 1. Location of the Formosa Mine site, Riddle, Oregon.

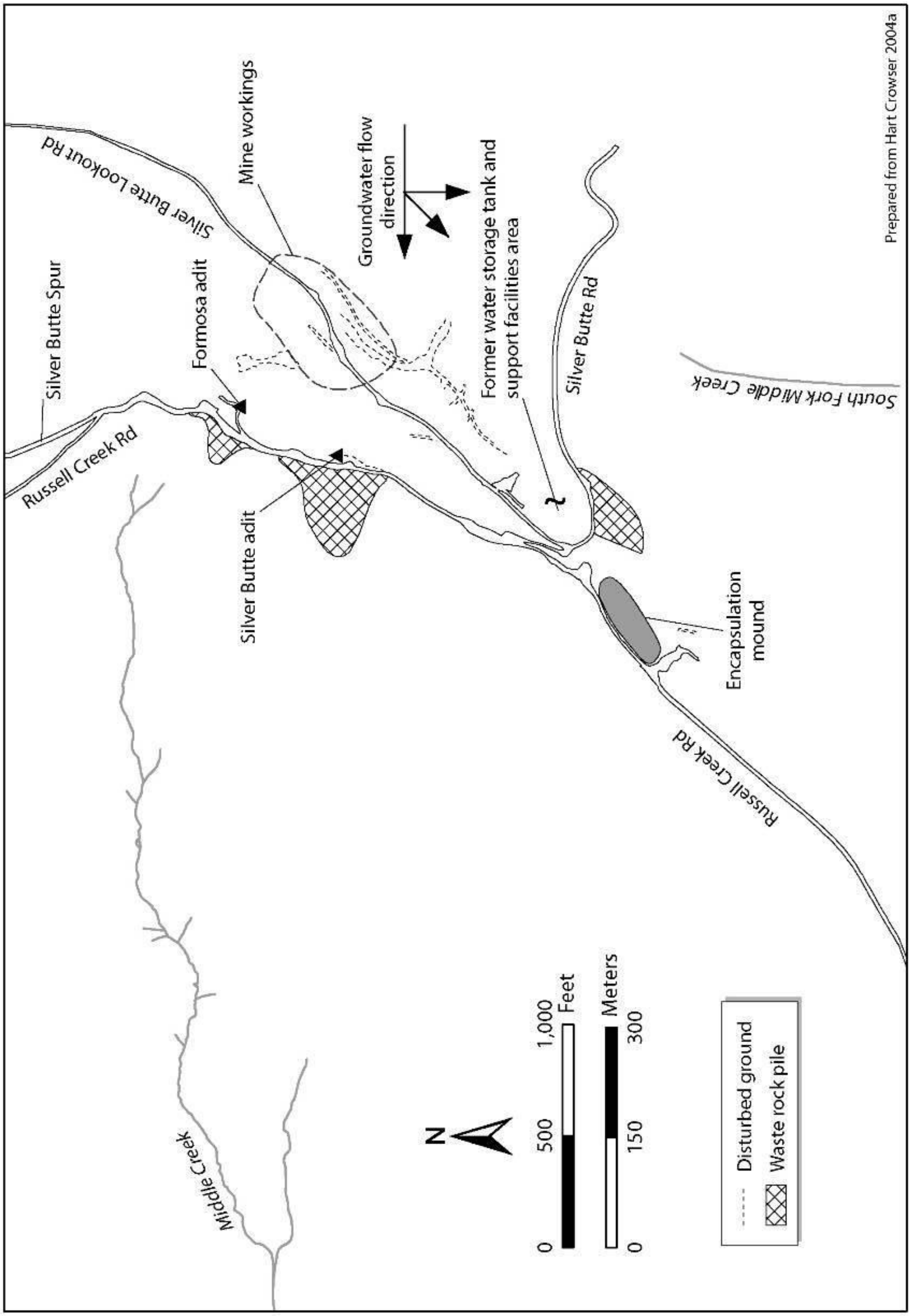

Figure 2. Detail of the Formosa Mine property.

Uncovered and uncontained waste rock piles with elevated concentrations of heavy metals still remain on the site (Figure 2).

According to the documents reviewed for this report, the drainage system never worked as intended and has resulted in contamination of the site and adjacent surface water bodies. During numerous investigations, elevated concentrations of metals were detected in samples of sediment, surface water, groundwater, and soil taken from the site, Middle Creek, South Fork Middle Creek, and Cow Creek (Hart Crowser 2004a, 2004b; USEPA 2007). Metals were detected in Middle Creek and South Fork Middle Creek at concentrations that exceed ODEQ screening-level values and U.S. Environmental Protection Agency (USEPA) ambient water quality criteria (AWQC) (Hart Crowser 2004a, 2004b).

Groundwater transport, surface water runoff, stormwater discharge, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. Acidic water flows from the former mine adits to the underground mine shafts, encapsulation mound, and waste rock piles. The acidic water discharges to South Fork Middle Creek and Middle Creek. Groundwater underlying the site flows radially, following the topography of Silver Butte (Figure 2). Groundwater is encountered approximately 10 to 30 m (30 to 100 ft) below ground surface, with elevations changing quickly during heavy rainfall (Hart Crowser 2004a, 2004b).

A remedial investigation (RI) was conducted by the Bureau of Land Management, Roseburg District and the ODEQ in June 1999; that RI focused on the observed decline of biological conditions at the site since the mine was closed. In 2002, the ODEQ conducted a supplemental RI to better define the contaminant sources at the site (USEPA 2007). In 2004, a feasibility study and a baseline ecological risk assessment were conducted by the ODEQ. A hazard ranking system package was completed for the site by the USEPA in March 2007. The site was placed on the National Priorities List in September 2007 (USEPA 2007, 2008a). Current activities underway at the site are a combined remedial investigation/feasibility study (RIFS), which the USEPA initiated in July 2008 (USEPA 2008a).

NOAA Trust Resources

The habitats of primary concern to NOAA are Middle Creek, South Fork Middle Creek, and Cow Creek, all tributaries to the South Umpqua River (Figure 1). The headwaters of Middle Creek and South Fork Middle Creek begin west and south of the mine, respectively. South Fork Middle Creek discharges to Middle Creek, which is a tributary of Cow Creek. Cow Creek ultimately discharges to the South Umpqua River.

In the vicinity of the site, tributaries of the South Umpqua River are generally moderate- to high-gradient streams flowing through deep valleys. The predominant vegetation in these valleys is the Douglas fir tree (Geyer 2003). Middle Creek is a Tier 1 Key Watershed under the Northwest Forest Plan (USFS 2006). Key Watersheds are a system of large refugia that provide high-quality water and are crucial for at-risk fish species and stocks. Key Watersheds include high-quality habitat as well as degraded habitat. Key Watersheds that include degraded habitat are given the highest priority for watershed restoration (USFS 2006).

The South Umpqua River watershed provides habitat for anadromous Chinook and coho salmon, Pacific lamprey, and steelhead trout (ODFW 2008; USEPA 2007), all of which are

NOAA trust resources that use Middle Creek, South Fork Middle Creek, and Cow Creek for spawning and rearing habitat and migratory routes (Table 1). NOAA Fisheries lists the Oregon Coast coho salmon as a threatened species under the Endangered Species Act and classifies this population of steelhead trout as a federal species of concern (NOAA Fisheries 2008).

Adult and juvenile coho salmon and steelhead trout have been observed in Middle Creek, South Fork Middle Creek, and Cow Creek during stream surveys. All three creeks provide spawning and rearing habitat for coho salmon and steelhead trout (ODFW 2008; USEPA 2007). Additionally, Cow Creek serves as a migration corridor for coho salmon and steelhead trout (ODFW 2008).

Cow Creek also provides spawning and rearing habitat and migratory routes for Chinook salmon (ODFW 2008).

Middle Creek, South Fork Middle Creek, and Cow Creek provide spawning and rearing habitat for Pacific lamprey, which has been documented in all three creeks (USEPA 2007). Pacific lamprey larvae, or ammocoetes, are an important food source for salmonids (BPA 2005). In recent years, groups have petitioned the U.S. Fish and Wildlife Service to protect Pacific lamprey under the Endangered Species Act (Geyer 2003). Historically, Pacific lamprey provided an important food source for Pacific Northwest tribes. The Pacific lamprey was also used by the tribes for medicinal and ceremonial purposes (BPA 2005).

Table 1. NOAA trust resources present in Middle Creek, South Fork Middle Creek, and Cow Creek near the Formosa Mine site (USEPA 2007; ODFW 2008).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Migratory Route	Comm.	Rec.
ANADROMOUS FISH						
Chinook salmon	*Oncorhynchus tshawytscha*	♦	♦	♦		
Coho salmon	*Oncorhynchus kisutch*	♦	♦	♦		
Pacific lamprey	*Lampetra tridentata*	♦	♦	♦		
Steelhead trout	*Oncorhynchus mykiss*	♦	♦	♦		♦

There are no commercial fisheries on Middle Creek, South Fork Middle Creek, or Cow Creek. A sport fishery targeting steelhead trout and resident trout species occurs on Cow Creek and targets resident trout species on the tributaries of Cow Creek (USEPA 2007).

No fish consumption advisories are currently in effect for Middle Creek, South Fork Middle Creek, or Cow Creek (ODHS 2008).

Site-Related Contamination

Over the course of numerous environmental investigations, many surface water, sediment, and soil samples were collected at the Formosa Mine site and analyzed for metals (Hart Crowser 2004a, 2004b). The primary contaminants of concern to NOAA are metals, including arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, and selenium.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always included when available. In the absence of such guidance, the screening guidelines for surface water are the AWQC (USEPA 2006); the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000). The screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2008b). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, are discussed below. When known, the general sampling locations are also provided (refer to Figures 1 and 2).

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Formosa Mine site (Hart Crowser 2004a, 2004b). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		**Water (µg/L)**		**Sediment (mg/kg)**	
Contaminant	Soil	ORNL-PRG[a]	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/INORGANICS						
Arsenic	**260**	9.9	7.7	150	**28**	9.79
Cadmium	**8.0**	0.36[d]	**420**	0.25[e]	**30**	0.99
Chromium	**5.1**	0.26[d]	8.3	11[f]	**230**	43.4
Copper	**1,400**	28[d]	**40,000**	9[e]	**16,000**	31.6
Lead	**660**	40.5	**140**	2.5[e]	**47**	35.8
Mercury	**3.4**	0.00051	N/A	0.77[g]	**1.0**	0.18
Nickel	11	30	**120**	52[e]	**170**	22.7
Selenium	<2.5	0.21	**9.1**	5.0[h]	0.9	NA
Silver	**4.9**	2	0.33	3.2[e,i]	2.0	4.5[j]
Zinc	**2,500**	8.5	**54,000**	120[e]	**11,000**	121

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006). Freshwater chronic criteria presented.

c: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).

d: Ecological soil screening guidelines (USEPA 2008b).

e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.

f: Screening guidelines represent concentrations for $Cr.^{+6}$

g: Derived from inorganic, but applied to total mercury.

h: Criterion expressed as total recoverable metal.

i: Chronic criterion not available; acute criterion presented.

j: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.

k. N/A: Not analyzed for.

NA: Screening guidelines not available.

ND: Not detected.

Surface Water

Five metals and selenium were detected in surface water samples collected from the Formosa Mine site at maximum concentrations that exceeded the AWQC (Table 2). The maximum concentrations of cadmium, copper, lead, nickel, selenium, and zinc were detected in samples collected from Middle Creek. The maximum concentrations of cadmium and copper exceeded the AWQC by three orders of magnitude, and zinc and lead exceeded the AWQC by two orders and one order of magnitude, respectively. The maximum concentrations of nickel and selenium exceeded the AWQCs by factors of approximately two.

Sediment

Eight metals were detected in sediment samples collected from the Formosa Mine site at maximum concentrations that exceeded screening guidelines; selenium was also detected for which no screening guideline is currently available (Table 2). The maximum concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc were detected in samples collected from Middle Creek. The maximum concentration of copper exceeded the TEC by two orders of magnitude. The maximum concentrations of cadmium and zinc exceeded the TECs by one order of magnitude. The maximum concentrations of nickel, mercury, chromium, and arsenic exceeded the TECs by factors of approximately seven, 5.5, five, and approximately 2.5, respectively; lead slightly exceeded the TEC. No screening guidelines are currently available for comparison to the maximum concentration of selenium detected in the sediment samples.

Soil

Eight metals were detected in soil samples collected from the Formosa Mine at maximum concentrations that exceeded screening guidelines (Table 2). The maximum concentrations of arsenic, lead, mercury, and silver were detected in samples taken in the vicinity of the Silver Butte adit. The maximum concentration of mercury exceeded the ORNL-PRG by three orders of magnitude; arsenic and lead exceeded the ORNL-PRGs by one order of magnitude. The maximum concentration of silver exceeded the ORNL-PRG by approximately a factor of two. The maximum concentrations of cadmium, copper, and zinc were detected in samples taken in the vicinity of the encapsulation mound. The maximum concentration of zinc exceeded the ORNL-PRG by two orders of magnitude. The maximum concentrations of cadmium and copper exceeded the USEPA ecological soil screening guidelines by one order of magnitude. The maximum concentration of chromium, which was detected in a sample taken in the vicinity of the Formosa adit, also exceeded the USEPA ecological soil screening guideline by one order of magnitude.

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Lockheed West Seattle

Seattle, Washington
EPA Facility ID: WAN001002655
Basin: Puget Sound
HUC: 177110019

Executive Summary

The Lockheed West Seattle site is a former shipyard in an industrial area of Seattle, King County, Washington. The site encompasses approximately 21 ha (52 acres); 11 ha (27 acres) are in the aquatic areas of Elliott Bay at the mouth of the West Duwamish Waterway. From 1946 to 1986, the facility was used for ship refurbishing and maintenance. The work was conducted at piers, in dry docks, and at a shipway. Wastes from these operations, including paint, metal scrapings, and sandblast grit, were discharged directly to Elliott Bay and the West Duwamish Waterway. Heavy metals, organotins (including tributyltin), PAHs, and PCBs have been detected in sediment samples collected from the West Duwamish Waterway and Elliott Bay during numerous investigations conducted at the site. Surface water runoff and direct discharge are the primary pathways for the migration of contaminants from the site to NOAA trust resources; groundwater transport is a secondary pathway. The habitats of primary concern to NOAA are Elliott Bay and the West Duwamish Waterway, which provide rearing and adult habitat and migratory routes for numerous NOAA trust resources, including anadromous, estuarine, and marine fish species, as well as invertebrates and marine mammals.

Site Background

The Lockheed West Seattle site is a former shipyard in an industrial area of Seattle, King County, Washington. The site encompasses approximately 21 ha (52 acres); 11 ha (27 acres) are in the aquatic areas of Elliott Bay at the mouth of the West Duwamish Waterway (Figure 1). Approximately 3 ha (7 acres) of the aquatic lands are currently owned by the Port of Seattle, and the remaining 8 ha (20 acres) of aquatic lands are owned by the Washington State Department of Natural Resources (USEPA 2006a). The West Duwamish Waterway is the western portion of the mouth of the Duwamish River.

The upland portion of the facility (Figure 2) was developed on fill material over mudflats in Elliott Bay. Two recently remediated Superfund sites are adjacent to the Lockheed West Seattle site: the Pacific Sound Resources Superfund site is to the west and the Harbor Island Superfund site is to the east (USEPA 2006b; Tetra Tech 2006).

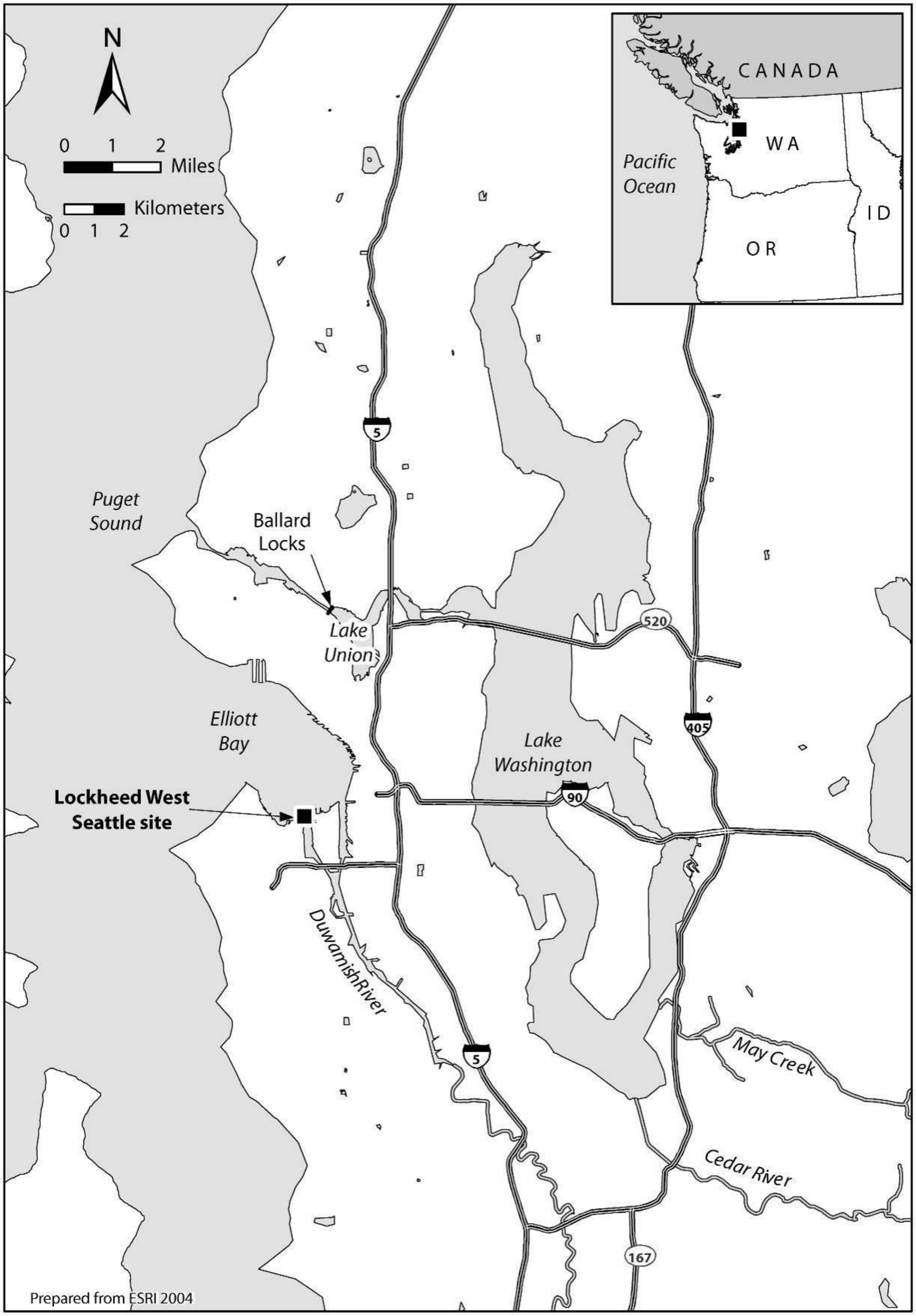

Figure 1. Location of the Lockheed West Seattle site in Seattle, Washington.

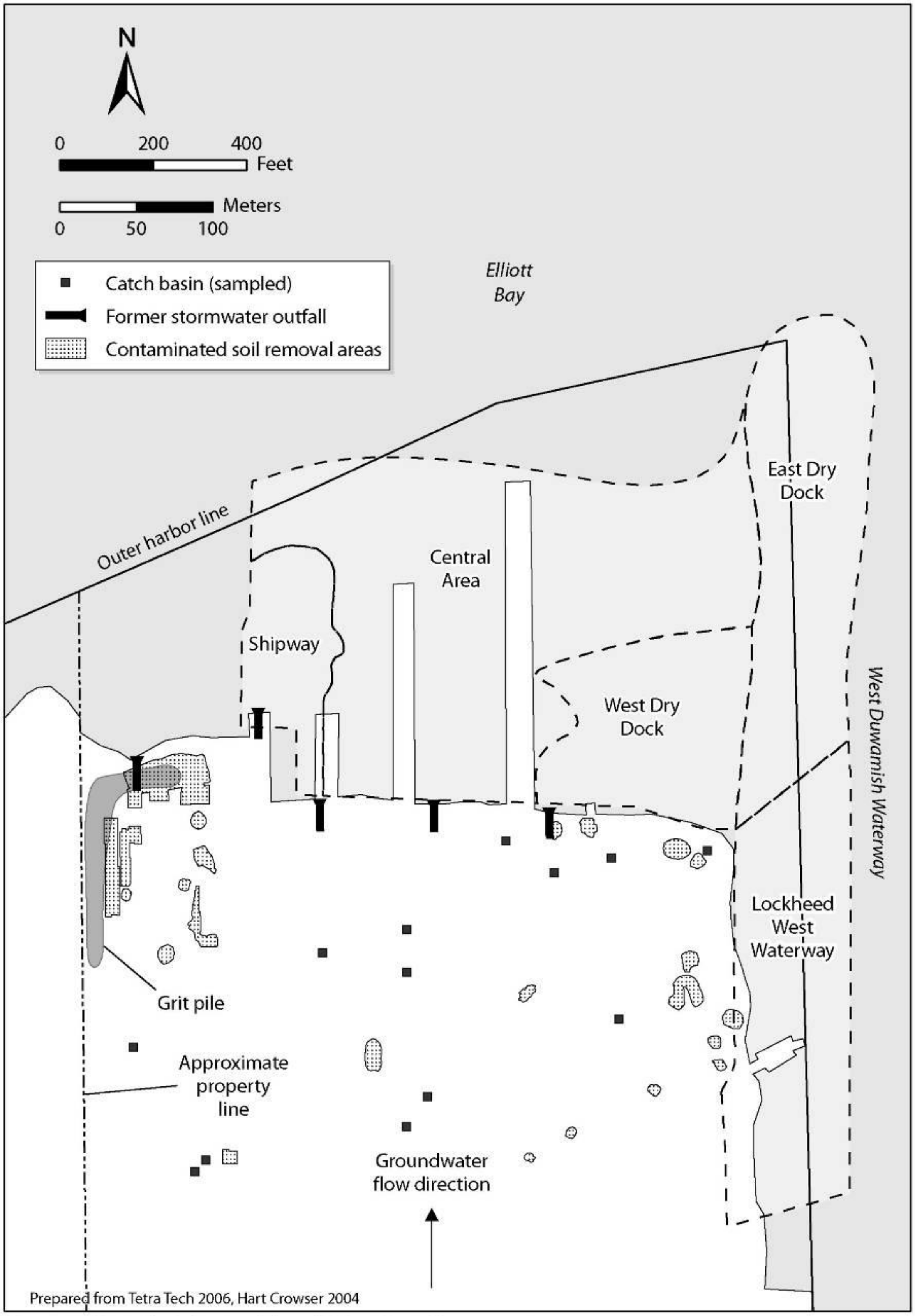

Figure 2. Detail of the Lockheed West Seattle property.

From 1946 to 1986, the facility was used for ship refurbishing and maintenance. The work was conducted at piers, in dry docks, and at a shipway. Operations included metal fabrication, pipe fitting, electrical wiring, sandblasting, painting, and yard vehicle maintenance. Paints used on ships contained metals to provide pigment and anti-fouling chemical agents to inhibit the growth of marine organisms on ship hulls. A sandblast grit pile was located in the northwestern portion of the site adjacent to the Elliott Bay shoreline (Figure 2). Runoff from the grit pile was not contained and was allowed to enter Elliott Bay. In addition, wastes, including paint, metal scrapings, and sandblast grit, were discharged directly to Elliott Bay and the West Duwamish Waterway. The stormwater system at the facility, which consisted of numerous catch basins draining to stormwater drainage pipes, also discharged directly to Elliott Bay and the West Duwamish Waterway (Tetra Tech 2006; USEPA 2006a).

Heavy metals (including arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), organotins (including tributyltin), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) have been detected in sediment samples collected from the West Duwamish Waterway and Elliott Bay during numerous investigations conducted at the site (Hart Crowser 2004; Tetra Tech 2006). In addition, paint chips and bits of metal have been observed in sediments adjacent to the facility during investigations (USEPA 2006a). Since 1989, groundwater monitoring has been conducted at the site, and metals, PAHs, and organotins have been detected in groundwater samples collected from site monitoring wells (Tetra Tech 2006). The concentrations of detected groundwater contaminants were not provided in the documents reviewed for this report.

In 1995, under the direction of the Washington State Department of Ecology (Ecology), contaminated soils in the upland portions of the site were removed, catch basin and storm drain sediments were removed, the upland area was capped with asphalt, and the stormwater system was replaced. Contaminated sediment in the aquatic areas has not been removed. As shown on Figure 2, Ecology has defined five units in the aquatic areas for remediation: the Shipway, the Central Area, the West Dry Dock, the Lockheed West Waterway, and the East Dry Dock (Tetra Tech 2006).

In 2006, a risk assessment/feasibility study was conducted on the aquatic portion of the site by a consultant working under contract to the former owner of the property. To determine the site’s eligibility for proposal to the U.S. Environmental Protection Agency’s (USEPA) National Priorities List (NPL), a hazard ranking system documentation package was completed in September 2006 (USEPA 2006a). The Lockheed West Seattle site was proposed to the NPL on September 27, 2006 (USEPA 2006b).

Surface water runoff and direct discharge are the primary pathways for the migration of contaminants from the site to NOAA trust resources; groundwater transport is a secondary pathway. Surface water and stormwater runoff at the Lockheed West Seattle site discharge directly to Elliott Bay and the West Duwamish Waterway. The flow and depth of groundwater underlying the site are tidally influenced, but groundwater generally flows north to Elliott Bay (Tetra Tech 2006). Contaminated groundwater underlying the site is expected to discharge to Elliott Bay and the West Duwamish Waterway (USEPA 2006a).

NOAA Trust Resources

The habitats of primary concern to NOAA are Elliott Bay and the West Duwamish Waterway. Elliott Bay is a large embayment of Puget Sound (Figure 1). The West Duwamish Waterway, which is the western portion of the mouth of the Duwamish River, forms the

Duwamish River estuary in the southern end of Elliott Bay adjacent to the site. This area is a transitional zone between estuarine and marine environments, with tides ranging from 4.6 m (15 ft) above mean lower low water (MLLW) to 1.4 m (4.5 ft) below MLLW. Tidal influence and river flow create consistent circulation in the vicinity of the site. Substrates in the area consist of sands, silts, and silty sands (Tetra Tech 2006). The shoreline in the vicinity is highly industrialized and developed.

Elliott Bay and the West Duwamish Waterway provide rearing and adult habitat and migratory routes for numerous NOAA trust resources, including anadromous, estuarine, and marine fish species, as well as invertebrates and marine mammals (Table 1). Anadromous species that use these habitats as migratory routes, nurseries, and osmoregulatory transition zones include Chinook, chum, coho, pink, and sockeye salmon, as well as steelhead trout (Foley 2007). Elliott Bay and the West Duwamish Waterway also provide adult habitat and a migratory route for the anadromous Pacific lamprey.

Chinook and coho salmon are the salmon species most frequently encountered in the Duwamish River, with the majority originating from two state and tribally managed hatcheries on the Green River, a tributary of the Duwamish River. NOAA Fisheries lists Chinook salmon as a threatened species and designates coho salmon as a species of concern. In addition, NOAA Fisheries has proposed steelhead trout for listing as a threatened species (NOAA Fisheries 2007). Bull trout and bald eagles, which are both listed by the U.S. Fish and Wildlife Service as threatened, have been observed in the vicinity of the site (USEPA 2006a).

Estuarine and marine species found in the vicinity include English sole, Pacific cod, Pacific herring, Pacific sand lance, Pacific staghorn sculpin, Pacific tomcod, prickly sculpin, shiner perch, starry flounder, surf smelt, threespine stickleback, and walleye pollock (Monaco et al. 1990). Estuarine and marine species primarily use Elliott Bay and the West Duwamish Waterway as juvenile rearing areas. Crab, shrimp, and squid are also found in the waters of Elliott Bay, which provides habitat for all life-history phases for many of these invertebrate species. The area also provides adult habitat for California sea lions, harbor porpoises, and harbor seals.

Commercial fisheries, as well as recreational and subsistence fishing, occur in the vicinity of the Lockheed West Seattle site. Table 1 identifies species targeted in these fisheries. The waters in the vicinity are the adjudicated usual and accustomed fishing grounds of the Muckleshoot and Suquamish Indian Tribes. Tribal fishers can be observed fishing in the area throughout the year (USEPA 2006a).

A fish consumption advisory is in effect for Puget Sound waters within King County (excluding Vashon Island) because of concentrations of mercury, PCBs, and historical industrial discharges.

Table 1. NOAA trust resources present in the West Duwamish Waterway and Elliott Bay near the Lockheed West Seattle site (Monaco et al. 1990; Bargman 1991; Tetra Tech 2006; Foley 2007; WDFW 2007).

Species		**Habitat Use**				**Fisheries**		
Common Name	Scientific Name	Spawning Area	Nursery Area	Migratory Route	Adult Habitat	Comm.	Rec.	Subsist.
ANADROMOUS FISH								
Chinook salmon	*Oncorhynchus tshawytscha*		♦	♦	♦	♦	♦	♦
Chum salmon	*Oncorhynchus keta*		♦	♦	♦	♦		
Coho salmon	*Oncorhynchus kisutch*		♦	♦	♦	♦	♦	♦
Pacific lamprey	*Lampetra tridentata*			♦	♦			
Pink salmon	*Oncorhynchus gorbuscha*		♦	♦	♦			
Sockeye salmon	*Oncorhynchus nerka*		♦	♦	♦			
Steelhead trout	*Oncorhynchus mykiss*		♦	♦	♦	♦	♦	♦
MARINE/ESTUARINE FISH								
English sole	*Parophrys vetulus*		♦					
Pacific cod	*Gadus macrocephalus*		♦			♦	♦	
Pacific herring	*Clupea pallasii*	♦	♦			♦		
Pacific sand lance	*Ammodytes hexapterus*		♦				♦	
Pacific staghorn sculpin	*Leptocottus armatus*		♦		♦			
Pacific tomcod	*Microgadus proximus*		♦					
Prickly sculpin	*Cottus asper*		♦					
Shiner perch	*Cymatogaster aggregata*	♦	♦		♦			
Starry flounder	*Platichthys stellatus*		♦			♦	♦	
Surf smelt	*Hypomesus pretiosus*		♦				♦	
Threespine stickleback	*Gasterosteus aculeatus*	♦	♦		♦			
Walleye pollock	*Theragra chalcogramma*		♦				♦	
INVERTEBRATES								
Blue mussel	*Mytilus edulis*	♦	♦		♦			
Dungeness crab	*Cancer magister*	♦	♦		♦		♦	♦
Opalescent inshore squid	*Loligo opalescens*							
Pandalid shrimp	*Pandalidae spp.*		♦		♦		♦	♦
Red rock crab	*Cancer productus*	♦	♦		♦		♦	♦
MARINE MAMMALS								
California sea lion	*Zalophus californianus*				♦			
Harbor porpoise	*Phocoena phocoena*				♦			
Harbor seal	*Phoca vitulina*				♦			

The advisory recommends consuming no more than one meal per week of Chinook salmon and no more than two meals per month of blackmouth, a resident Chinook salmon of Puget Sound. The advisory recommends no consumption of rockfish from Elliott Bay (WDOH 2006). In addition, the advisory recommends no consumption of English sole and other flatfish from the Duwamish Waterway and no more than two meals per month of flatfish from Elliott Bay. The advisory recommends no consumption of crab from the Duwamish Waterway and warns that the consumption of crab, shellfish, or seaweed from Elliott Bay may be unsafe due to pollution. The advisory recommends no consumption of crab hepatopancreas from Elliott Bay. Shellfish and seaweed harvesting in Elliott Bay and the Duwamish Waterway is closed due to pollution (WDOH 2006).

Site-Related Contamination

Large numbers of sediment samples have been collected over the years during numerous environmental investigations conducted at the Lockheed West Seattle site. These samples have been analyzed for a wide range of environmental contaminants, including metals, semivolatile organic compounds (including PAHs), organotins (including tributyltin), and PCBs (Hart Crowser 2004; Tetra Tech 2006). The primary contaminants of concern to NOAA are metals, tributyltin, PAHs, and PCBs.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always used when available. In this case, the regional specific screening guidelines are the Washington State Department of Ecology's Sediment Management Standards (SMS) (Ecology 1995) and the sediment threshold for tributyltin, which is protective of most juvenile salmonid prey (Meador et al. 2002). Other screening guidelines that will be used for sediment in a saltwater environment are the effects range-low (ERL) concentrations (Long et al. 1998). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which there are no screening guidelines are discussed below. When known, the general sampling locations (refer to Figure 2) are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Lockheed West Seattle site. Contaminant values in bold exceed or are equal to screening guidelines (Hart Crowser 2004; Tetra Tech 2006).

		Sediment (mg/kg)	
Contaminant	Sediment	SMS[a]	ERL[b]
METALS/INORGANICS			
Arsenic	**710**	57	8.2
Cadmium	**7.3**	5.1	1.2
Chromium	**660**	260	81
Copper	**1,900**	390	34
Lead	**2,200**	450	46.7
Mercury	**2.2**	0.41	0.15
Silver	**1.3**	6.1	1
Zinc	**2,600**	410	150
ORGANOTINS			
Tributyltin	**6**	NA	0.12[c]
PAHs			
Acenaphthene	**5.4**	0.32	0.016
Acenaphthylene	**1.9**	1.32	0.044
Anthracene	**8.7**	4.4	0.0853
Benz(a)anthracene	**19**	2.2	0.261
Benzo(a)pyrene	**15**	1.98	0.43
Benzo(b+k)fluoranthene	**22**	4.6	1.8[d]
Chrysene	**15**	2.2	0.384
Dibenz(a,h)anthracene	**4.2**	0.24	0.0634
Fluoranthene	**35**	3.2	0.6
Fluorene	**6**	0.46	0.019
Indeno(1,2,3-cd)pyrene	**8.9**	0.68	0.6[d]
2-Methylnaphthalene	**1.6**	0.76	0.07
Naphthalene	**6.9**	1.98	0.16
Phenanthrene	**35**	2	0.24
Pyrene	**36**	20	0.665
Total LPAH	**64**	7.4	0.552
Total HPAH	**160**	19.2	1.7
PCBs			
Total PCBs	**5.9**	0.24	0.0227

a: Washington State Sediment Management Standard (SMS) Marine Sediment Quality Standards. The SMS is based on organic carbon content of the sediment so a 2% total organic carbon content is assumed (Ecology 1995).

b: Effects range-low (ERL) represents the 10th percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al. (1998).

c: This number is based on the tissue residue approach and available data. The number protects most salmonid prey species against severe adverse sublethal effects. This number is based on sediment with a 2% total organic carbon content (Meador et al. 2002).

d: Marine apparent effects threshold (AET) for bioassays. The AET represents the concentration above which adverse biological impacts would be expected.

NA: Screening guideline not available.

Sediment

Eight metals were detected in sediment samples collected from the Lockheed West Seattle site at maximum concentrations that exceeded the screening guidelines. The maximum concentrations of arsenic and silver were detected in samples collected from Elliott Bay in the site's Central Area. The maximum concentration of arsenic exceeded the ERL and the SMS by one order of magnitude. The maximum concentration of silver slightly exceeded the ERL.

The maximum concentrations of cadmium, chromium, copper, lead, mercury, and zinc were detected in samples collected from Elliot Bay along the eastern border of the site in the East Dry Dock area. The maximum concentrations of copper, lead, mercury, and zinc exceeded the ERLs by one order of magnitude. The maximum concentrations of chromium and cadmium exceeded the ERLs by a factor of eight and six, respectively. The maximum concentration of zinc exceeded the SMS by a factor of six. The maximum concentrations of copper, lead, and mercury exceeded the SMSs by a factor of approximately five. The maximum concentration of chromium exceeded the SMS by a factor of 2.5 and the maximum concentration of cadmium slightly exceeded the SMS.

The maximum concentration of tributyltin, which was detected in a sample collected from Elliott Bay in the eastern portion of the site in the Central Area, exceeded Meador's sediment threshold by one order of magnitude. No SMS is available for comparison to the maximum concentration of tributyltin.

Sixteen PAHs were detected in sediment samples collected from the Lockheed West Seattle site at maximum concentrations that exceeded screening guidelines; maximum concentrations of total low-molecular-weight PAHs (LPAHs) and high-molecular-weight PAHs (HPAHs) also exceeded screening guidelines. The maximum concentrations of all detected PAHs (Table 2) occurred in samples collected from Elliott Bay along the eastern border of the site in the East Dry Dock area. The maximum concentrations of acenaphthene, anthracene, fluorene, phenanthrene, and total LPAHs exceeded the ERLs by two orders of magnitude. The maximum concentrations of acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, 2-methylnaphthalene, naphthalene, pyrene, and total HPAHs exceeded the ERLs by one order of magnitude. The maximum concentrations of total benzofluoranthenes and indeno(1,2,3-cd)pyrene exceeded the apparent effects threshold (AET) by one order of magnitude.

The maximum concentrations of acenaphthene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, and phenanthrene exceeded the SMSs by one order of magnitude. The maximum concentrations of benzo(a)anthracene and total LPAHs exceeded the SMSs by a factor of approximately nine. The maximum concentrations of total HPAHs, benzo(a)pyrene, and chrysene exceeded the SMSs by a factor of eight, 7.5, and seven, respectively. The maximum concentrations of total benzofluoranthenes, naphthalene, and 2-methylnaphthalene exceeded the SMSs by a factor of four, three, and two, respectively. The maximum concentrations of acenaphthylene, anthracene, and pyrene slightly exceeded the SMSs.

PCBs were detected in sediment samples collected from the Lockheed West Seattle site at concentrations that exceeded the screening guidelines. The maximum concentration of total PCBs, which was detected in a sample collected from Elliott Bay along the eastern border of the site in the East Dry Dock area, exceeded the ERL by two orders of magnitude and the SMS by one order of magnitude.

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Glossary of terms

Adit Horizontal entrance to a mine.

Adult habitat The environment where an aquatic resource lives after reaching physical and sexual maturity.

Aestivation The dormant or sluggish state that some animals enter to cope with periods of hot and dry conditions.

Ambient water quality criteria (AWQC) The U.S. Environmental Protection Agency's (USEPA) compilation of nationally recommended water quality criteria, based on data and scientific judgments on pollutant concentrations and how they affect the environment or human health.[1]

Amphidromous refers to predominately freshwater species that require estuarine or marine waters for completion of larval phases.

Anadromous Migrating from marine waters to breed in freshwater. Examples of anadromous fish include salmon, river herring (alewife), and striped bass.

Aquifer An underground geological formation, or group of formations, containing water. Are sources of groundwater for wells and springs.

Aroclor A trade name for a group of polychlorinated biphenyls (PCBs).

Artesian aquifer An aquifer in which groundwater is confined under pressure by impermeable rock layers.

Baghouse dust Particles collected from the air by an air pollution system.

Bioavailable The fraction of the total chemical in the surrounding environment that is available for uptake by organisms. The environment may include water, sediment, suspended particles, and food items.

Biotransformation Chemical alteration of a substance within the body.

Body burden The amount of a chemical stored in the body at a given time, especially a potential toxin in the body as the result of exposure.

Boiler slag Molten inorganic material that drains to the bottom of the furnace when coal is being converted so that it can be used to create power.

Borehole A hole made with drilling equipment.

Brood To hatch eggs.

Capacitor An electric circuit element used to store charge temporarily.

Catadromous Living in fresh water but migrating to marine waters to breed. An example is the American eel.

Chemical affinity An attraction or force between particles that causes them to combine.

Coal tar A material obtained from the destructive distillation of coal in the production of coal gas. The crude tar contains a large number of organic compounds (e.g., benzene, naphthalene, methylbenzene, etc.), and is used as roofing, waterfproofing, and insulating compounds. It is also used as a raw material for dyes, drugs, and paints.

Confined aquifer An aquifer that is bounded above and below by impermeable rock layers.

Confluence The point where two or more streams meet or flow together.

Contaminants of concern Chemicals at a hazardous waste site that are likely to have an adverse effect on NOAA trust resources.

Contaminant partitioning In general, it is the tendency of a contaminant to be in the air, water, soil, or sediment based on the relative chemical affinities of that contaminant.

Decant To pour off without disturbing the sediment.

Demersal Dwelling at or near, sinking to, or deposited near the bottom of a body of water.

Depurate Elimination of a chemical from an organism by desorption, diffusion, excretion, egestion, biotransformation, or another route.

Desorption To remove an absorbed substance from.

Diadromous Fishes that migrate between fresh and salt water (e.g., salmon and American eel).

Effects range–low (ERL) NOAA sediment quality guidelines derived from the examination of a large number of individual contamination studies, all in salt water. The ERLs are indicative of contaminant concentrations below which adverse effects rarely occur.[2]

Egestion To discharge or excrete from the body.

Emergency Removal Action Steps taken to remove contaminated materials that pose imminent threats to local residents (e.g., removal of leaking drums or the excavation of explosive waste).[3]

Emergent plants/vegetation Rooted aquatic plants with some herbaceous vegetative parts that project above the water surface. Also referred to as emersed vegetation.

Emergent wetlands Class of wetland habitat characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, that are present for most of the growing season.

Emergent wetland, subclass: non-persistent No obvious signs of emergent vegetation at certain seasons.

Emergent wetland, subclass: persistent Erect, rooted, herbaceous aquatic plants. Species that normally remain standing until the beginning of the next growing season.

Endangered species Animals, birds, fish, plants, or other living organisms threatened with extinction by anthropogenic (human-caused) or other natural changes in their environment.[3]

Endangered Species Act A 1973 act of Congress mandating that endangered and threatened species of fish, wildlife, and plants be protected and restored.

Environmental medium/media External conditions affecting the life, development, and survival of an organism, including air, water, and soil, which are the subject of regulatory concern and activities.

Ephemeral Short-lived or transitory.

Estuary, estuarine Region of interaction between rivers and nearshore marine waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife. *See wetlands.*

Fish passage Features of a dam that enable fish to move around, through, or over without harm. Generally an upstream fish ladder or a downstream bypass system.

Flue A tunnel or conduit that connects a furnace to a chimney stack.

Forage To search for food.

Groundwater The supply of fresh water found beneath the earth's surface, which supplies wells and springs.[3]

Groundwater monitoring well See monitoring well.

Groundwater plume A visible or measurable discharge of a contaminant from a given point of origin into groundwater.

Habitat The place where a plant or animal species naturally lives and grows or characteristics of the soil, water, and biologic community (other plants and animals) that make this possible.

Habitat of concern The habitat that will be or is being affected by contaminants of concern from a hazardous waste site.

Hazardous ranking system/hazard ranking system package The principal screening tool used by the USEPA to evaluate risks to public health and the environment associated with abandoned or uncontrolled hazardous waste sites.[3]

Heavy metals Metallic elements with high atomic weights (e.g., mercury, chromium, cadmium, arsenic, and lead).

Hectare 2.471 acres or 10,000 square meters (m^2).

Heterogeneous Consisting of dissimilar parts or elements.

Hydrologic Unit Code (HUC) The United States is divided into hydrologic units for water resource planning and data management. Hydrologic units represent natural and human-imposed areas. Each HUC is a unique eight-digit number. The first two digits indicate the major geographic area or region, the second two digits indicate the sub-region, the third two digits indicate the accounting units, and the fourth two digits indicate the cataloging units. Cataloging units are also called “watersheds.”

Hydrophyte (1) Plants that grow in water or saturated soils. (2) Any macrophyte that grows in wetlands or aquatic habitats on a substrate that is at least periodically deficient in oxygen because of excessive water content.

Ingot A mass of metal that is cast in a standard shape for convenient storage or transportation.

Inorganic compounds Chemical substances of mineral origin, not of basically carbon structure.

Intertidal That area of the shore between the high and low water marks; the intertidal zone of oceans and estuaries is regularly covered and exposed by the tides.

Invertebrate An animal without a spinal column or backbone.

Isomers Different substances that have the same formula.

Iteroparous Animals that do not die after spawning.

Juvenile habitat The environment in which an organism lives from one year of age until sexual maturity.

Karst A type of topography that results from dissolution and collapse of carbonate rocks such as limestone and dolomite and characterized by closed depressions or sinkholes, caves, and underground drainage.[4]

Leachate Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil.[3]

Lowhead dam Dams that range from a six-inch drop off to a 25- foot drop off.

Macrophyte A plant that can be seen without the aid of optics.

Mainstem The principal channel of a drainage system into which other smaller streams or rivers flow.

Marine Of or relating to the sea.

Marsh A type of wetland that does not accumulate appreciable peat deposits (partially decomposed plants and other organic materials that can build up in poorly drained wetland habitats) and is dominated by plants with little or no woody tissue. *See wetland.*

Materiel The equipment, apparatus, and supplies of a military force.

Mean U.S. soil screening guidelines Average concentrations of inorganic compounds found in natural soils of the United States.

Metals Chemical elements with particular properties that include being good conductors of electricity and heat; in these reports, generally synonymous with inorganic compounds.

Migratory corridor, migratory route A body of water that adult fish travel through but do not remain in for any significant time.

Monitoring well (1) A well used to obtain water quality samples or measure groundwater levels. (2) A well drilled to collect groundwater samples for the purpose of physical, chemical, or biological analysis to determine the amounts, types, and distribution of contaminants beneath a site.

National Priorities List A list of hazardous waste sites, compiled by the USEPA, where hazardous wastes have been found and the initial evaluation shows a significant risk to human health or the environment. NPL sites are often called "Superfund sites" because Superfund money can be used by the USEPA to investigate and clean up these sites.

Neutralization Decreasing the acidity or alkalinity of a substance by adding alkaline or acidic materials, respectively.

NOAA trust resources Natural resources in coastal and marine areas, including the anadromous and catadromous fish that migrate between freshwater and coastal and marine areas.

Nursery habitat The habitat where larvae or juveniles settle, seek shelter, feed, and mature.

Oligohaline A low salinity region of an estuary, typically 0.5 to 5.0 parts per thousand salinity.

Order of magnitude A change in the value of a quantity or unit by a factor of 10.

Ordnance Military materiel, such as weapons, ammunition, artillery, combat vehicles, and equipment.

Organic compounds / chemicals / substances / materials Naturally occurring (animal- or plant-produced) or synthetic substances containing mainly carbon, hydrogen, nitrogen, and oxygen.[3]

Outfall The point where wastewater or drainage discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.[5]

Palustrine wetland a wetland beyond the influence of tidal brackish waters and typically dominated by persistent vegetation that remain standing into the next growing season; most inland wetlands fall into this classification; located in upland areas.

Pathway (for migration of contaminants) The physical course a chemical or pollutant takes from its source to the exposed organism.[3]

Pelagic Living or occurring in the open sea.

Pentachlorophenol (PCP) A manufactured chemical that is not found naturally in the environment. It was used as a biocide and wood preservative, and was one of the most heavily used pesticides in the United States. Now, only certified applicators can purchase and use this chemical. It is still used in industry as a wood preservative for power line poles, railroad ties, cross arms, and fence posts.[6]

Pesticides Substances or mixtures thereof intended for preventing, destroying, repelling, or mitigating any pest.[3]

Polychlorinated biphenyls (PCBs) A group of synthetic organic compounds that can cause a number of different harmful effects. There are no known natural sources of PCBs in the environment. PCBs are either oily liquids or solids and are colorless to light yellow.[6]

Polycyclic aromatic hydrocarbons (PAHs) A group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. Also referred to as polycyclic aromatic hydrocarbons (PAHs).[6]

Rearing habitat *See nursery habitat.*

Remediation Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site.[3]

Rinsate The solution remaining after something is rinsed.

Rock flour Very finely powdered rock, produced when rocks are ground together.

Runoff That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface-water. It can carry pollutants from the air and land into receiving waters.

Salinity A measurement of the amount (usually in parts per thousand) of salt in water.

Salmonid Fish of the family Salmonidae, which includes salmon and steelhead.

Sediment The organic material that is transported and deposited by wind and water.

Semivolatile organic compounds (SVOCs) Organic compounds that volatilize slowly at standard temperature (20°C and 1 atm pressure).

Slag The glassy waste product created during the smelting of metal ores.

Spawning habitat The habitat where fish reproduce.

Steam (or boiler) blowdown To control solids in the boiler water

Stormwater Precipitation that accumulates in natural and/or constructed storage and stormwater systems during and immediately following a storm event.

Storm sewer A system of pipes (separate from sanitary sewers) that carries water runoff from buildings and land surfaces.[3]

Substrate The composition of a streambed, including either mineral or organic materials.[7]

Sump A low-lying place such as a pit, that receives drainage.

Superfund Money collected from a special tax on chemicals and raw petroleum that is appropriated by Congress. These funds are used to investigate, evaluate, and clean up the worst hazardous waste sites in the U.S. These sites are listed on the NPL.

Supratidal The area of the shore above the normal high-tide line.

Surface water All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.).

Surface water runoff Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions.[3]

Tailings Residue of raw material or waste separated out during the processing of crops or mineral ores.[3]

Threatened species Plants and animals whose numbers are very low or decreasing rapidly. Threatened species are not endangered species yet, but are likely to become endangered in the future.[8]

Threshold Effects Concentration (TEC) Concentration below which harmful effects are unlikely to be observed.

Threshold effect level (TEL) The concentration of a contaminant below which negative biological effects are expected to occur only rarely.

Trace elements In these reports, generally synonymous with inorganic compounds.

Trust resources *See NOAA trust resources.*

Trustee (for natural resources) The party responsible for maintaining the original characteristics of our land, water, and the plants and animals that live there. NOAA is a federal trustee for natural resources that spend any portion of their life cycle in a marine or estuarine environment; and their habitats.

Unconfined aquifer An aquifer that is not confined under pressure and is bounded by permeable layers.

Uptake The transfer of a chemical into or onto an aquatic organism.

Volatile organic compounds (VOCs) Organic compounds that evaporate readily.[6]

Wastewater The spent or used water from a home, community, farm, or industry, which contains dissolved or suspended matter.

Water Quality Criteria Levels of water quality expected to render a body of water suitable for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water table The level of groundwater.

Watershed The region draining into a river, river system, or other body of water.

Wetland An area that is saturated by surface or groundwater with vegetation adapted for life under those soil conditions including marshes, estuaries, swamps, bogs, and fens.

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[1] http://www.epa.gov/waterscience/criteria/ (accessed August 2005).

[2] http://response.restoration.noaa.gov/cpr/sediment/SPQ.pdf (accessed August 2005).

[3] http://www.epa.gov/OCEPAterms/ (accessed August 2005).

[4] http://water.usgs.gov/pubs/circ/circ1166/nawqa91.e.html (accessed August 2005).

[5] http://www.forester.net/sw_glossary.html (accessed August 2005).

[6] http://www.atsdr.cdc.gov/toxprofiles/ (accessed August 2005).

[7] http://www.streamnet.org/pub-ed/ff/Glossary/ (accessed August 2005).

[8] http://www.epa.gov/espp/coloring/especies.htm (accessed August 2005).

Appendix

Table 1. List of the 396 hazardous Waste Site Reports published by NOAA to date. Sites in bold italics are included in this volume.

Region 1

Connecticut	Date	EPA Facility ID
Barkhamsted-New Hartford Landfill	1989	CTD980732333
Beacon Heights Inc. Landfill	1984	CTD07212206
Broad Brook Mill	2003	CT0002055887
Gallups Quarry	1989	CTD108960972
Kellogg-Deering Well Field	1987	CTD98067081
New London Naval Submarine Base	1990	CTD980906515
O'Sullivans Island	1984	CTD98066799
Raymark Industries, Inc.	1996	CTD001186618
Yaworski Waste Lagoon	1985	CTD00977496

Maine		
Brunswick Naval Air Station	1987	ME8170022018
Callahan Mining Corp	2004	MED980524128
Eastland Woolen Mill	2002	MED980915474
McKin Company	1984	MED980524078
O'Connor Company	1984	MED980731475
Portsmouth Naval Shipyard	1995	ME7170022019
Saco Municipal Landfill	1989	MED980504393

Massachusetts		
Atlas Tack Corporation	1989	MAD001026319
Blackburn & Union Privileges	1993	MAD982191363
Cannon Engineering	1984	MAD980525232

Region 1 *cont.*

Massachusetts *cont.*	**Date**	**EPA Facility ID**
Charles George Land Reclamation	1987	MAD003809266
General Electric - Housatonic River	1999	MAD002084093
Groveland Wells 1 & 2	1987	MAD980732317
Hanscom Air Force Base	1995	MA8570024424
Haverhill Municipal Landfill	1985	MAD980523336
Industri-Plex 128	1987	MAD076580950
Natick Research, Development, and Engineering Center	1995	MA1210020631
Naval Weapons Industrial Reserve Plant	1995	MA6170023570
New Bedford Harbor	1984	MAD980731335
Nyanza Chemical Waste Dump	1987	MAD990685422
Olin Chemical	***2008***	***MAD001403104***
South Weymouth Naval Air Station	1995	MA2170022022
Sullivan's Ledge	1987	MAD980731343
U.S. Army Materials Technology Laboratory	1995	MA0213820939

New Hampshire		
Beede Waste Oil	1997	NHD018958140
Coakley Landfill	1985	NHD06442415
Dover Municipal Landfill	1987	NHD98052019
Fletcher's Paint Works and Storage	1989	NHD001079649
Grugnale Waste Disposal Site	1985	NHD06991103
Mohawk Tannery	2005	NHD981889629
New Hampshire Plating Co., Inc.	1992	NHD001091453
Pease Air Force Base	1990	NH7570024847
Savage Municipal Water Supply	1985	NHD98067100
Sylvester’s	1985	NHD09936354

Rhode Island		
Centredale Manor Restoration Project	2005	RID981203755
Davis Liquid Waste	1987	RID980523070
Kingston Dump/URI Disposal Area	1992	RID981063993

Region 1 *cont.*

Rhode Island *cont.*	**Date**	**EPA Facility ID**
Naval Construction Battalion Center	1990	RI6170022036
Naval Education Training Center	1990	RI6170085470
Peterson-Puritan, Inc.	1987	RID055176283
Picillo Farm	1987	RID980579056
Rose Hill Regional Landfill	1989	RID980521025
Stamina Mills Inc.	1987	RID980731442
Western Sand and Gravel	1987	RID009764929

Vermont		
BFI Sanitary Landfill	1989	VTD980520092
Elizabeth Mine	2003	VTD988366621
Ely Copper Mine	2003	VTD988366571
Old Springfield Landfill	1987	VTD00086023
Pike Hill Copper Mine	***2008***	***VTD988366720***

Region 2

New Jersey		
Albert Steel Drum	1984	NJD00052515
American Cyanamid	1985	NJD00217327
Atlantic Resources	2004	NJD981558430
Bog Creek Farm	1984	NJD06315715
Brick Township Landfill	1984	NJD98050517
Brook Industrial Park	1989	NJD078251675
Chemical Control	1984	NJD00060748
Chemical Insecticide Corporation	1990	NJD980484653
Chipman Chemical (Reagent Chemical Company)	1985	NJD98052889
Cornell Dubilier Electronics, Inc.	1999	NJ981557879
Cosden Chemical Coatings Corp.	1987	NJD00056553
Crown Vantage Landfill	2007	NJN000204492
Curcio Scrap Metal Inc.	1987	NJD01171758
De Rewal Chemical Company	1985	NJD98076137

Region 2 *cont.*

New Jersey *cont.*	**Date**	**EPA Facility ID**
Denzer and Schafer X-Ray	1984	NJD04664440
Diamond Alkali/Diamond Shamrock Corporation	1984	NJD98052899
Diamond Head Oil Refinery Div.	2004	NJD092226000
Emmell's Septic Landfill	2002	NJD980772727
FAA Technical Center Atlantic City Airport	1990	NJ9690510020
Federal Creosote	2007	NJ0001900281
Garden State Cleaners	1989	NJD053280160
Global Sanitary Landfill	1989	NJD063160667
Hercules, Inc.	1984	NJD00234905
Higgins Disposal Service	1989	NJD053102232
Higgins Farm	1989	NJD981490261
Horseshoe Road Dump	1984	NJD9806636
Horseshoe Road Industrial Complex	1995	NJD980663678
Ideal Cooperage	1984	NJD98053290
Industrial Latex	1989	NJD981178411
Jackson Township Landfill	1984	NJD98050528
Kauffman & Minteer	1989	NJD002493054
Kin-Buc Landfill	1984	NJD04986083
Koppers Company	1984	NJD00244511
Krysowaty Farm	1985	NJD98052983
LCP Chemicals, Inc.	1999	NJD079303020
Lightman Drum Company	2007	NJD014743678
Martin Aaron, Inc.	2003	NJD014623854
McGuire Air Force Base #1	2007	NJ0570024018
Middlesex Sampling Plant	2002	NJ0890090012
Mobil Chemical Company	1984	NJD00060675
NL Industries	1984	NJD06184324
Perth Amboy's PCBs	1984	NJD98065390
PJP Landfill	1984	NJD98050564
Puchack Well Field	1999	NJD981084767
Quanta Resources	2004	NJD000606442
Roebling Steel Company	1984	NJD07373225

Region 2 *cont.*

New Jersey *cont.*	**Date**	**EPA Facility ID**
Rolling Knolls LF	***2008***	***NJD980505192***
Roosevelt Drive-In	1984	NJD03025048
Route 561 Dump	2002	NJ0000453514
Sayreville Landfill	1984	NJD98050575
Sayreville Pesticide	1984	NA
Scientific Chemical Processing, Inc.	1984	NJD07056540
Sherwin-Williams/Hilliards Creek	***2008***	***NJD980417976***
South Jersey Clothing Company	1989	NJD980766828
Standard Chlorine	***2008***	***NJD002175057***
Syncon Resins	1984	NJD06426381
T. Fiore Demolition, Inc. Site	1984	NA
Toms River Chemical Company	1984	NA
United States Avenue Burn	2002	NJ0001120799
Universal Oil Products, Inc.	1984	NJD00200510
Ventron/Velsicol	1984	NJD98052987
White Chemical Company	1984	NJD00123918
White Swan Laundry and Cleaner Inc.	***2008***	***NJSFN0204241***
Williams Property	1984	NJD98052994
Woodbrook Road Dump	2005	NJSFN0204260
Zschiegner Refining Company	1999	NJD986643153

New York		
Action Anodizing	1989	NYD072366453
Applied Environmental Services	1985	NYD98053565
Brookhaven National Laboratory	1990	NY7890008975
C & J Disposal Site	1989	NYD981561954
Carroll and Dubias Sewage Disposal	1989	NYD010968014
Computer Circuits	2002	NYD125499673
Consolidated Iron and Metal	2004	NY0002455756
Ellenville Scrap Iron and Metal	2003	NYSFN0204190
Jones Sanitation	1987	NYD98053455
Lawrence Aviation Industries, Inc.	2007	NYD002041531

Region 2 *cont.*

New York *cont.*	**Date**	**EPA Facility ID**
Li Tungsten	1992	NYD986882660
Liberty Industrial Finishing	1985	NYD00033729
MacKenzie Chemical Works	2004	NYD980753420
Marathon Battery	1984	NYD01095975
Mattiace Petrochemical Company, Inc.	1989	NYD000512459
North Sea Municipal Landfill	1985	NYD98076252
Old Roosevelt Field Contaminated Groundwater Area	2003	NYSFN0204234
Peter Cooper	1999	NYD980530265
Port Washington Landfill	1984	NYD98065420
Rowe Industries Groundwater Contamination	1987	NYD98148695
Sidney Landfill	1989	NYD980507677
Smithtown Groundwater Contamination	2003	NY0002318889
Stanton Cleaners Area Ground Water Contamination	2002	NYD047650197

Puerto Rico		
Clear Ambient Service	1984	PRD09041613
Frontera Creek	1984	PRD98064096
Naval Security Group Activity (NSGA)	1989	PR4170027383
Pesticide Warehouse I	2007	PRD987367349
Pesticide Warehouse III	2004	PRD987367299
Scorpio Recycling, Inc.	2005	PRD987376662
V&M/Albaladejo Farms	1997	PRD987366101
Vega Baja Solid Waste Disposal	2002	PRD980512669

Virgin Islands		
Island Chemical Company	1996	VID980651095
Tutu Wellfield	1993	VID982272569

Region 3

Delaware	Date	EPA Facility ID
Army Creek Landfill	1984	DED98049449
Cokers Sanitation Services Landfills	1986	DED98070486
Delaware City PVC	1984	DED98055166
Delaware Sand & Gravel Landfill	1984	DED00060597
Dover Air Force Base	1987	DE857002401
Dover Gas and Light Company	1987	DED98069355
E.I. DuPont Newport Landfill	1987	DED98055512
Halby Chemical Company	1986	DED98083095
Kent County Landfill	1989	DED980705727
Koppers Company Facilities	1990	DED980552244
National Cash Register Corporation	1986	DED04395838
New Castle Spill Site	1984	DED05898044
New Castle Steel	1984	DED98070525
Old Brine Sludge	1984	DED98070489
Pigeon Point Landfill	1987	DED98049460
Sealand Limited	1989	DED981035520
Standard Chlorine of Delaware, Inc.	1986	DED04121247
Sussex County Landfill	1989	DED980494637
Tybouts Corner Landfill	1984	DED00060607
Wildcat Landfill	1984	DED98070495

Maryland		
68th Street Dump/Industrial Enterprises	2002	MDD980918387
Aberdeen, Michaelsville Landfill	1986	MD3210021355
Aberdeen Proving Ground – Edgewood Area	1986	MD2210020036
Andrews Air Force Base	2003	MD0570024000
Anne Arundel County Landfill	1989	MDD980705057
Beltsville Agricultural Research Center	1995	MD0120508940
Brandywine DRMO	2003	MD9570024803
Bush Valley Landfill	1989	MDD980504195
Central Chemical Corporation	1999	MDD003061447
Curtis Bay Coast Guard Yard	2007	MD4690307844

Region 3 *cont.*

Pennsylvania	Date	EPA Facility ID
Fort George G. Meade	1997	MD9210020567
Joy Reclamation Co.	1984	MDD030321178
Naval Air Station Patuxent River	1996	MD7170024536
Ordnance Products, Inc.	1995	MDD982364341
Sand, Gravel and Stone	1984	MDD980705164
Southern Maryland Wood Treating	1987	MDD980704852
Woodlawn County Landfill	1987	MDD980504344
Austin Avenue Radiation Site	1993	PAD987341716
Boarhead Farms	1989	PAD047726161
Bridesburg Dump	1984	PAD98050840
Butler Tunnel	1987	PAD98050845
Crater Resources, Inc.	1993	PAD980419097
Croydon TCE	1986	PAD98103500
Douglassville Disposal Site	1987	PAD00238486
Elizabethtown Landfill	1989	PAD980539712
Enterprise Avenue	1984	PAD98055291
FMC Marcus Hook, aka East Tenth St. Industrial Area	1996	PAD980714505
Foote Mineral Company	1993	PAD077087989
Franklin Slag Pile (MDC)	***2008***	***PASFN0305549***
Hellertown Manufacturing Company	1987	PAD00239074
Jacks Creek/Sitkin Smelting & Refining.	1989	PAD980829493
Keyser Avenue Borehole	1989	PAD981036049
Lower Darby Creek Area	2003	PASFN0305521
Metal Bank of America	1984	PAD04655709
Occidental Chemical/Firestone	1989	PAD980229298
Paoli Railyard	1987	PAD98069259
Price Battery	***2008***	***PAN000305679***
Publicker Industries	1990	PAD981939200
Recticon/Allied Steel Corporation	1989	PAD002353969
Revere Chemical Company	1986	PAD05139549
Rohm and Haas Landfill	1986	PAD09163797
Ryeland Road Arsenic Site	2007	PAD981033459

Region 3 *cont.*

Pennsylvania *cont.*	**Date**	**EPA Facility ID**
Salford Quarry	1997	PAD980693204
Tinicum National Environmental Center	1986	PA614351544
Tysons Dump	1985	PAD98069202
UGI Columbia Gas Plant	1995	PAD980539126
U.S. Navy Ships Parts Control Center	1996	PA3170022104
Wade (ABM) Site	1984	PAD98053940

Virginia		
Abex Corporation	1989	VA980551683
Arrowhead Associates Inc./Scovill Corporation	1989	VAD042916361
Atlantic Wood Industries, Inc.	1987	VAD99071041
C and R Battery Co., Inc.	1987	VAD04995791
Chisman Creek	1984	VAD98071291
Former Nansemond Ordnance Depot	2002	VAD123933426
Fort Eustis	1996	VA6210020321
Kim-Stan Landfill	2002	VAD077923449
Langley Air Force Base	1995	VA2800005033
Marine Corps Combat Development Command Quantico	1995	VA1170024722
Naval Amphibious Base Little Creek	2002	VA5170022482
Naval Surface Weapons Center, Dahlgren Laboratory	1993	VA7170024684
Naval Weapons Station Yorktown	1993	VA8170024170
Norfolk Naval Base	1997	VA6170061463
NWS Yorktown - Cheatham Annex	2004	VA3170024605
Saunders Supply Company	1987	VAD00311738
St. Juliens Creek Annex (U.S. Navy)	2007	VA5170000181
USN Norfolk Naval Shipyard	1999	VA1170024813

Washington D.C.		
Washington Naval Yard	1999	DC91700243100

Region 4

Alabama	Date	EPA Facility ID
American Brass, Inc.	2002	ALD98186846
Ciba-Geigy Corporation	1990	ALD001221902
Olin Chemical Corporation	1990	ALD008188708
Redwing Carriers, Inc.	1989	ALD980844385

Florida		
62nd Street Dump	1984	FLD98072887
Agrico Chemical Company	1989	FLD980221857
American Creosote Works	1984	FLD00816199
Broward County/21st Manor Dump	1992	FLD9819300506
Chem-Form, Inc.	1990	FLD080174402
Harris Corporation/General Development Utilities	1986	FLD00060233
Helena Chemical Company	1993	FLD053502696
Kassouf-Kimerling	1984	FLD00060233
Kennedy Generating Station	2007	NA
MRI Corporation	1997	FLD088787585
Munisport Landfill	1984	FLD08453544
Naval Air Station Cecil Field	1990	FL5170022474
Naval Air Station Jacksonville	1990	FL6170024412
Naval Air Station Whiting Field	1996	FL2170023244
Pensacola Naval Air Station	1990	FL9170024567
Picketville Landfill	1984	FLD98055635
Solitron Microwave	2002	FLD045459526
Standard Auto Bumper Corporation	1989	FLD004126520
Stauffer Chemical Company	1993	FLD004092534
Stauffer Chemical Company	1993	FL010596013
Tyndall Air Force Base	1997	FL1570024124
United Metals, Inc.	2004	FLD098924038
Woodbury Chemical Company	1989	FLD004146346

Region 4 *cont.*

Georgia	Date	EPA Facility ID
Brunswick Wood Preserving	1997	GAD981024466
Camilla Wood Preserving	1999	GAD008212409
Terry Creek Dredge Spoil/Hercules Outfall	1997	GAD982112658

Mississippi		
Chemfax, Inc.	1995	MSD008154486
Davis Timber Company	2004	MSD046497012
Gautier Oil Company, Inc.	1989	MSD098596489
Picayune Wood Treating Site	2007	MSD065490930

North Carolina		
ABC One Hour Cleaners	1989	NCD024644494
Camp Lejeune Marine Corps Base: Site 21 Lot 40	1989	NC6170022580
FCX, Incorporated	1989	NCD981475932
New Hanover County Airport Burn Pit	1989	NCD981021157
Potter's Septic Tank Services Pits	1989	NCD981023260
Reasor Chemical Company	2004	NCD986187094

South Carolina		
Brewer Gold Mine	***2008***	***SCD987577913***
Geiger (C&M Oil)	1984	SCD98071127
Helena Chemical Company	1989	SCD058753971
Koppers Company, Inc., Charleston Plant	1993	SCD980310239
Macalloy Corporation	2004	SCD003360476
Savannah River Plant	1990	SC1890008989
Wam Chem, Inc.	1984	SCD03740536

Region 5

Wisconsin	Date	EPA Facility ID
Ashland/Northern States Power Lakefront	2007	WISFN0507952
Fox River NRDA/PCB Releases	2003	WI0001954841

Region 6

Louisiana		
Bayou Sorrell	1984	LAD98074554
Delatte Metals	2002	LAD052510344
Devil's Swamp Lake	2007	LAD981155872
Madisonville Creosote Works	1997	LAD981522998
Mallard Bay Landing Bulk Plant	2004	LA0000187518

Texas		
ALCOA (Point Comfort/Lavaca Bay)	1995	TXD008123168
Bailey Waste Disposal	1985	TXD98086464
Brine Service Company	2004	TX0000605264
Brio Refining, Inc.	1989	TXD980625453
Crystal Chemical Company	1989	TXD990707010
Dixie Oil Processors	1989	TXD089793046
Falcon Refinery	2007	TXD086278058
French Limited	1989	TXD980514814
Gulfco Marine Maintenance	2007	TXD055144539
Highlands Acid Pits	1989	TXD980514996
Malone Service Company, Inc.	2003	TXD980854789
Motco Corp.	1984	TXD98062985
Palmer Barge Line	2005	TXD068104561
Patrick Bayou	2003	TX000605329
San Jacinto River Waste Pits	***2008***	***TXN000606611***
Sikes Disposal Pits	1989	TXD980513956
Star Lake Canal	2007	TX0001414341

Region 6 *cont.*

Texas *cont.*	**Date**	**EPA Facility ID**
State Marine	1999	TXD099801102
Tex-Tin Corporation	1989	TXD062113329

Region 9

American Samoa		
Taputimu Farm	1984	ASD98063765

California		
Alviso Dumping Areas	1985	NA
Camp Pendleton Marine Corps Base	1990	CA2170023533
Coast Wood Preserving	1984	CAD06301588
Cooper Drum Company	1993	CAD055753370
CTS Printex, Inc.	1989	CAD009212838
Del Amo	1992; 2004	CAD029544731
Del Norte County Pesticide Storage Area	1984	CAD00062617
El Toro Marine Corps Air Station	1989	CA6170023208
Fort Ord Army Base	1990	CA7210020676
GBF, Inc. Dump	1989	CAD980498562
GBF/Pittsburg Landfill	1993	CAD980498562
Halaco Engineering Company	***2008***	***CAD009688052***
Hewlett-Packard	1989	CAD980884209
Intersil, Inc., and Siemens Components	1989	CAD041472341
Iron Mountain Mine	1989	CAD980498612
Jasco Chemical Corporation	1989	CAD009103318
Liquid Gold Oil Corporation	1984	CAT00064620
McCormick & Baxter Creosoting Company	1993	CAD009106527
MGM Brakes	1984	CAD00007412
Moffett Field Naval Air Station	1986	CA217009007
Montrose Chemical Corportion	1985	CAD00824271
Naval Air Station Alameda	1989	CA2170023236

Region 9 *cont.*

California *cont.*	**Date**	**EPA Facility ID**
Naval Weapons Station	1989	CA7170024528
Naval Weapons Station Concord	1993	CA7170024528
Naval Station Treasure Island – Hunters Point Annex	1989	CA1170090087
Pacific Coast Pipelines	1989	CAD980636781
Riverbank Army Ammunition Depot	1989	CA7210020759
Sola Optical USA, Inc.	1989	CAD981171523
Travis Air Force Base	1990	CA5570024575
Zoecon Corporation/ Rhone-Poulenc, Incorporated	1985	CAT00061135

Guam		
Andersen Air Force Base	1993	GU6571999519

Hawaii		
Del Monte Corporation (Oahu Plantation)	1995	HID980637631
Pearl City Landfill	1984	HID980585178
Pearl Harbor Naval Complex	1992	HI4170090076

Region 10

Alaska		
Elmendorf Air Force Base	1990	AK8570028649
Fort Richardson	1995	AK6214522157
Klag Bay Site	2002	AK0002364768
Naval Air Station Adak	1993	AK7170090099
Standard Steel	1990	AK980978787

Idaho		
Blackbird Mine	1995	IDD980725832
Stibnite/Yellow Pine Mining Area	2003	ID9122307607

Region 10 *cont.*

Oregon	Date	EPA Facility ID
Allied Plating, Inc.	1987	ORD009051442
Formosa Mine	***2008***	***ORN001002616***
Gould, Inc.	1984	ORD095003687
Harbor Oil	2004	ORD071803985
Martin-Marietta Aluminum Co.	1987	ORD052221025
McCormick & Baxter Creosoting Company	1995	ORD009020603
Northwest Pipe and Casing Company	1993	ORD980988307
Portland Harbor	2003	ORSFN1002155
Stauffer Chemical Company	1984	NA
Taylor Lumber and Treating	2005	ORD009042532
Teledyne Wah Chang	1985	ORD050955848
Union Pacific Tie Treating Facility	1990	ORD009049412

Washington		
Aluminum Company of America (ALCOA)	1989	WAD009045279
American Crossarm and Conduit Company	1989	WAD057311094
Bonneville Power Administration, Ross Complex	1990	WA1891406349
Centralia Landfill	1989	WAD980836662
Commencement Bay, Nearshore Sites	1984	WAD980726368
Commencement Bay, South Tacoma	1984	WAD980726301
Hamilton Island Landfill	1992	WA5210890096
Hanford – Areas 100, 200, 300, 1100	1989	WA3890090075
Harbor Island	1984	WAD980722839
Jackson Park Housing Complex	1995	WA3170090044
Kent Highlands Landfill	1989	WAD980639462
Lockheed West Seattle	***2008***	***WAN001002655***
Lower Duwamish Waterway	2003	WA0002329803
Naval Air Station Whidbey Island Ault Field	1986	WA5170090059
Naval Air Station Whidbey Island Seaplane Base	1986	WA6170090058
Northwest Transformer	1989	WAD027315621
Oeser Company	1997	WAD008957243
Old Navy Dump	1996	WA8680030931

Region 10 *cont.*

Washington *cont.*	**Date**	**EPA Facility ID**
Pacific Sound Resources	1995	WAD009248287
Puget Sound Naval Shipyard	1995	WA2170023418
Quendall Terminal	1985; 2007	WAD980639215
Tulalip Landfill	1992	WAD980369256
U.S. Naval Submarine Base, Bangor	1990	WA5170027291
Western Processing	1984	WAD009487513
Wyckoff Company Eagle Harbor	1986	WAD009248295

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