Coastal Hazardous Waste Site

REVIEWS

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Coastal Hazardous Waste Site Reviews

Introduction

This report identifies uncontrolled hazardous waste sites that could pose a threat to natural resources for which the National Oceanic and Atmospheric Administration (NOAA) acts as a trustee. NOAA carries out responsibilities as a Federal trustee for natural resources under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan. As a trustee, NOAA identifies sites that could affect natural resources, determines the potential for injury to the resources, evaluates cleanup alternatives, and carries out restoration actions. NOAA works with the U.S. Environmental Protection Agency (EPA) to identify and assess risks to coastal resources from hazardous waste sites, and to develop strategies to minimize those risks.

NOAA regularly conducts evaluations of hazardous waste sites proposed for addition to the National Priorities List[1] (NPL) by EPA. The waste sites evaluated in this report are drawn from the list of all sites, including Federal facilities, proposed for inclusion on the NPL on December 23, 1996 and April 1, 1997.

The sites of concern to NOAA are located in counties bordering the Atlantic Ocean, Pacific Ocean, Great Lakes, and Gulf of Mexico, or are near inland water bodies that support anadromous fish populations. Not all sites in coastal states will affect NOAA trust resources. To select sites on the National Priorities List for initial investigation, only sites in coastal counties or sites bordering important anadromous or catadromous fish habitat are considered to have potential to affect trust resources. This initial selection criterion works better in some states than in others, depending on topography, hydrography, and the nature of political subdivisions.

These reports are an overall guide to the potential for injury to NOAA trust resources resulting from a site. NOAA uses this information to establish priorities for investigating sites. Sites that appear to pose ongoing problems will be followed by a NOAA Coastal Resource Coordinator (CRC) in the appropriate region. The CRC communicates concerns about ecological impact to EPA, reviews sampling and monitoring plans for the site, and helps plan and set objectives for remedial actions to clean up the site. NOAA works with other trustees to plan a coordinated approach for remedial action that protects all natural resources (not just those for which NOAA is a steward). Other Federal and state trustees can use the hazardous waste site reports to help determine the risk of injury to their trust resources. EPA uses the site reports to help identify the types of information that may be needed to complete an environmental assessment of the site.

These coastal site reports are often NOAA's first examination of a site. Sites with potential to impact NOAA resources may also have a more in-depth assessment of potential injury to environmental receptors, called a Preliminary Natural Resource Survey (PNRS). EPA may request a PNRS early in the remedial process to document the rationale for adding a site to the National Priorities List.

Eleven coastal sites were identified in 1997 using this selection method and coastal hazardous waste site reports completed for them. The current reporting brings the total number of sites considered by NOAA to 747. Defense Installation Natural Resource Assessment Guidance Reports, similar to PNRSs, were completed under a cooperative agreement with the U.S. Air Force in 1994. NOAA has completed a total of 303 coastal hazardous waste site reviews since 1984 (published in April 1984[2], June 1985[3], April 1986[4], June 1987[5], March 1989[6], June 1990[7], September 1992[8], December 1993[9], June 1995[10], September 1995[11], July 1996[12], and this report). NOAA has completed 140 PNRSs and 3 U.S. Air Force reports since 1988 (see table below).

Year	NPL Reports	PNRS	USAF Reports
1984	74		
1985	20		
1986	15		
1987	33		
1988		17	
1989	71	33	
1990	24	32	
1991		16	
1992	8	15	
1993	18	8	
1994		8	3
1995	21	6	
1996	8	1	
1997	11	4	
Total	303	140	3

Several sites have had multiple reviews or PNRSs; these multiples are reflected in the total numbers above. Three hundred sites have been reviewed (three sites more than once), and 140 sites have had PNRSs (three more than once).

The 1997 Coastal Hazardous Waste Site Reviews contain four major sections. "Site Exposure Potential" describes activities at the site that caused the release of contaminants, local topography, and potential contaminant migration pathways. "NOAA Trust Habitats and Species" describes the types of habitats and species at risk of injury from releases at the site. The life stages of organisms using habitats near the site are discussed, as are commercial and recreational fisheries. "Site-Related Contamination" identifies contaminants of concern to NOAA, the partitioning of the contaminants in the environment, and the concentrations at which the contaminants are found. "Summary" cogently recaps this information.

Tables and Screening Values

Most of these reports contain tables of contaminants measured at the site. These tables were formulated to highlight contaminants that represent a potential problem, and to focus our concerns on only a few of the many contaminants normally present at a waste site. Data presented in tables were screened against standard comparison values, depending on the source of the sample. Screening values used are ambient water quality criteria[14], soil averages[15,16], and Effects Range Low (ERL) values[17]. Because releases to the environment from hazardous waste sites can span many years, we are concerned about chronic impacts. Therefore, we typically make comparisons with the lower standard value (e.g., chronic vs. acute AWQC, and ERL vs. ERM). No criteria similar to the AWQC are available for sediment. Thus, sediment concentrations were screened by comparison with the ERL reported by Long et al.[17] The ERL value is the sediment concentration corresponding to the lowest 10-percentile of biological measurements reported as effects. As such, it represents the low end of the range of concentrations at which effects were observed in the studies compiled by the authors.

Soil samples were compared to selected averages reported in *Element concentrations in soils and other surficial materials of the coterminous United States* (Shacklette and Boerngen 1984), except for cadmium and silver which are compared to concentrations reported in *Hazardous Waste Land Treatment* (EPA 1983). These values were averaged from a data set from soil throughout the entire U.S. Ideally, reference values for soil would be calculated on a regional basis, from a data set large enough to give a value representative of the area. In the absence of such data, the national average values were used as a reference for comparison purposes only.

All of the hazardous waste sites considered by NOAA in this review are contained in the Table of Contents, including the name and location of the site and the beginning page number of the site report. Table 1 lists all of the sites at which NOAA has been involved that could potentially affect trust resources, as of December 1997. Table 2 lists acronyms, abbreviations, and terms commonly used in these waste site reports.

[1]National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300.
[2]Ocean Assessments Division. 1984. *Coastal Hazardous Waste Site Review April 13, 1984.* NOAA/OAD, Seattle, Washington.
[3]Pavia, R., and L. Harris, eds. 1985. *Coastal Hazardous Waste Site Review June 30, 1985.* NOAA/OAD, Seattle, Washington
[4]Pavia, R., and L. Harris, eds. 1986. *Coastal Hazardous Waste Site Review: Site Reports April 1986.* NOAA/OAD, Seattle, Washington.
[5]Pavia, R., and L. Harris, eds. 1987. *Coastal Hazardous Waste Site Review: Site Reports June 1987.* NOAA/OAD, Seattle, Washington.
[6]Pavia, R., and L. Harris, eds. 1989. *Coastal Hazardous Waste Site Review: Site Reports March 1989*. NOAA/OAD, Seattle, Washington.
[7]Hoff, R., and L. Harris, eds. 1990. *Coastal Hazardous Waste Site Review: Site Reports June 1990.* NOAA/OAD, Seattle, Washington.
[8]Beckvar, N., and L. Harris, eds. 1992. *Coastal Hazardous Waste Site Reviews September 1992*. NOAA/ORCA, Seattle, Washington.
[9]Beckvar, N., and L. Harris, eds. 1993. *Coastal Hazardous Waste Site Reviews December 1993.* NOAA/ORCA, Seattle, Washington.
[10]Beckvar, N., G. Garman, and L. Harris, eds. 1995. *Coastal Hazardous Waste Site Reviews June 1995.* NOAA/ORCA, Seattle, Washington.
[11]Garman, G., and L. Harris, eds. 1995. *Coastal Hazardous Waste Site Reviews September 1995.* NOAA/ORCA, Seattle, Washington.
[12]Garman, G., and L. Harris, eds. 1996. *Coastal Hazardous Waste Site Reviews July 1996.* NOAA/ORCA, Seattle, Washington.
[13]Garman, G., and L. Harris, eds. 1997. *Coastal Hazardous Waste Site Reviews December 1997.* NOAA/ORCA, Seattle, Washington.
[14]U.S. EPA. 1993. *Water quality criteria.* Washington, DC: U.S. Environmental Protection Agency, Office of Water, Health and Ecological Criteria Division. 294 pp.
[15]U.S. EPA. 1983. *Hazardous waste land treatment.* EPA/530/SW-83/874. Cincinnati: Municipal Environmental Research Laboratory. 702 pp.
[16]Shacklette, H.T., and J.G. Boerngen. 1984. *Element concentrations in soils and other surficial materials of the conterminous United States.* USGS Professional Paper 1270. Washington, D.C.: U.S. Geological Survey.
[17]Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environmental Management 19*(1):81-97.

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 2 (cont.)				
NJ	NJD000606442	Quanta Resources		
NJ	NJD986589190	Raritan Arsenal		
NJ	NJD980529713	Reich Farms		
NJ	NJD070415005	Renora, Inc.		
NJ	NJD980529739	Ringwood Mines/Landfill		
NJ	NJD073732257	Roebling Steel Co.	1984	1990
NJ	NJD030250484	Roosevelt Drive-In	1984	
NJ	NJD980505754	Sayreville Landfill	1984	1990
NJ	NJD070565403	Scientific Chemical Processing	1984	1989
NJ	NJD980505762	Sharkey Landfill		1990
NJ	NJD002365930	Shieldalloy Corp.		
NJ	NJD980766828	South Jersey Clothing Co.	1989	
NJ	NJD041743220	Swope Oil & Chemical Co.		
NJ	NJD064263817	Syncon Resins	1984	1992
NJ	NJD980761357	Tabernacle Drum Dump		
NJ	NJD002005106	Universal Oil Products (Chemical Division)	1984	
NJ	NJD980761399	Upper Deerfield Township Sanitary Landfill		
NJ	NJD980529879	Ventron/Velsicol	1984	
NJ	NJD002385664	Vineland Chemical Co., Inc.		1990
NJ	NJD054981337	Waldick Aerospace Devices, Inc.		1990
NJ	NJD001239185	White Chemical Corp.	1984	
NJ	NJD980529945	Williams Property	1984	1992
NJ	NJD980532824	Wilson Farm		
NJ	NJD045653854	Witco Chemical Corp. (Oakland Pit)		
NJ	NJD980505887	Woodland Route 532 Dump		
NJ	NJD980505879	Woodland Route 72 Dump		
NY	NYD980780829	93rd Street School		
NY	NYD072366453	Action Anodizing, Plating, & Polishing	1989	
NY	NYD980506232	ALCOA Aggregation Site		
NY	NYD002066330	American Thermostat Co.		
NY	NYD001485226	Anchor Chemicals		
NY	NYD980535652	Applied Environmental Services	1985	1991
NY	NYD980507693	Batavia Landfill		
NY	NYD980768675	BEC (Binghampton Equipment Co.) Trucking		1990
NY	NYD980768683	Bioclinical Laboratories, Inc.		
NY	NYD980652275	Brewster Well Field		
NY	NY7890008975	Brookhaven National Laboratory (USDOE)	1990	
NY	NYD980780670	Byron Barrel & Drum		
NY	NYD981561954	C & J Disposal Leasing Co. Dump	1989	
NY	NYD010968014	Carrol & Dubies Sewage Disposal	1989	
NY	NYD981184229	Circuitron Corp.		
NY	NYD002044584	Claremont Polychemical		
NY	NYD000511576	Clothier Disposal		
NY	NYD980768691	Colesville Municipal Landfill		
NY	NYD982276933	Cornwall Landfill		
NY	NYD980528475	Cortese Landfill		
NY	NYD980508048	Croton Point Sanitary Landfill		
NY	NYD980780746	Endicott Village Well Field		
NY	NYD981560923	Forest Glen Mobile Home Subdivision		
NY	NYD091972554	General Motors (Central Foundry Division)		1989
NY	NYD002050110	Genzale Plating Co.		

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 2 (cont.)				
NY	NYD980768717	Goldisc Recordings, Inc.		
NY	NY4571924451	Griffiss Air Force Base		
NY	NYD980785661	Haviland Complex		
NY	NYD980780779	Hertel Landfill		
NY	NYD980506810	Hooker (102nd Street)		
NY	NYD002920312	Hooker Chemical/Ruco Polymer Corp.		
NY	NYD980763841	Hudson River PCBs		1989
NY	NYD000813428	Jones Chemicals, Inc.		
NY	NYD980534556	Jones Sanitation	1987	
NY	NYD980780795	Katonah Municipal Well		
NY	NYD002041531	Lawrence Aviation Industries, Inc.		
NY	NYD986882660	Li Tungsten Corp.	1992	1993
NY	NYD053169694	Liberty Heat Treating Co., Inc.		
NY	NYD000337295	Liberty Industrial Finishing	1985	1993
NY	NYD000606947	Love Canal		
NY	NYD013468939	Ludlow Sand & Gravel		
NY	NYD980535124	Malta Rocket Fuel Area		
NY	NYD010959757	Marathon Battery Corp.	1984	1989
NY	NYD000512459	Mattiace Petrochemical Co., Inc.	1989	1990
NY	NYD980763742	MEK Spill - Hicksville		
NY	NYD002014595	Nepera Chemical Co., Inc.		
NY	NYD000514257	Niagara County Refuse		
NY	NYD980664361	Niagara Mohawk Power Co. (Saratoga Springs)		
NY	NYD980762520	North Sea Municipal Landfill	1985	1989
NY	NYD991292004	Pasley Solvents & Chemicals, Inc.		
NY	NY6141790018	Pennsylvania/Fountain Ave. Landfill[3]		
NY	NYD000511659	Pollution Abatement Services		
NY	NYD980654206	Port Washington Landfill	1984	1989
NY	NYD980768774	Preferred Plating Corp.		
NY	NYD002245967	Reynolds Metals Co.		
NY	NYD980507735	Richardson Hill Road Landfill/Pond		
NY	NYD981486954	Rowe Industries Ground Water Contamination	1987	1991
NY	NYD980507677	Sidney Landfill	1989	
NY	NYD980535215	Sinclair Refinery		
NY	NYD980421176	Solvent Savers		
NY	NYD980780878	Suffern Village Wellfield		
NY	NYD000511360	Syosset Landfill		
NY	NYD980509285	Tri-Cities Barrel Co., Inc.		
NY	NYD002059517	Tronic Plating Co., Inc.		
NY	NYD980509376	Volney Municipal Landfill		
NY	NYD980535496	Wallkill Landfill		
NY	NYD980506679	Warwick Landfill		
NY	NYD980652259	Wide Beach Development		
NY	NYD000511733	York Oil Co.		
PR	PRD090416132	Clear Ambient Services Co.	1984	
PR	PRD980640965	Frontera Creek	1984	1991

[3]Formerly Pennsylvania Avenue Landfill

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 2 (cont.)				
PR	PRD090282757	GE Wiring Devices		
PR	PRD980512362	Juncos Landfill		
PR	PR4170027383	Naval Security Group Activity	1989	1991
PR	PRD980301154	Upjohn Facility		
PR	**PRD987366101**	**V&M/Albaladejo Farms**	**1997**	
PR	PRD980763775	Vega Alta Public Supply Wells		
VI	VID980651095	Island Chemical Corp./V.I. Chemical Corp.	1996	
VI	VID982272569	Tutu Wellfield	1993	
Federal Region 3				
DE	DED980494496	Army Creek Landfill	1984	
DE	DED980704860	Coker's Sanitation Service Landfills	1986	1990
DE	DED980551667	Delaware City PVC Plant	1984	
DE	DED000605972	Delaware Sand & Gravel	1984	
DE	DE8570024010	Dover Air Force Base	1987	1989
DE	DED980693550	Dover Gas and Light Company	1987	
DE	DED980555122	E.I. Du Pont, Newport Landfill	1987	1991/1992
DE	DED980830954	Halby Chemical	1986	1990
DE	DED980705727	Kent County Landfill	1989	
DE	DED980552244	Koppers Co. Facilities Site	1990	
DE	DED043958388	NCR Corp., Millsboro	1986	
DE	DED058980442	New Castle Spill Site	1984	1989
DE	DED980705255	New Castle Steel Plant	1984	
DE	DED980704894	Old Brine Sludge Landfill	1984	
DE	DED980494603	Pigeon Point Landfill	1987	
DE	DED981035520	Sealand Ltd.	1989	
DE	DED041212473	Standard Chlorine Co.	1986	
DE	DED980494637	Sussex Co. Landfill #5	1989	
DE	DED000606079	Tybouts Corner Landfill	1984	
DE	DED980705545	Tyler Refrigeration Pit		
DE	DED980704951	Wildcat Landfill	1984	
MD	MDD069396711	Allied Chemical Corp. Baltimore Works		
MD	MDD980705057	Anne Arundel County Landfill	1989	
MD	MDD980504195	Bush Valley Landfill	1989	1993
MD	MDD980555478	Chemical Metals Industries		
MD	MDD030324073	Dundalk Marine Terminal		
MD	MDD000731356	Hawkins Pt./Md. Port Admin.		
MD	MDD030321178	Joy Reclamation Co.	1984	
MD	MDD980923783	Kane & Lombard Street Drums		
MD	MDD064882889	Mid-Atlantic Wood Preservers		
MD	MD7170024684	Naval Surface Warfare Center		**1997**
MD	MDD985397256	Naval Training Center Bainbridge		
MD	MDD982364341	Ordnance Products, Inc.	1995	
MD	MDD980705164	Sand Gravel & Stone Site	1984	1990
MD	MDD980704852	Southern Maryland Wood Treating	1987	
MD	MDD000218008	Spectron Inc.		**1997**
MD	MD0120508940	U.S. Agricultural Center Beltsville (2 tenants)	1995	
MD	MD2210020036	USA Aberdeen - Edgewood	1986	
		Bush River Watershed		1994
		Gun Powder River Watershed		1994

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 3 (cont.)				
MD	MD3210021355	USA Aberdeen - Michaelsville	1986	
		Romney Creek Watershed		1994
MD	**MD9210020567**	**USA Fort George Meade**	**1997**	
MD	MD0570024000	USAF Andrews Air Force Base		1994[4]
MD	MD7170024536	USN Patuxent Naval Air Station	1996	
MD	MDD980504344	Woodlawn Co. Landfill	1987	
PA	PAD004351003	A.I.W. Frank		
PA	PAD000436436	Ambler Asbestos Piles		
PA	PAD009224981	American Electronic Lab., Inc.		
PA	PAD980693048	AMP, Inc.		
PA	PAD987341716	Austin Avenue Radiation Site	1993	
PA	PAD003053709	Avco Lycoming - Williamsport Division		
PA	PAD061105128	Bally Ground Water Contamination		
PA	PAD047726161	Boarhead Farms	1989	
PA	PAD980508402	Bridesburg Dump	1984	
PA	PAD980691760	Brodhead Creek		
PA	PAD980831812	Brown's Battery Breaking		1991
PA	PAD980508451	Butler Mine Tunnel	1987	
PA	PAD980419097	Crater Resources/Keystone Coke/Alan Wood	1993	
PA	PAD981035009	Croydon TCE Spill	1986	
PA	PAD981038052	Delta Quarries/Stotler Landfill		
PA	PAD002384865	Douglassville Disposal	1987	
PA	PAD003058047	Drake Chemical		
PA	PAD981740004	Dublin Water Supply		
PA	PAD987323458	East Tenth Street Site		
PA	PAD980830533	Eastern Diversified Metals		
PA	PAD980539712	Elizabethtown Landfill	1989	
PA	PAD980552913	Enterprise Avenue	1984	
PA	PAD980714505	FMC Marcus Hook	1996	
PA	AD077087989	Foote Mineral Co.	1993	
PA	PAD987332541	Hamburg Playground Site		
PA	PAD002338010	Havertown PCP Site		
PA	PAD002390748	Hellertown Manufacturing Co.	1987	
PA	PAD009862939	Henderson Road Site		1989
PA	PAD980508493	Industrial Drive Site		
PA	PAD980508493	Jack's Creek/Sitkin Smelting	1989	
PA	PAD981036049	Keyser Ave. Borehole	1989	
PA	PAD980508931	Lord Shope Landfill		
PA	PAD014353445	Malvern TCE Site		
PA	PAD046557096	Metal Bank of America	1984	1990
PA	PAD982366957	Metropolitan Mirror & Glass Co., Inc.		
PA	PAD980538763	Middletown Air Field		
PA	PAD980539068	Modern Sanitation Landfill		
PA	PAD980508766	Moyers Landfill		
PA	PAD980691372	MW Manufacturing		
PA	PAD107214116	National Vulcanized Fiber		
PA	PAD096834494	North Penn-Area 1		
PA	PAD002342475	North Penn-Area 2		

[4] U.S. Air Force report.

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 3 (cont.)				
PA	PAD980692693	North Penn-Area 5		
PA	PAD980926976	North Penn-Area 6		
PA	PAD002498632	North Penn-Area 7		
PA	PAD057152365	North Penn-Area 12		
PA	PAD079160842	Novak Sanitary Landfill		
PA	PAD980229298	Occidental Chem./Firestone	1989	
PA	PAD002395887	Palmerton Zinc Pile		
PA	PAD980692594	Paoli Rail Yard	1987	1991
PA	PAD981939200	Publicker/Cuyahoga Wrecking Plant	1990	
PA	PAD039017694	Raymark	1996	
PA	PAD002353969	Recticon/Allied Steel	1989	
PA	PAD051395499	Revere Chemical Co.	1986	
PA	PAD091637975	Rohm and Haas Landfill	1986	
PA	**PAD980693204**	**Salford Quarry**	**1997**	
PA	PAD980830889	Shriver's Corner Site		
PA	PAD014269971	Stanley Kessler		
PA	PA6143515447	Tinicum National Environmental Center	1986	
PA	PAD980692024	Tysons Dump #1	1985	
PA	PAD980539126	UGI Corp. Gas Manufacturing Plant	1995	
PA	PA6170024545	USN Naval Warfare Center		
PA	PA417002241	USN Philadelphia Naval Shipyard		
PA	PA3170022104	USN Ships Parts Control Center	1996	
PA	PAD980539407	Wade (ABM)	1984	
PA	PAD980537773	William Dick Lagoons		
VA	VAD980551683	Abex Corp.	1989	
VA	VAD042916361	Arrowhead Associates/Scovill	1989	
VA	VAD990710410	Atlantic Wood Industries, Inc.	1987	1990
VA	VAD049957913	C & R Battery Co., Inc.	1987	
VA	VAD980712913	Chisman Creek	1984	
VA	VAD007972482	Clarke L.A. & Son		
VA	VAD980539878	H & H Inc.-Burn Pit		
VA	VAD988197133	Hampton Roads Welders Site		
VA	VA1170024722	Marine Corps Combat and Development Command	1995	
VA	VA2800005033	NASA-Langley Research Center[5]	1995	**1997**
VA	VA7170024684	Naval Surface Warfare Center - Dahlgren	1993	
VA	VA8170024170	Naval Weapons Station - Yorktown	1993	**1997**
VA	VAD071040752	Rentokil Inc., Virginia Wood Preserving Division		
VA	VAD020312013	Richmond, Fredericksburg & Potomac Railroad		1994
VA	VAD003117389	Saunders Supply Co.	1987	
VA	VAD980917983	Suffolk City Landfill		
VA	VA3971520751	U.S. Defense General Supply Center		
VA	VA6210020321	USA Fort Eustis	1996	
VA	VA7210020981	USA Woodbridge Research Facility		
VA	VA4570024477	USAF Langley Air Force Base[5]		**1997**
VA	VA5170022482	USN Naval Amphibious Base/Little Creek		
VA	VA1170024813	USN Naval Shipyard Norfolk		
VA	**VA6170061463**	**USN Norfolk Naval Base**	**1997**	

[5] USAF Langley Air Force Base and Langley Research Center have been combined into one CERCLA site: Langley Air Force Base/NASA Langley Research Center.

VA	VA9170022488	USN Radio Transmitting Facility		

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 4				
WV	WV0170023691	Allegany Ballistics Laboratory		
WV	WVD004336749	Follansbee Site		
AL	ALD058221326	Alabama Wood Treating Corp., Inc.		
AL	ALD001221902	Ciba-Geigy Corp. (McIntosh Plant)	1990	
AL	ALD000604249	Gulf Oil Co.		
AL	ALD041906173	Interstate Lead Co. (Ilco)		
AL	ALD008188708	Olin Corp. (McIntosh Plant)	1990	
AL	ALD980844385	Redwing Carriers, Inc. (Saraland)	1989	
AL	ALD095688875	Stauffer Chemical Co. (Cold Creek Plant)		1990
AL	ALD008161176	Stauffer Chemical Co. (Lemoyne Plant)		
AL	ALD007454085	T.H. Agriculture & Nutrition (Montgomery)		
AL	AL0570024182	USAF Maxwell Air Force Base		
AL	AL2170024630	US Naval Outlying Barin Field		
FL	FLD980221857	Agrico Chemical Co.	1989	
FL	FLD004145140	Airco Plating Co.		
FL	FLD008161994	American Creosote Works (Pensacola Plant)	1984	1989
FL	FLD020536538	Anaconda Aluminum Co./Milgo Electronics		
FL	FLD981014368	Anodyne, Inc.		
FL	FLD004574190	B&B Chemical Co., Inc.		
FL	FLD088783865	Bay Drum		
FL	FLD980494660	Beulah Landfill		
FL	FLD052172954	BMI-Textron		
FL	FLD981930506	Broward County-21st Manor Dump	1992	
FL	FLD980709356	Cabot/Koppers		
FL	FLD080174402	Chemform, Inc.	1990	
FL	FLD004064242	Chevron Chemical Co. (Ortho Division)		
FL	FLD991279894	Coleman-Evans Wood Preserving Co.		
FL	FLD980602288	Davie Landfill		
FL	FLD000833368	Dubose Oil Products Co.		
FL	FL984184127	Florida Petroleum Processors		
FL	FLD050432251	Florida Steel Corp.		
FL	FLD000602334	Harris Corp. (Palm Bay Plant)	1986	1990
FL	FLD053502696	Helena Chemical Co. (Tampa Plant)	1993	
FL	FLD980709802	Hipps Road Landfill		
FL	FLD004119681	Hollingsworth Solderless Terminal		
FL	FLD980727820	Kassouf-Kimerling Battery Disposal		
FL	FLD981019235	Madison County Sanitary Landfill		
FL	**FLD088787585**	**MRI Corporation**	**1997**	
FL	FLD084535442	Munisport Landfill	1984	
FL	FLD004091807	Peak Oil Co./Bay Drum Co.		
FL	FLD984259374	Peele-Dixie Wellfield Site		
FL	FL9170024567	Pensacola Naval Air Station	1990	
FL	FLD032544587	Pepper Steel & Alloys, Inc.		
FL	FLD980556351	Pickettville Road Landfill	1984	1990
FL	FLD004054284	Piper Aircraft/Vero Beach Water & Sewer		
FL	FLD984169763	Pleasant Grove Landfill		
FL	FLD000824888	Reeves SE Corp. Southeastern Wire Division		
FL	FLD000824896	Reeves SE Galvanizing Corp.		
FL	FLD980602882	Sapp Battery Salvage		1989
FL	FLD062794003	Schuylkill Metals Corp.		

FL FLD043861392 Sherwood Medical Industries

			Report Date	
State	**Cerclis**	**Site Name**	**Review**	**PNRS**

Federal Region 4 (cont.)

FL	FLD980728877	Sixty-Second Street Dump	1984	1989
FL	FLD004126520	Standard Auto Bumper Corp.	1989	
FL	FLD004092532	Stauffer Chemical Co. (Tampa Plant)	1993	
FL	FLD010596013	Stauffer Chemical Co. (Tarpon Springs)	1993	
FL	FLD000648055	Sydney Mine Sludge Ponds		1989
FL	FLD980494959	Taylor Road Landfill		
FL	FL2800016121	USAF Cape Canaveral Air Force Base		
FL	FL7570024037	USAF Homestead Air Force Base		
FL	**FL1570024124**	**USAF Tyndall Air Force Base**	**1997**	
FL	FL6170022952	USAF NAS Key West (Boca Chica)		
FL	FL2570024404	USAF Patrick Air Force Base		
FL	FL1690331300	USCG Station Key West		
FL	FL5170022474	USN Air Station Cecil Field	1990	
FL	FL6170024412	USN NAS Jacksonville	1990	
FL	FL6800014585	US NASA Kennedy Space Center		
FL	FL9170024260	USN Naval Air Station Mayport		
FL	FL2170023244	USN Naval Air Station Whiting Field Site 5	1996	
FL	FL8170023792	USN Naval Coastal Systems Center		
FL	FLD980602767	Whitehouse Oil Pits		
FL	FLD041184383	Wilson Concepts of Florida, Inc.		
FL	FLD981021470	Wingate Road Municipal Incinerator Dump		
FL	FLD004146346	Woodbury Chemical Co. (Princeton Plant)	1989	
FL	FLD049985302	Zellwood Ground Water Contamination		
GA	GAD095840674	Cedartown Industries, Inc.		
GA	GAD980495402	Cedartown Municipal Landfill		
GA	GAD990741092	Diamond Shamrock Corp. Landfill		
GA	**GAD981024466**	**Brunswick Wood Preserving**	**1997**	
GA	GAD008212409	Escambia Wood - Camilla		
GA	GAD990855074	Firestone Tire & Rubber Co. (Albany Plant)		
GA	GAD004065520	Hercules, Inc.		
GA	GAD980556906	Hercules 009 Landfill		
GA	GAD000827444	International Paper Co.		
GA	GAD099303182	LCP Chemicals Georgia, Inc.		1995
GA	GAD980838619	Mathis Brothers Landfill		
GA	GAD001700699	Monsanto Corp. (Augusta Plant)		
GA	GAD980495451	New Sterling Landfill		
GA	**GAD982112658**	**Terry Creek Dredge Spoil /Hercules Outfall**	**1997**	
GA	GAD042101261	T.H. Agriculture & Nutrition (Albany)		
GA	GA1570024330	USAF Robins Air Force Base (Landfill/Sludge lagoon)		
GA	GAD003269578	Woolfolk Chemical Works, Inc.		
MS	MSD008154486	Chemfax, Inc.	1995	
MS	MSD098596489	Gautier Oil Co., Inc.	1989	
MS	MS2170022626	US Naval Const. Battalion Center		
NC	NCD024644494	ABC One Hour Cleaners	1989	
NC	NCD980840409	Charles Macon Lagoon & Drum Storage		
NC	NC1170027261	Cherry Point Marine Corps Air Station		
NC	NCD980840342	Dockery Property		

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 4 (cont.)				
NC	NCD981475932	FCX , Inc. (Washington Plant)	1989	
NC	NCD981927502	Geigy Chemical Corp. (Aberdeen Plant)		
NC	NCD079044426	General Electric Co./Shepherd Farm		
NC	NCD003200383	Koppers Co., Inc. (Morrisville Plant)		
NC	NCD991278953	National Starch & Chemical Corp.		
NC	NCD981021157	New Hanover County Airport Burn Pit	1989	
NC	NCD986186518	Old ATC Refinery		
NC	NCD981023260	Potter's Septic Tank Service Pits	1989	
NC	NC6170022580	USMC Camp Lejeune	1989	
SC	SCD987581337	Calhoun Park/Ansonborough Homes/Scegco		1993
SC	SCD980558316	Carolawn, Inc.		
SC	SCD980846034	Charleston Landfill		
SC	SCD980711279	Geiger (C&M Oil)	1984	
SC	SCD058753971	Helena Chemical Co. Landfill	1989	
SC	SCD055915086	International Paper Co.		
SC	SCD094995503	Kalama Specialty Chemicals		
SC	SCD980310239	Koppers Co., Inc. (Charleston Plant)	1993	
SC	SCD991279324	Leonard Chemical Co., Inc.		
SC	SCD980558043	Lexington County Landfill Area		
SC	SC0170022560	Naval Shipyard - Charleston		
SC	SC8170022620	Naval Weapons Station - Charleston		
SC	SCD037398120	Palmetto Recycling, Inc.		
SC	SCD002601656	Para-Chem Southern, Inc.		
SC	SC6170022762	Parris Island Marine Corps Recruit Depot		1995
SC	SC1890008989	US DOE Savannah River Site	1990	
SC	SCD987572674	US DOI Charleston Harbor Site		1993
SC	SCD037405362	Wamchem, Inc.	1984	
Federal Region 5				
IL	ILD000802827	Outboard Marine Corporation		
MI	MID006007306	Allied Paper/Portage Creek/Kalamazoo River		
MI	MID980678627	Cannelton Industries		
MI	MID980679799	Deer Lake		
MI	MID006014906	Hooker Montague Plant		
MI	MID981192628	Manistique River/Harbor Area of Concern		
MI	MID072569510	Muskegon Chemical Co.		
MI	MID980901946	Torch Lake		
MN	MND039045430	St. Louis River - USX Duluth		
OH	OHD980614572	Fields Brook		
WI	WID006136659	Fort Howard Paper Co. Sludge Site		
WI	WID006141402	Fort Howard Steel Incorporated		
WI	WID006073225	Kohler Co. Landfill		
WI	WID039052626	Moss-American Kerr-McGee Oil Co.		
WI	WID980996367	Sheboygan Harbor & River		
Federal Region 6				
AR	ARD980496723	South 8th Street Landfill		
LA	LAD000239814	American Creosote Works, Inc. (Winnfield)		
LA	LAD980745632	Bayou Bonfouca		
LA	LAD981916570	Bayou D'Inde		
LA	LAD980745541	Bayou Sorrell Site	1984	

			Report Date	
State	Cerclis	Site Name	Review	PNRS
Federal Region 6 (cont.)				
LA	LAD985195346	Bayou Verdine		
LA	LAD980501423	Calcasieu Parish Landfill		
LA	LAD985202464	Devil's Swamp Lake		
LA	LAD985169317	GSU (North Ryan St.)/Utilities Yard		
LA	**LAD981522998**	**Madisonville Creosote Works, Inc.**	**1997**	
LA	LAD057482713	Petro-Processors of Louisiana, Inc.		
LA	LAD062644232	Ponchatoula Battery Co.		
LA	LAD008086506	PPG Industries, Inc.		
LA	LAD008149015	Southern Shipbuilding, Inc.		
TX	TXD008123168	ALCOA (Point Comfort)/Lavaca Bay	1995	
TX	TXD980864649	Bailey Waste Disposal	1985	1989
TX	TXD980625453	Brio Refining , Inc.	1989	1989
TX	TXD990707010	Crystal Chemical Co.	1989	1989
TX	TXD089793046	Dixie Oil Processors, Inc.	1989	1989
TX	TXD980514814	French Ltd.	1989	1989
TX	TXD980748453	Geneva Industries/Fuhrmann Energy		
TX	TXD980745582	Harris (Farley Street)		
TX	TXD980514996	Highlands Acid Pit	1989	
TX	TXD980625636	Keown Supply Co.		
TX	TXD980629851	Motco, Inc.	1984	
TX	TXD980873343	North Cavalcade Street		
TX	TXD980873350	Petro-Chemical Systems (Turtle Bayou)		
TX	TXD062132147	Sheridan Disposal Services		
TX	TXD980513956	Sikes Disposal Pits	1989	
TX	TXD980873327	Sol Lynn/Industrial Transformers		
TX	TXD980810386	South Cavalcade Street		
TX	TX0001407444	Sprague Road Groundwater		
TX	TXD062113329	Tex-Tin Corp.	1989	
TX	TXD055143705	Triangle Chemical Company		
Federal Region 9				
AS	ASD980637656	Taputimu Farm	1984	
CA	CAD980358832	Aerojet General Corp.		
CA	CA2170023236	Alameda Naval Air Station	1989	
CA	CA2170023533	Camp Pendleton Marine Corps Base	1990	1992
CA	CAD009114919	Chevron USA Richmond Refinery		
CA	CAD063015887	Coast Wood Preserving	1984	
CA	CA7170024528	Concord Naval Weapons Station	1989/1993	1990
CA	CAD055753370	Cooper Drum Co.	1993	
CA	CAD980498455	Crazy Horse Sanitary Landfill		
CA	CAD009212838	CTS Printex, Inc.	1989	
CA	CAD029544731	Del Amo Facility	1992	
CA	CAD000626176	Del Norte Pesticide Storage	1984	
CA	CA6170023208	El Toro Marine Corps Air Station	1989	
CA	CAD981159585	Farallon Islands		1990
CA	CA7210020676	Fort Ord	1990	1992
CA	CAD980636914	Fresno Municipal Sanitary Landfill		
CA	CAD980498562	GBF & Pittsburg Dumps	1989/1993	
CA	CA3570024288	Hamilton Air Force Base		
CA	CAD980884209	Hewlett-Packard (620-640 Page Mill Road)	1989	
CA	CAD058783952	Hexcel Corp.		

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 9 (cont.)				
CA	CAD041472341	Intersil Inc./Siemens Components	1989	
CA	CAD980498612	Iron Mountain Mine	1989	1989
CA	CAD000625731	J.H. Baxter & Co.		
CA	CAD009103318	Jasco Chemical Corp.	1989	
CA	CA9800013030	Jet Propulsion Laboratory (NASA)		
CA	CAD008274938	Kaiser Steel Corp. (Fontana Plant)		
CA	CAD981429715	Kearney - KPF		
CA	CA3170024381	Lemoore Naval Air Station		
CA	CAT000646208	Liquid Gold Oil Corp.	1984	
CA	CA2170023194	Long Beach Naval Station		
CA	CAD065021594	Louisiana-Pacific Corp.		
CA	CA7170024775	Mare Island Naval Shipyard		
CA	CAD009106527	McCormick & Baxter Creosoting Co.	1993	
CA	CAD982463812	M-E-W Study Area		
CA	CAD000074120	MGM Brakes	1984	
CA	CAD981997752	Modesto Ground Water Contamination		
CA	CA2170090078	Moffett Naval Air Station	1986	
CA	CAD008242711	Montrose Chemical Corp.	1985	
CA	CA1170090483	Naval Shipyard Long Beach		
CA	CA0170090021	Naval Supply Center Pt. Molate Site		
CA	CAD981434517	Newmark Ground Water Contamination		
CA	CA7170090016	North Island Naval Air Station		
CA	CA4170090027	Oakland Naval Supply Center		
CA	CAD980636781	Pacific Coast Pipe Lines	1989	
CA	CA9170027271	Pacific Missile Test Center		
CA	CA1170090236	Point Loma Naval Complex		
CA	CA6170023323	Port Hueneme Naval Construct. Battalion Center		
CA	CAD982462343	Redwood Shore Landfill		
CA	CAT000611350	Rhone-Poulenc, Inc./Zoecon Corp.	1985	
CA	CA7210020759	Riverbank Army Ammunition Plant	1989	
CA	CAD009452657	Romic Chemical Corp		
CA	CA0210020780	Sacramento Army Depot		
CA	CA0170024491	Seal Beach Naval Weapons Station		
CA	CAD009164021	Shell Oil Co. Martinez		
CA	CAD980637482	Simpson-Shasta Ranch		
CA	CAD981171523	Sola Optical USA, Inc.	1989	
CA	CAD059494310	Solvent Service, Inc.		
CA	CAD980894885	South Bay Asbestos Area	1985	
CA	CAD009138488	Spectra-Physics, Inc.		
CA	CAD980893275	Sulphur Bank Mercury Mine		
CA	CAD990832735	Synertek, Inc. (Building 1)		
CA	CAD000072751	Tosco Corp. Avon Refinery		
CA	CA5570024575	Travis Air Force Base	1990	
CA	CA1170090087	Treasure I. Naval Station - Hunters Pt. Annex	1989	1989
CA	CAD009159088	TRW Microwave, Inc. (Building 825)		
CA	CAD981436363	United Heckathorn Co.		
CA	CA9570025149	Vandenberg Air Force Base		1994[6]
GU	GU6571999519	Andersen Air Force Base	1993	
GU	GU7170027323	Naval Air Station Guam		

[6] USAF Report.

State	Cerclis	Site Name	Report Date: Review	Report Date: PNRS
Federal Region 9 (cont.)				
HI	HID033233305	ABC Chemical Corp.		
HI	HI3570028719	Bellows Air Force Station		
HI	HID981424138	Chemwood Treatment Co., Inc.		
HI	HID980637631	Del Monte Corporation (Oahu Plantation)	1995	
HI	HID981581788	Hawaiian Western Steel Limited		
HI	HI8570028722	Hickam Air Force Base		
HI	HI0000768382	Honolulu Skeet Club		
HI	HI4210090003	Johnston Atoll		
HI	HI6170090074	Kahoolawe Island		
HI	HID980497184	Kailua-Kona Landfill		
HI	HID980497176	Kapaa Landfill		
HI	HID980497226	Kewalo Incinerator Ash Dump		
HI	HI6170022762	MCAS Kanehoe Landfill		
HI	HI3170024340	Naval Submarine Base		
HI	HID980585178	Pearl City Landfill	1984	
HI	HI2170024341	Pearl Harbor Naval Complex	1992	1993
HI	HI2170024341	Pearl Harbor Naval Station		
HI	HID982400475	Waiakea Pond/Hawaiian Cane Products Plant		1990
MQ	MQ6170027332	Midway Island Naval Air Station		
TT	TTD981622285	PCB Wastes (15 Saipan)		
WQ	WQ0570090001	Wake Island Air field		
Federal Region 10				
AK	AK4170024323	Adak Naval Air Station	1993	
AK	AKD009252487	Alaska Pulp Corp.		1995
AK	AK6214522157	Fort Richardson (US ARMY)	1995	
AK	AK6210022426	Fort Wainwright		
AK	AKD980978787	Standard Steel & Metals Salvage Yard (USDOT)	1990	1990
AK	AK9570028705	USAF Eareckson Air Force Station		
AK	AK8570028649	USAF Elmendorf Air Force Base	1990	1990/1994[7]
AK	AK0131490021	USDOC NOAA National Marine Fisheries Service		
ID	IDD980725832	Blackbird Mine	1995	1994
ID	IDD980665459	Stibnite/Yellow Pine Mining Area		
OR	ORD009051442	Allied Plating, Inc.	1987	1988
OR	ORD987185030	East Multnomah County Groundwater		
OR	ORD095003687	Gould, Inc.	1984	1988
OR	ORD068782820	Joseph Forest Products		
OR	ORD052221025	Martin-Marietta Aluminum Co.	1987	1988
OR	ORD009020603	McCormick & Baxter Creosote Co. (Portland)	1995	1995
OR	ORD980988307	Northwest Pipe & Casing Co.	1993	
OR	ORD009412677	Reynolds Metals Co.		
OR	ORD009025347	Rhone Poulence Inc. Basic Chemicals Division	1984	
OR	ORD009042532	Taylor Lumber and Treating, Inc.		1991
OR	ORD050955848	Teledyne Wah Chang	1985	1988
OR	ORD009049412	Union Pacific Railroad Tie Treatment	1990	1990
WA	WAD009045279	ALCOA (Vancouver Smelter)	1989	1989
WA	WAD057311094	American Crossarm & Conduit Co.	1989	1988
WA	WA5170027291	Bangor Naval Submarine Base	1990	1991

[7] USAF Report.

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 10 (cont.)				
WA	WA7170027265	Bangor Ordnance Disposal		1991
WA	WA1891406349	Bonneville Power Admin. Ross (USDOE)	1990	1990
WA	WAD009624453	Boomsnub/Airco		
WA	WAD980836662	Centralia Municipal Landfill	1989	1989
WA	WAD980726368	Commencement Bay , Near Shore/Tide Flats	1984[8]	1988
WA	WAD980726301	Commencement Bay , South Tacoma Channel	1984[8]	
WA	WA5210890096	Hamilton Island Landfill (USA/COE)	1992	1991
WA	WA3890090076	Hanford 100-Area (USDOE)	1989	1988
WA	WAD980722839	Harbor Island (Lead)	1984	1989
WA	WA3170090044	Jackson Park Housing Complex (USNAVY)	1995	
WA	WA5170090059	Naval Air Station Whidbey Island (Ault)	1986	1989
WA	WA6170090058	Naval Air Station Whidbey Island (Seaplane)	1986	1989
WA	WA1170023419	Naval Undersea Warfare Station (4 Areas)		1989
WA	WAD027315621	Northwest Transformer (South Harkness St.)	1989	1988
WA	**WAD008957243**	**Oeser Company**	**1997**	
WA	WA8680030931	Old Navy Dump/Manchester Lab (USEPA/NOAA)	1996	1995
WA	WAD009248287	Pacific Sound Resources	1995	1992
WA	WAD009422411	Pacific Wood Treating		
WA	WA0000026534	Palermo Groundwater Contamination		
WA	WA4170090001	Port Hadlock Detachment (USNAVY)		1989/1995
WA	WA2170023418	Puget Sound Naval Shipyard Complex	1995	
WA	WAD980639215	Quendall Terminals	1985	
WA	WAD980639462	Seattle Municipal Landfill (Kent Highlands)	1989	1988
WA	WAD980976328	Strandley/Manning Site		1992
WA	WAD980639256	Tulalip Landfill	1992	1991
WA	WA2170023426	USN Fuel Depot Naval Support Center Puget Sound		
WA	WAD988519708	Vancouver Water Station #1 Contamination		
WA	WAD980639280	Washington Natural gas - Seattle Plant		1996
WA	WAD009487513	Western Processing Co., Inc.	1984	
WA	WAD009041450	Weyerhaeuser Co.		
WA	WAD009248295	Wyckoff Co./Eagle Harbor	1986	1988

[8] Evaluated in a single Coastal Hazardous Waste Site Review.

Table 2. Acronyms and abbreviations used in Coastal Hazardous Waste Site Reviews

AST	above-ground storage tank
AWQC	Ambient water quality criteria for the protection of aquatic life
bgs	below ground surface
BHC	benzene hexachloride
BNA	base, neutral, and acid-extractable organic compounds
BOD	biological oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
cm	centimeter
COC	contaminant of concern
COD	chemical oxygen demand
COE	U.S. Army Corps of Engineers
CRC	Coastal Resource Coordinator
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
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
ETAG	Ecological and Technical Assessment Group
ha	hectare
HMX	cyclotetramethylene tetranitramine
HRS	Hazard Ranking System
IRM	Immediate Removal Measure
kg	kilogram
km	kilometer
L	liter
LNAPL	light, non-aqueous phase liquid
LOEL	lowest observed effects level
m	meter
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
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	polynuclear aromatic hydrocarbon
PA/SI	Preliminary Assessment/Site Investigation
PCB	polychlorinated biphenyl

PCE perchloroethylene (aka tetrachloroethylene)

Table 2 (cont.)

PCP	pentachlorophenol
PNRS	Preliminary Natural Resource Survey
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
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
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
<	less than
>	greater than

PLEASE CITE AS:

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1

Beede Waste Oil

Plaistow, New Hampshire
CERCLIS #NHD018958140

Site Exposure Potential

The Beede Waste Oil site comprises two parcels of land on about 16 ha in Plaistow, New Hampshire (Figure 1). Kelly Brook flows through the site for about 0.6 km and then flows into the Little River approximately 1.5 km downstream from Parcel 1 (Figure 2). From the confluence with Kelly Brook, the Little River flows about 7 km before entering the Merrimack River, which enters the Atlantic Ocean approximately 35 km downstream.

The site was a waste oil recycling and virgin fuel oil storage and distribution facility from 1926 until 1994. Parcel 1 was used for petroleum and waste storage and handling, and Parcel 2 was used primarily for commercial sand and gravel operations (Figure 2). There are numerous localized areas on the site where wastes were stored or disposed. The most contaminated areas include a former surface lagoon where waste oils were deposited, surface-water runoff pits where releases of petroleum products were documented, and two interceptor trenches (SH&A 1995; Figure 2). By 1978, 86 aboveground storage tanks (ASTs) with a total capacity of 4.9 million liters were in use; 38 of these tanks are documented to have contained waste oil, sludge, or water contaminated with PCBs and trace elements. There are numerous piles of contaminated soil and debris, with an estimated total

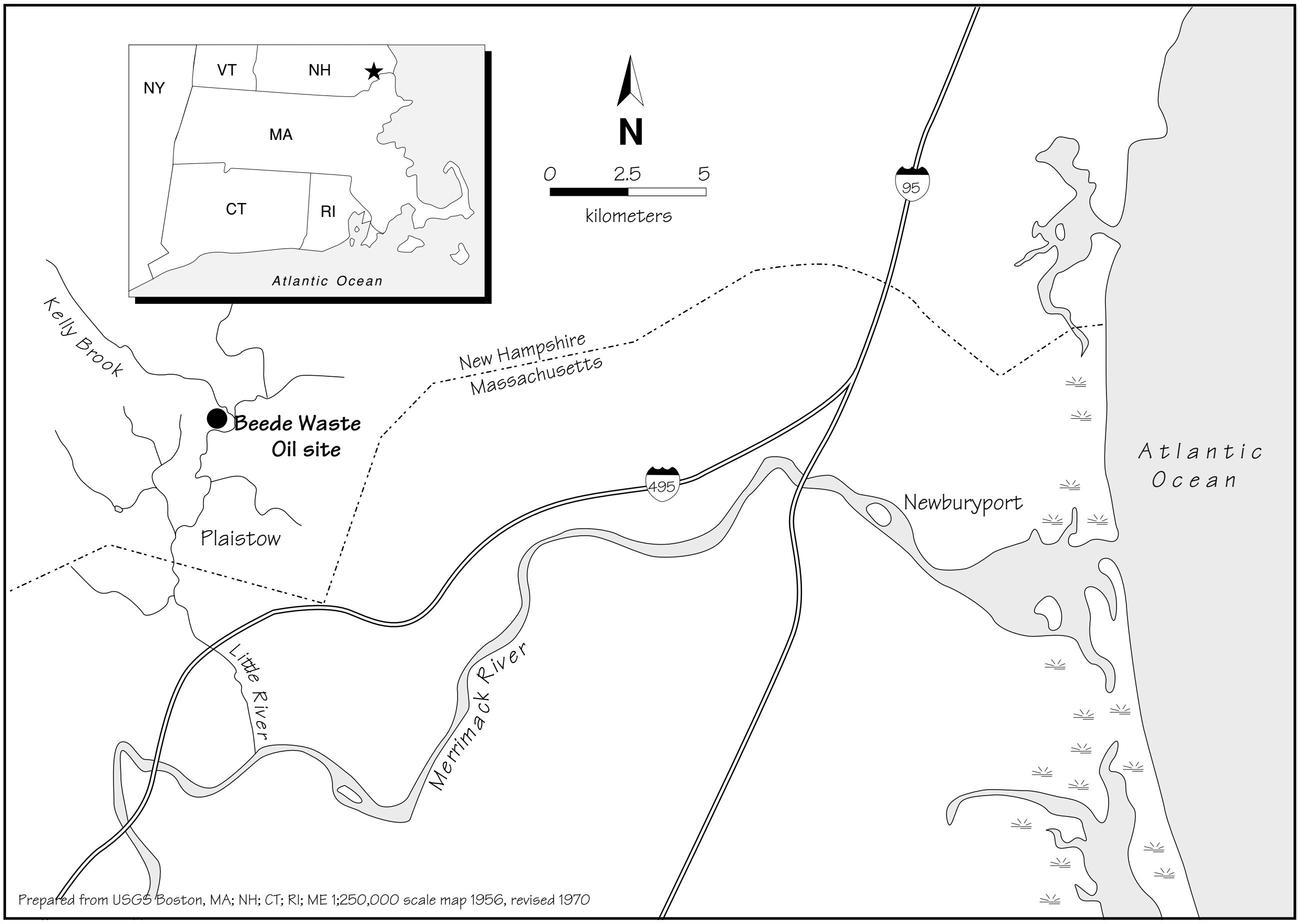

Figure 1. Location of Beede Waste Oil site in Plaistow, New Hampshire.

volume of 15,000 m^3, at the site. Although most of the contaminated soils are located on Parcel 1, PCB-contaminated soils are stockpiled on Parcel 2, also (SH&A 1995). In 1992, the New Hampshire Department of Environmental Services began maintaining oil-absorbent booms in Kelly Brook because free product oil was observed discharging into the brook east of the older site building. Free product oil samples analyzed from groundwater at the site contain combinations of lubricating oil, kerosene, weathered gasoline, light fuel oil, Fuel Oil No. 2, and diesel oil (SH&A 1995).

Groundwater and seeps of waste oils appear to be the primary pathways for migration of contaminants from the site to Kelly Brook. The available site documents did not discuss any drainage ditches on-site that lead to Kelly Brook, although this is a possible migration pathway. The topography of Parcel 1 is relatively flat but the northeastern portion slopes towards Kelly Brook. The

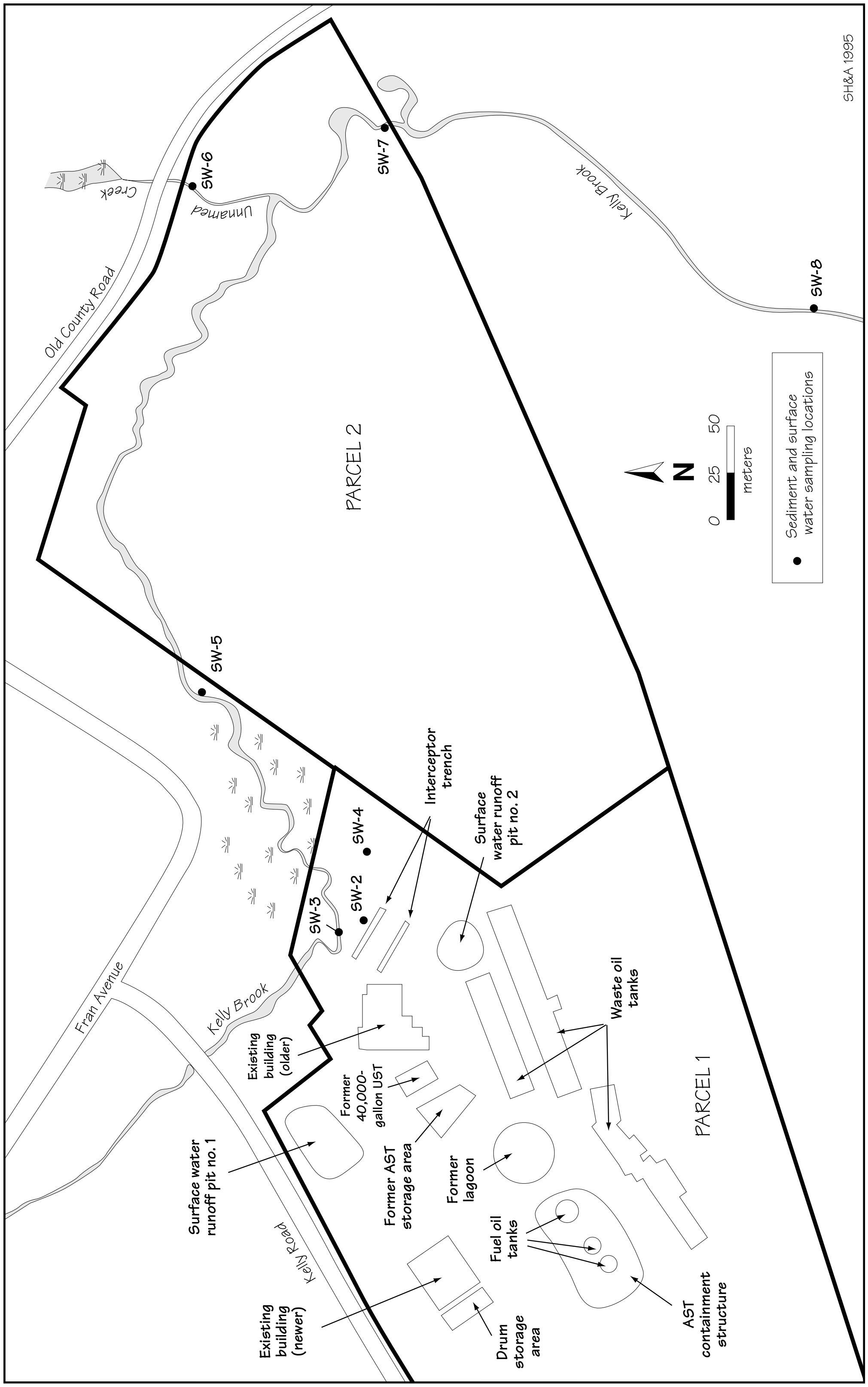

Figure 2. Detail of the Beede Waste Oil site in Plaistow, New Hampshire.

topography of Parcel 2 varies as a result of sand and gravel mining operations (SH&A 1995). The overburden geology in the region is characterized as primarily marine sand containing a few beds of silt and clayey silt with some surficial deposits of glacial sand and gravel, and till. Bedrock has been encountered at 20 to 23 m below the ground surface (bgs). Groundwater is typically found at depths ranging from approximately 1 to 7m bgs; aquifer thicknesses at the site range from approximately 15 to more than 25 m. Groundwater beneath Parcel 1 generally flows east and northeast. The principal zone of discharge for overburden groundwater flowing from the site is Kelly Brook. The average volumetric discharge of groundwater from the site to Kelly Brook is an estimated 240 m^3/day, or approximately 4% of the average stream flow (SH&A 1995).

NOAA Trust Habitats and Species

The primary habitats of concern to NOAA are surface water, stream channel bottom, and associated riparian zones of Kelly Brook, the Little River, and the Merrimack River. Anadromous and catadromous fish species that use the three streams are the resources of concern to NOAA (Table 1).

Kelly Brook is a small, spring-fed stream that flows from its headwaters for approximately 7 km to the Little River. The stream is high-gradient, cold-water with typical riffle-pool habitats for most of its length. Gravel substrates dominate riffle stretches of the stream with finer sands in pool environments. The Little River is a moderate-sized, short stream originating in Bayberry Pond, approximately 3 km upstream of the confluence of Kelly Brook, and discharging to the Merrimack River approximately 7 km downstream of the confluence. The Little River is lower gradient with a primarily warm-water fish assemblage. Substrates are likely composed of sands with finer sediments in ponded areas (Ingham personal communication 1997).

Kelly Brook and the Little River have populations of catadromous American eel throughout both streams. Anadromous species do not use these streams.

The Little River discharges into Reach I of the lower Merrimack River. Reach I is the lower 50 km of the river from the Essex Dam, in Lawrence, Massachusetts, to the mouth. The river in this reach is large, generally between 200 and 400 m wide with pools of 7 m or deeper. Sediments range from large rubble to silts with 65% of the bottom substrate classified as sand and gravel, and 14% as fine silts (USFWS 1982). The confluence of the Little and Merrimack rivers is near the transition between freshwater riverine and tidal estuarine habitat (Ingham pers. commun. 1997).

The Merrimack River has runs of seven anadromous species: Atlantic sturgeon, Atlantic salmon, American shad, alewife, blueback herring, rainbow smelt, and striped bass. In addition, the river is within the known distribution of the shortnose sturgeon, but verified collections of this

Table 1. Major NOAA trust species that use Kelly Brook, Little River, and lower Merrimack River near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
Kelly Brook/Little River						
American eel	*Anguilla rostrata*		♦	♦		
Merrimack River						
Alewife	*Alosa pseudoharengus*	♦	♦	♦		
American eel	*Anguilla rostrata*		♦	♦		
American shad	*Alosa sapidissima*	♦	♦	♦		
Atlantic salmon*	*Salmo salar*					♦
Atlantic sturgeon	*Acipenser oxyrhynchus*	♦	♦	♦		
Blueback herring	*Alosa aestivalis*	♦	♦	♦		
Rainbow smelt	*Osmerus mordax*	♦	♦	♦		♦
Sea lamprey	*Petromyzon marinus*		♦	♦		
Striped bass	*Morone saxatilis*	♦	♦	♦		♦

* Atlantic salmon use the lower Merrimack River near the site as a migratory corridor to upstream spawning grounds

protected species have not been made. The catadromous American eel and the anadromous and parasitic sea lamprey are also found in the river. Atlantic sturgeon, rainbow smelt, and striped bass use non-tidal, freshwater segments of Reach I as a primary spawning ground and nursery area. Alewife, blueback herring, and American shad also spawn in Reach I and migrate above the Essex Dam. Atlantic salmon use Reach I as a migratory corridor to spawning grounds in the upper watershed (USFWS 1982).

In 1981, the States of Massachusetts and New Hampshire, the U.S. Fish and Wildlife Service, NOAA's National Marine Fisheries Service, and the U.S. Forest Service formed the Policy and Technical Committees for Anadromous Fishery Management of the Merrimack River. The goals of the committees are restoring anadromous fish populations within the basin and restoration of spawning habitat by developing fish passage facilities at key dams. Atlantic salmon and American shad are the target species; the other anadromous species also would benefit from this management program. Since the inception of the program, several formerly impassable dams upstream of the site have had fish passage facilities installed. A major stocking program of juvenile Atlantic salmon and American shad is underway, planting fish in several tributaries and the mainstem Merrimack upstream of the site (USFWS 1982).

There are no plans to stock the Little River with anadromous fish because of its small size. However, the New Hampshire Department of Fish and Game stocks and manages the river for recreational taking of brook trout, a non-NOAA trust species. Kelly Brook also contains a self-sustaining population of brook trout (Ingham pers. commun. 1997).

The habitat type and the presence of a recreational brook trout fishery in the Little River indicate that blueback herring and alewife could inhabit the river, although they have not been observed there. These species could use the Little River in the future if restoration activities on the Merrimack River enhance their overall populations in the watershed.

Site-Related Contamination

Data on site-related contamination for this report were obtained from the Site and Waste Characterization (SH&A 1995), which reported results from sampling conducted as part of the characterization in 1995, and briefly reviewed results from previous investigations. Based on the Site and Waste Characterization, PCBs and trace elements are the primary contaminants of concern to NOAA. VOCs and petroleum hydrocarbons reported as total petroleum hydrocarbon (TPH) were detected at elevated concentrations in soil and groundwater on-site, and in surface water and sediment of Kelly Brook. However, VOCs are of limited concern to NOAA at their detected concentrations, although their presence on- and off-site indicates that contaminants have migrated from the site. VOCs can facilitate environmental transport of other, less soluble organic contaminants, such as PCBs, but this is undocumented at the site. Petroleum hydrocarbons may pose a risk to trust resources but screening guidelines are not available for these compounds.

Soil and groundwater data indicate potential sources of contaminants to Kelly Brook and NOAA trust resources. VOCs and TPH in or near the water table were highest in soils near the former lagoon and Surface Water Runoff Pit No. 2 (up to 440 mg/kg total non-chlorinated aromatic VOCs, up to 210 mg/kg total chlorinated VOCs, and up to 35,000 mg/kg TPH) (SH&A 1995). Maximum concentrations of trace elements and PCBs detected in soils are presented in Table 2. Limited data were available for trace elements in soils. During the Site and Waste Characterization, total PCBs were detected in 10 of 14 soil samples at concentrations of 0.4 to 1.4 mg/kg. In earlier studies, total PCBs were typically detected in soils at concentrations of approximately 5 mg/kg or less, although PCB concentrations as high as 1500 mg/kg were reported (U.S. EPA 1994, as cited in SH&A; NHDES 1995, as cited in SH&A 1995).

A light, non-aqueous phase liquid (LNAPL) floating on the groundwater at ten monitoring wells affects an estimated 0.4 to 0.8 ha. PCBs have been detected in all LNAPL samples, at concentrations of 11 to 80 mg/kg. LNAPL thicknesses typically range from 0.3 to 1.5 m, with the greatest thicknesses found at the former

Table 2. Maximum concentrations of contaminants of concern to NOAA detected in soil and groundwater at the Beede Waste Oil site compared to NOAA screening guidelines.

	Soil mg/kg	Avg. U.S.[a] mg/kg	Groundwater µg/L	Freshwater Chronic AWQC[b] µg/L
Trace Elements				
Arsenic	N/A	5.2	90[d]	190
Cadmium	N/A	0.06[c]	27[d]	1.1
Lead	189[e]	16	2,600[d]	3.2
Organic Compounds				
Aroclor 1242	1.0[d]	NA	ND[f]	NA
Aroclor 1260	0.4[d]	NA	ND[f]	NA
Total PCBs	1,500[e]	NA	ND[f]	0.014

N/A: Not analyzed
NA: Not available
a: Shacklette and Boerngen (1984)
b: U.S. EPA 1993
c: Lindsay (1979; cadmium represents average concentrations in the earth's crust)
d: SH&A (1995)
e: NHDES (1995); U.S. EPA (1994)
f: Haley and Aldrich 1994; detection limit not reported.

lagoon and near the interceptor trenches (SH&A 1995).

Total non-chlorinated aromatic VOCs and total chlorinated VOCs were detected in groundwater at concentrations up to 4.4 and 7.2 mg/L, respectively (SH&A 1995). Table 2 presents maximum concentrations of trace elements detected in groundwater. Elevated concentrations of trace elements were correlated with the presence of LNAPL. PCBs were not analyzed in groundwater during the Site and Waste Characterization. During a previous investigation conducted by Haley and Aldrich in 1994, samples analyzed for PCBs were all non-detect, but detection limits were not reported (SH&A 1995).

In general, the highest concentrations of contaminants in surface water and sediment were found in samples collected from between the interceptor trench and Kelly Brook (colocated samples SW-2 and SS-2; see Figure 2). This area was flooded in April 1990. VOCs were detected in surface water at 9 µg/L in sample SW-2 and at 10 µg/L in Kelly Brook. The highest concentrations of petroleum hydrocarbons were detected in samples SW-2 and SS-2 (88 mg/L in surface water and 1600 mg/kg in sediment). Petroleum hydrocarbons were not detected within Kelly Brook in 1995, although discharges of free product into the brook had been observed in 1992.

Table 3 presents maximum concentrations of trace elements and PCBs detected in surface water and sediment. Trace elements were not detected in sediment during the Site and Waste Characterization, but both the specific trace elements analyzed and the detection limits were unclear. Concentrations of arsenic and lead exceeded their respective ERLs in sediment samples collected from a location in the floodplain of Kelly Brook during a previous study (NHDES 1995, as cited in SH&A 1995). During the Site and Waste Characterization, the only samples in which PCBs were detected were SW-2 (15 µg/L) and SS-2 (2.2 mg/kg). In previous studies, PCBs were detected at concentrations of up to 25 mg/kg in sediment and 3300 µg/L in surface water; elevated concentrations were found primarily in the floodplain of Kelly Brook. Contaminants were not detected at concentrations of concern in Kelly Brook at SW-8; however, sampling has not been conducted in depositional areas downstream of SW-8.

Summary

For nearly 70 years, the Beede Waste Oil site was used to store and handle petroleum products and waste oils. Kelly Brook flows through the site to the Little River which discharges to the Merrimack River. Catadromous American eel is the only NOAA trust resource observed in Kelly

Table 3. Maximum concentrations of contaminants of concern to NOAA detected in Kelly Brook and associated floodplain during investigations at the Beede Waste Oil site compared to NOAA screening guidelines.

	Surface Water µg/L	Freshwater Chronic AWQC[a] µg/L	Sediment mg/kg	ERL[b] mg/kg
Trace Elements				
Arsenic	ND[c]	190	51[d]	8.2
Cadmium	1[c]	1.1	1.7[d]	1.2
Lead	ND[c]	3.2	130[d]	46.7
Organic Compounds				
Aroclor 1260	15[c]	NA	2.2[c]	NA
Total PCBs	3,300[e]	0.014	25[e]	0.0227

NA: Not available.
ND: Not detected; detection limits not available.
a: U.S. EPA 1993
b: Effects range-low (Long et al. 1995)
c: SH&A 1995
d: NHDES 1995
e: Detected during a previous investigation, not identified but reported in SH&A 1995.

Brook and the Little River. However, alewife and blueback herring may use the Little River in the future if anadromous fish restoration activities on the Merrimack River succeed at enhancing their populations in the watershed. Oily free product has been observed discharging into Kelly Brook from the site; and LNAPL floating on the groundwater contained elevated concentrations of PCBs. Very high concentrations of PCBs have been detected in Kelly Brook surface water.

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2

V&M/Albaladejo Farms

Vega Baja, Puerto Rico
CERCLIS #PRD987366101

Site Exposure Potential

The V&M/Albaladejo Farms site is in the Almirante Norte Ward of the municipality of Vega Baja, Puerto Rico, 1.6 km west of Route 160. The site consists of four zones (Zones 1 through 4), four burned areas (Burned Areas I through IV), and two suspected burned areas (Figures 1 and 2). The Río Indio flows north approximately 650 m northwest of the site (CDM 1996). About 5 km north of the site, the Río Indio joins the Río Cibuco, which discharges to the Atlantic Ocean about 14 river km north of the site (USGS 1982a & b). The area covered by the site includes two farms located in the limestone uplands characterized by landforms typical of karst terrain, including heavily vegetated, steep hills surrounded by small valleys, sinkholes, subsurface channels, and caves (CDM 1996).

Zone 1 (280 m^2) cuts directly into the hillside at the end of a vehicular path and is littered with scrap, wire, and ash. Portions of the site have soil stained green, and surface contamination is estimated to vary in depth from 0.3 to 1 m below the surface (CDM 1996).

Zone 2 covers an area of 186 m^2 and is north of Zone 1. A hand-dug pit is coated with metal shavings and is surrounded by scrap metal. A steep, vehicular path from the site provides a

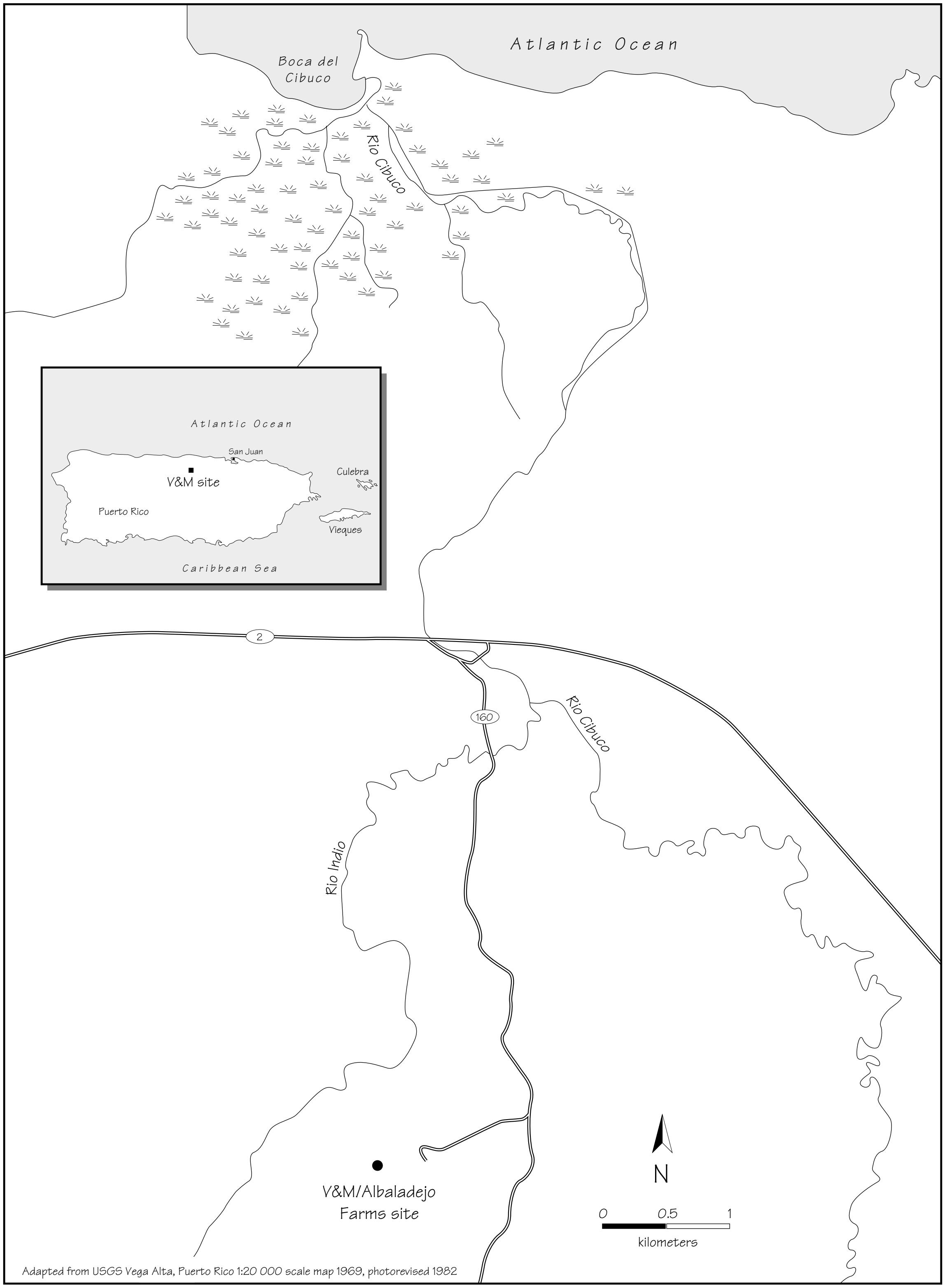

Figure 1. Location of V&M/Albaladejo Farms site in Puerto Rico.

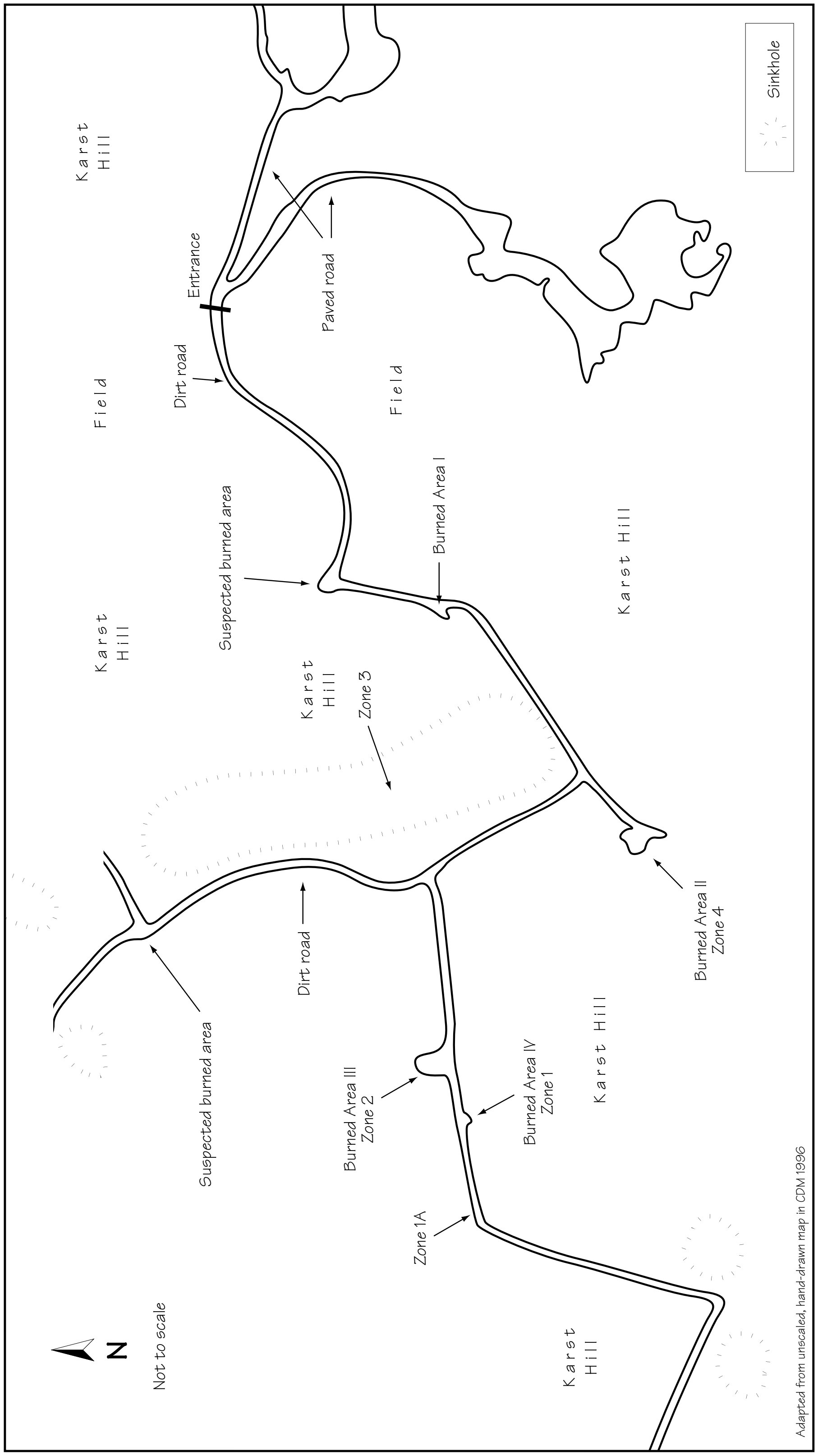

Figure 2. Detail of the V&M/Albaladejo Farms site.

direct route for surface water runoff to flow towards sinkholes located approximately 180 m east of the site (CDM 1996).

Zone 3 is heavily vegetated and is located within a large sinkhole that occupies the center of the site, and reportedly consists of two burn areas. Two smaller sinkholes are located within the large sinkhole. The areal extent of soil contamination at Zone 3 is unknown (CDM 1996).

Zone 4 is located east of Zone 1 across a heavily vegetated ridge. Scrap and wire remnants cover this cleared area of approximately 370 m^2. The hillside east of Zone 4 is believed to have been tilled in the past, possibly introducing contamination deeper into the soil (CDM 1996).

The V&M site was used for dumping plastic-coated electric cables, electrical equipment, and car batteries. The wastes were burned to recover copper, aluminum, and lead. It is believed that open burning without containment was used during the burning and recovery process. It is not known when the burning activity began on either the V&M or the Albaladejo farm properties. Beginning in 1985, trucks that were allegedly working for the Puerto Rico Telephone Company and the Puerto Rico Electric and Power Authority were observed carrying wastes onto the site. Burning reportedly ceased in 1986 when the V&M farm was purchased by its current owner, but continued into 1988 on the Albaladejo farm. The total quantity of waste disposal at the site is unknown (CDM 1996).

Groundwater movement is believed to be the primary mechanism of contaminant transport from the site. The Aymamon and Aguada Formations together form one of the primary sources of groundwater within the region, comprising the upper, unconfined aquifer system. On a regional scale, groundwater in the Aymamon-Aguada Formation flows northward towards the Atlantic Ocean. Local groundwater flow direction near the site may be to the north-northwest, possibly discharging to the Río Indio (CDM 1996).

Direct infiltration of precipitation on outcrop areas and surface runoff into sinkholes is the primary source of recharge to the water table aquifer. The bedrock/soil interface is probably part of a highly irregular, well-developed karst. This implies that recharge, be it percolation through soil or into sinkholes, follows a complex path of least resistance influenced by joints, bedding planes, and open or sediment-filled solution channels. Hydraulic conductivity estimates of the upper aquifer range from about 150 m/day to more than 450 m/day.

NOAA Trust Habitats and Species

Habitats of concern to NOAA are surface water and bottom substrates of the Río Indio, the Río Cibuco, and their tributaries. Riparian zones, estuaries, and wetlands associated with these rivers, including mangrove swamps located at the mouth of the Río Cibuco, also are NOAA trust habitats potentially threatened by the transport of contaminants from the site.

Most of the native fish and shrimp species in Puerto Rico are compulsory migrators, either catadromous or amphidromous, and thus NOAA trust species (Oland 1997; Yoshioka 1997; Table 1). The term *amphidromous* refers to predominantly freshwater species in which the life cycle includes a larval phase in marine or estuarine water. These fish and shrimp mature and reproduce in freshwater, releasing either eggs or larvae which are carried downstream. These species are iteroparous (they do not die after spawning) and can spawn several times during their life cycle. For shrimp, the first-stage larvae are non-feeding and must reach waters containing salinities of approximately 15 ppt in order to molt to a feeding-stage larvae (Oland 1997).

The gobies and most of the shrimp species are capable of passing large obstacles (high waterfalls, and dams with surface water overflow) in their migrations upstream; they are found in the headwaters, up to the point where flow becomes intermittent (Oland 1997).

The mountain mullet is a popular native game fish that can sustain swimming speeds similar to trout, is very active, and is sensitive to disturbance. High dams and reservoirs have eliminated the mullet from many upland streams. The fat sleeper and spiny-cheeked sleeper are usually restricted to the lower portions of the river near the estuary. Larval sirajo gobies, known as setí, are collected during their upstream migration and eaten as a local delicacy. The catadromous American eel is occasionally taken by fishermen and likely used as bait (Oland 1997).

Bigmouth sleepers and the river goby are found in most rivers as well as some reservoirs. Both are believed to pass part of their life cycle in saltwater, but may be capable of completing their life cycles in freshwater. Although both species are taken as a food fish, little is known about the life history of the river goby (Oland 1997).

Shrimp are diverse and abundant, and are often the predominant predators, herbivores, and detritivores found in these streams. Shrimp of the genus *Macrobrachium* provide a popular fishery for both food and bait. *Macrobrachium* can grow quite large; for example, the big claw river shrimp is over 50 cm long with claws. Shrimp of the genus *Atya* are also large, and are commonly fished throughout the Caribbean (Oland 1997).

No information was found regarding dams or barriers on either Río Indio or Río Cibuco that might prevent migration of NOAA trust resources along the river near the site.

An extensive wetland system exists at the mouth of Río Cibuco. This wetland system includes extensive estuarine mangrove forests and herbaceous wetlands. It is listed by the Puerto Rico Department of Natural and Environmental Resources as a Critical Coastal Wildlife Area (Oland 1997).

Table 1. Target species of commercial and recreational interest likely to be found in Río Indio, Río Cibuco, and the estuary. (This table is not a complete listing of NOAA trust resources found in lower Río Cibuco and the estuary.)

		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning	Nursery/ Juvenile Rearing	Adult Forage	Comm.	Recr.
AMPHIDROMOUS/CATADROMOUS FISHES						
American eel	*Anguilla rostrata*		◆	◆		◆
Big-mouth sleeper[1]	*Gobiomorus dormitor*	◆	◆	◆	◆	◆
Fat sleeper	*Dormitator maculatus*	◆	◆	◆		
Mountain mullet	*Agonostomus monticola*	◆	◆	◆		◆
River goby[1]	*Awaous tajasica*	◆	◆	◆	◆	◆
Sirajo goby	*Sicydium plumieri*	◆	◆	◆	◆	
Spiny-cheek sleeper	*Eleotris pisonis*	◆	◆	◆		
CRUSTACEANS						
Big Claw River shrimp	*Macrobrachium carcinus*	◆	◆	◆	◆	◆
Cascade River prawn	*Macrobrachium heterochirus*	◆	◆	◆	◆	◆
Cinnamon River shrimp	*Macrobrachium acanthurus*	◆	◆	◆	◆	◆
Shrimp[2]	*Atya innocous*	◆	◆	◆	◆	◆
Shrimp[2]	*Atya lanipes*	◆	◆	◆	◆	◆
Shrimp[2]	*Atya scabra*	◆	◆	◆	◆	◆
Shrimp[2]	*Jonga serrei*	◆	◆	◆		
Shrimp[2]	*Macrobrachium crenulatum*	◆	◆	◆	◆	◆
Shrimp[2]	*Macrobrachium faustinum*	◆	◆	◆	◆	◆
Shrimp[2]	*Micratya poeyi*	◆	◆	◆		
Shrimp[2]	*Potimirrim americana*	◆	◆	◆		
Shrimp[2]	*Potimirrim glabra*	◆	◆	◆		
Shrimp[2]	*Potimirrim mexicana*	◆	◆	◆		
Shrimp[2]	*Xiphocaris elongata*	◆	◆	◆		

1: There are some reports of populations located in reservoirs; may not be an obligate migrator.

2: No common name provided by USFWS or found in *Common and Scientific Names of Aquatic Invertebrates of the United States and Canada* published by the American Fisheries Society.

Site-Related Contamination

Aluminum, antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, selenium, and silver were reported in soils from the site at concentrations exceeding their mean concentrations in soils of the earth's crust (U.S. EPA 1983). Groundwater, surface water, and sediment samples have not yet been collected at the site or from off-site areas near the site. These data will be collected following completion of a planned removal of the most contaminated soils (Kwan 1997).

Surface soil samples collected during the 1989 site investigation were reported to have elevated concentrations of copper (403,000 mg/kg), antimony (633 mg/kg), and dioxins (110 ng/kg TCDD TEQ). Mercury, silver, toluene, fluoranthene, pyrene, and 4,4'-DDD were also reported in soil samples. Soil samples collected from burn areas during November 1994 had the following average trace element concentrations: aluminum (24,356 mg/kg), antimony (1,363 mg/kg), cadmium (329 mg/kg), copper (57,697 mg/kg), lead (16,410 mg/kg), and silver (20 mg/kg; CDM 1996). Table 2 presents results of a soil study conducted in 1994.

In a study conducted by the U.S. Environmental Protection Agency in March 1996, more than 230 soil samples were collected along grids set out in Zones 1, 2, and 4 and analyzed for copper and lead. The maximum reported copper concentration was 214,000 mg/kg, while that for lead was 116,000 mg/kg (CDM 1996).

Table 2. Maximum concentrations of trace elements detected in soils at the V&M/Albaladejo Farms Site in 1994 (CDM 1996) compared to their mean concentrations in U.S. soils (Lindsay 1979; Shacklette and Boerngen 1984).

Trace Element	Maximum Concentration, mg/kg	Frequency of Detection	Location	Mean Conc. in U.S. Soils[a], mg/kg
Antimony	2,600	16/16	Zone 2	0.5
Arsenic	250	16/16	Zone 4	5.2
Cadmium	40	16/16	Zone 2	0.06[b]
Chromium	170	16/16	Zone 2	37
Copper	240,000	16/16	Zone 1	17
Lead	68,000	16/16	Zone 4	16
Manganese	2,100	16/16	Zone 2	330
Mercury	0.36	14/16	Zone 4	0.06
Selenium	8.2	14/16	Zone 4	0.3
Silver	20	15/16	Zone 2	0.05[b]

a: Shacklette and Boerngen (1984)
b: Lindsay (1979; cadmium and silver represent average concentrations in the earth's crust)

Summary

Studies at the V&M site indicate that site soils are contaminated with trace elements, particularly antimony, arsenic, cadmium, silver, copper, and lead. No investigations examined contamination in on-site groundwater or in surface water and sediments of Río Indio, 650 m northwest of the site (and the nearest identified habitat that could support NOAA trust resources). Groundwater migration is the primary mechanism for potential transport of contaminants off-site to NOAA trust resources, although no studies have yet been conducted to verify this.

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3

Fort George G. Meade

Anne Arundel County, Maryland
CERCLIS #MD9210020567

Site Exposure Potential

Fort George G. Meade occupies approximately 5,500 ha in Anne Arundel County, Maryland, between Baltimore and Washington, D.C. (Figure 1). The Patuxent River, which drains the area, flows along the southern border of the facility. A tributary stream, the Little Patuxent River, flows through the facility and receives runoff from several waste sites (Figure 2). The Patuxent River enters the Chesapeake Bay approximately 100 km from Fort Meade.

In 1917 Congress authorized Fort Meade as a training facility. In 1988, the U.S. Army Base Realignment and Closure Act (BRAC) mandated the closure and/or realignment of approximately 3,600 ha encompassing the southernmost two-thirds of the installation (Figure 2). In 1991 the U.S. Army transferred 3,300 ha of the BRAC parcel to the Department of the Interior's Patuxent Wildlife Research Center for use as a wildlife refuge (ICF Kaiser 1997).

Table 1 lists waste sites that have been evaluated at Fort Meade, along with information about the dates of use and types of waste disposed at each site (ICF Kaiser 1997). The sites include six landfills, the Helicopter Hangar Area, the Defense Reutilization and Management Office (DRMO) Salvage Yard, the Fire Training Area, and the Ordnance Demolition Area. Materials

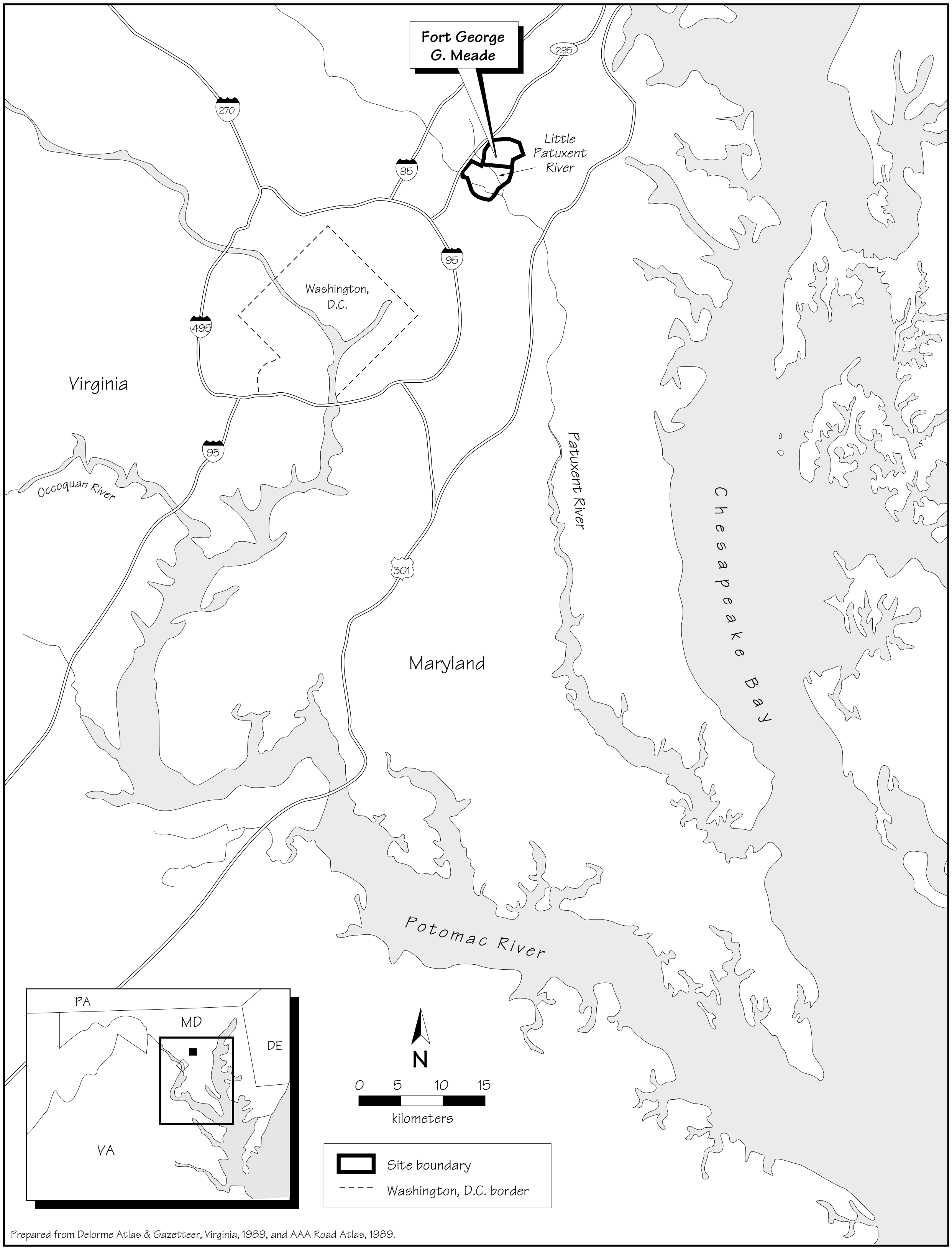

Figure 1. Location of Fort George G. Meade in Anne Arundel County, Maryland.

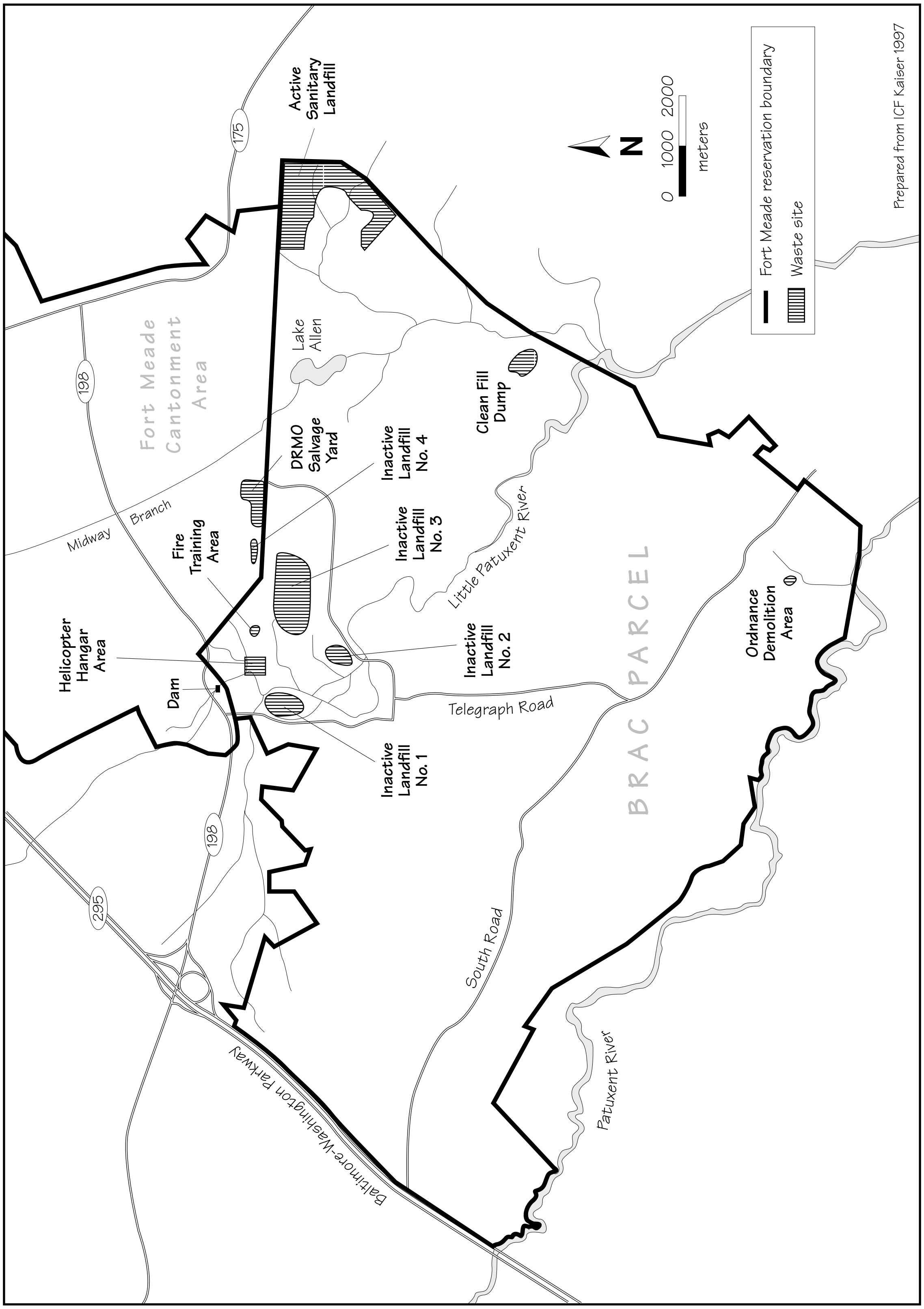

Figure 2. Detail of waste sites at Fort George G. Meade.

Table 1. Description of hazardous waste sites at FGGM.

Site Name	Dates	History of Use	Potential Migration Pathway
Inactive Landfill 1	1950-1964	Used as an unlined sanitary landfill. No information has been found regarding the types of material disposed.	Drainage is towards the Little Patuxent River. Eastern portions of the site are wetlands in the 100-year floodplain of the river. Shallow groundwater discharges to the wetlands and Little Patuxent River.
Inactive Landfill 2	1950s to 1980s	Operated as an unlined rubble-disposal facility.	Border of the landfill is approximately 75 m from the LIttle Patuxent River and drainage is towards the river. The area between IAL2 and the river includes wetlands within the 100-year floodplain. Groundwater flows radially from the site, following topography, and then towards the Little Patuxent River.
Inactive Landfill 3	Late 1940s and 1950s	Used as a sanitary and "leaf-dump" landfill. The Tipton Army Airfield was constructed over the fill area in 1963.	Runoff is conveyed from the site by drainageways towards the Little Patuxent River. An extensive stormwater collection system beneath the airfield directs water to french drains that lead to the Little Patuxent River. Groundwater flow is generally southwest towards the river.
Inactive Landfill 4	1950s to 1970s	Used primarily as a rubble disposal area.	A low-gradient drainage swale runs through the center of the site, conducting surface water runoff towards the Little Patuxent River. Groundwater flows to the west and southwest towards the Little Patuxent River.
Clean Fill Dump	1972 to 1985	Used for disposal of miscellaneous debris such as stumps, trees, logs, concrete, construction debris, old appliances, and soil. Other materials that may have been disposed here include garbage, food wastes, cans, bottles, ash, and possible hazardous materials. Uncontrolled dumping continued in marshy areas outside the main dump perimeter after 1985.	Landfill is drained by several unnamed streams and drainage swales, generally toward the Little Patuxent River, about 350 m to the south. Groundwater flows towards the river.
Active Sanitary Landfill	1958 to present	Used for disposal of sanitary wastes as well as petroleum wastes, pesticide wastes, and sewage sludges in three unlined cells.	Most of the landfill's surface water runoff flows into two retention ponds at the western boundary. These ponds discharge into a small stream that enters a tributary to the Little Patuxent River about 4 km from the landfill. Groundwater flow follows the topography of the site.
Helicopter Hangar Area	NA	Materials used or stored in this area include JP-4 fuel, hydraulic and lubricating oils, detergents, and solvents.	The Little Patuxent River is about 20 m northwest of the site. There are two outfalls from the HHA into the Little Patuxent River. Groundwater flows to the northwest.
Defense Reutilization and Management Office (DRMO) Salvage Yard	NA	Used as a storage area for a variety of equipment, including discarded vehicles, electrical transformers, electronic equipment, heating and cooling units, pipes, dumpsters, and scrap metals.	Located about 500 m from a tributary to Lake Allen, and about 1 km from the Little Patuxent River. Information on surface water runoff was not available. Groundwater flows from the site to the east and northeast.
Fire Training Area	1979 to present	Used for fire training. Fires are set using aviation fuel or gasoline and extinguished with either water or aqueous foam composed primarily of pressurized biological proteins.	Information on surface runoff or groundwater flow pathways from the site was not available. The site is located about 400 m from the Little Patuxent River.
Ordnance Demolition Area	NA	Used for demolition of obsolete ordnance.	A stream near the eastern berm of the site flows southward for about 750 m to the Patuxent River. Direction of groundwater flow is to the southwest.

used or disposed at these sites included municipal and domestic waste, pesticides, electrical transformers, solvents, PCBs, inert material, and waste oils and lubricants.

Surface water and groundwater are potential pathways for contaminant migration from the site. The Little Patuxent River flows southeast across Fort Meade along a broad, flat river valley with extensive wetlands. In general, much of the terrain at Fort Meade is low-lying. Approximately half of the BRAC parcel has been identified as wetlands, including portions of Inactive Landfill 1 (IAL1), Inactive Landfill 2 (IAL2), and the Clean Fill Dump. The Little Patuxent River flows near the borders of the Helicopter Hangar Area, IAL1, IAL2, and the Clean Fill Dump. Several unnamed tributaries also flow across Fort Meade. Table 1 describes surface water pathways for each of the identified waste sites.

There are groundwater aquifers at Fort Meade within several geologic formations consisting of unconsolidated sands, clays, and silts. There are three distinct aquifers at the site (the upper Patapsco, the lower Patapsco, and the Patuxent) separated by confining layers. Because the underlying formations dip towards the east and are progressively exposed, the surficial deposits vary. The regional groundwater flow is to the southeast, but local flow in the surficial deposits generally mirrors the topography. Soils within the BRAC parcel are primarily loamy and clayey underlain by an unstable clay of low permeability. Groundwater studies at the site indicate that the shallow sands aquifer is probably discharging to the Little Patuxent River (ICF Kaiser 1997).

NOAA Trust Habitats and Species

The primary habitats of concern to NOAA are surface water, stream bottom, and associated riparian zones of the Little Patuxent River, its tributaries, and the Patuxent River. Anadromous and catadromous fish species that use the streams are the resources of concern to NOAA (EA Engineering 1992; Table 2).

The Little Patuxent River is a medium-sized, warmwater stream with a warmwater resident fish population dominated by river chub, shiners, and sunfish. The stream is typically 15 to 23 m wide and 0.6 to 2.5 m deep as it traverses Fort Meade. Slow-flowing runs dominate this portion of the stream with smaller areas of riffle/pool habitat. Sediments range from cobble to silty sands. Extensive hardwood wetlands are located along the river on the Fort Meade property. Overcup oak stands dominate in areas submerged for most of the year, while red maple, sweetgum, and red ash are prevalent in areas that are seasonally flooded (EA Engineering 1992).

Several anadromous species use the Little Patuxent River during their spawning runs in the spring, including white perch, hickory shad, alewife, and blueback herring. Before 1991, the

Table 2. Major NOAA trust species that use the Little Patuxent River and Patuxent River near Fort Meade.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
Alewife	*Alosa pseudoharengus*	♦	♦			
American eel	*Anguilla rostrata*		♦	♦		
Blueback herring	*Alosa aestivalis*	♦	♦			
Hickory shad	*Alosa mediocris*	♦	♦			
Striped bass	*Morone saxatilis*	♦*	♦*	♦*		♦
White perch	*Morone americana*	♦	♦			♦

* Striped bass are found in the lower Patuxent River and estuary approximately 30 km downstream of FGGM. They are not found near the site.

Fort Meade Dam, located on the facility, was the upstream extent of migratory runs in the river. In 1991, fish passage facilities were constructed, allowing passage to areas upstream of Fort Meade. The catadromous American eel is a common, year-round resident of the Little Patuxent River. In a 1992 fish survey, eels were collected at all Fort Meade stream stations (EA Engineering 1992).

The Patuxent River is a large, warmwater stream typically about 30 m wide and 0.6 to 3 m deep. The river at the site is low-gradient, dominated by slow-flowing runs; bottom substrates range from sands to silts with a few areas of cobble. The riparian zone of the Patuxent River near Fort Meade is dominated by hardwood wetlands of the type seen on the Little Patuxent (EA Engineering 1992). The anadromous species that spawn in the Little Patuxent River are also found in the Patuxent River next to the site during spawning runs. Striped bass, another anadromous species, is abundant in the lower Patuxent River, but is restricted to tidal portions, 30 km or more downstream of the site. American eel are found throughout the Patuxent and Chesapeake basins (Stone et al. 1994).

There are extensive recreational and commercial fisheries in the lower Patuxent River and estuary, but not adjacent to the site. Recreational fisheries in several ponds and small impoundments on Fort Meade are stocked with catfish, bluegill, and largemouth bass. No Federal threatened or endangered aquatic species are present in the Little Patuxent and Patuxent rivers near Fort Meade. There are no consumption advisories for the basin (EA Engineering 1992).

Site-Related Contamination

This report summarizes results from the most recent sampling conducted at each of the hazardous waste sites at Fort Meade. At IAL1, IAL2, IAL3, and the Clean Fill Dump, the most recent sampling was conducted in 1996 as part of a remedial investigation for those areas (ICF Kaiser 1997). A 1995 site inspection contained the most recent results for the Helicopter Hangar Area, the DRMO Salvage Yard, the Fire Training Area, and the Ordnance Demolition Area (Arthur D. Little 1995). The most recent sampling at the Active Sanitary Landfill was conducted in 1993 for the remedial investigation (Arthur D. Little 1994). For IAL4, the most recent sampling results were presented in a 1992 site inspection study (EA Engineering 1992).

Table 3 presents the maximum concentrations of contaminants detected in groundwater and soils throughout Fort Meade during the investigations, along with the areas where the maximum concentrations were detected.

The highest concentrations of trace elements in groundwater were in samples collected from the Helicopter Hangar Area, the Active Sanitary Landfill, and the Clean Fill Dump. Groundwater seep samples collected from the Active Sanitary Landfill contained elevated concentrations of a number of trace elements. Soils containing the highest concentrations of trace elements were collected from IAL3 and the Clean Fill Dump. In general, soil and groundwater samples exceeded screening guidelines for trace elements at Fort Meade areas so infrequently and sporadically that gradients of contamination were not apparent.

Pesticides were most frequently detected in soils and groundwater at the landfill areas. Explosive compounds were detected in groundwater but not in soils at the Ordnance Demolition Area and at IAL3. PCBs are the primary contaminants of concern at the DRMO Salvage Yard. Aroclor 1260 was detected in five of six soil samples collected at the salvage yard in 1993 at concentrations ranging from 0.27 to 4 mg/kg (Arthur D. Little 1995). During a previous investigation in 1991, total PCBs were detected at a maximum concentration of 93 mg/kg in the southernmost area of the DRMO Salvage Yard, an area that was not sampled in 1993 (Arthur D. Little 1995). PCBs were not detected in groundwater at the salvage yard, but detection limits were not available.

Surface water and sediment samples have been collected from drainages and tributaries associated with the following areas: IAL1, IAL2, IAL3, IAL4, the Active Sanitary Landfill, the Clean Fill Dump, the Helicopter Hangar Area, and the Fire Training Area (EA Engineering 1992; Arthur D. Little 1994; ICF Kaiser 1997). In addition, during the 1996 RI (ICF Kaiser 1997), sediment and surface water samples were collected from the Little Patuxent River along a stretch from the Helicopter Hangar Area to the Clean Fill Dump. Maximum concentrations of contaminants in surface water and sediment detected during those studies are shown in Table 4, along with the areas

Table 3. Maximum concentrations of contaminants in groundwater and soils detected during recent investigations, locations of maximum concentrations, and water and soil screening guidelines.

	Groundwater	Location	AWQC[a]	Soils	Location	Mean U.S.[b]
Trace Elements (µg/L or mg/kg)						
Arsenic	270	HHA	190	14	IAL3	5.2
Cadmium	35	HHA	1.1[c]	3.0	CFD	0.06
Copper	380	HHA	12[c]	70	CFD	17
Lead	220	HHA	3.2[c]	1,000	CFD	16
Mercury	1.2	ASL	0.012	1.2	IAL3	0.06
Nickel	1,100	ASL	160	40	CFD	13
Silver	ND	--	0.12	3.3	IAL3	0.05
Zinc	8,200	CFD	110[c]	750	CFD	48
PCBs						
Total PCBs	ND	--	0.014	93	DSY	NA
Pesticides (µg/L or µg/kg)						
Gamma chlordane	0.0085	IAL1	0.0043[d]	0.21	CFD	NA
Alpha chlordane	0.012	IAL1	0.0043[d]	ND	--	NA
DDT	0.12	IAL1	0.001	1.2	CFD	NA
DDE	ND	--	NA	0.26	CFD	NA
DDD	0.029	IAL1	NA	0.68	IAL3	NA
Endosulfan II	0.01	CFD	0.056[e]	0.015	CFD	NA
Endrin	0.039	IAL1	0.0023	0.082	CFD	NA
Other Organic Compounds (µg/L or µg/kg)						
RDX	84	ODA	NA	ND	--	NA
HMX	9.1	ODA	NA	ND	--	NA
1,3,5-Trinitrobenzene	0.68	IAL3	NA	ND	--	NA
2,4,6-Trinitrotoluene	7.8	IAL3	NA	ND	--	NA
2,4-Nitrotoluene	0.62	ODA	NA	ND	--	NA
4-Nitrotoluene	2.2	IAL3	NA	ND	--	NA
2-Amino-4,6-dinitrotoluene	0.52	IAL3	NA	ND	--	NA
4-Amino-2,6-dinitrotoluene	32	IAL3	NA	ND	--	NA

a: Ambient water quality criteria for the protection of aquatic organisms. Freshwater chronic criteria presented (EPA 1993).
b: Shacklette and Boerngen (1984), except for cadmium and silver which represent average concentrations in the earth's crust from Lindsay (1979).
c: Hardness-dependent criteria; 100 mg/L $CaCO_3$ assumed.
d: Chlordane value used.
e: Endosulfan value used.
ND: Not detected; detection limit not available.
NA: Screening guidelines not available.
ASL: Active Sanitary Landfill
CFD: Clean Fill Dump
HHA: Helicopter Hangar Area
IAL1: Inactive Landfill 1
IAL3: Inactive Landfill 2
ODA: Orndance Demolition Area

Table 4. Maximum concentrations of contaminants in surface water and sediment detected during recent investigations; locations of maximum concentrations; and water and sediment screening guidelines.

	Surface Water µg/L	Location	AWQC[a] µg/L	Sediment mg/kg	Location	ERL[b] mg/kg
Trace Elements						
Arsenic	2.6	ASL stream	190	14	AL4 drainage swale	8.2
Cadmium	ND	--	1.1[c]	1.8	IAL3[d]	1.2
Chromium	47	CFD tributary	11	24	HHA Little Patuxent R.	81
Copper	36	CFD tributary	12[c]	70	IAL4 drainage swale	34
Lead	37	CFD tributary	3.2[c]	170	IAL4 drainage swale	46.7
Mercury	ND	--	0.012	0.51	IAL4 drainage swale	0.15
Silver	0.149	IAL1 east marsh	0.12	4.8	CFD tributary	1.0
Zinc	145	CFD tributary	110[c]	180	CFD tributary	150
PCBs						
Aroclor 1260	ND	--	0.014	0.51	IAL4 drainage swale	0.0027
Pesticides						
Chlordane	ND	--	NA	0.15	CFD tributary	NA
DDD	ND	--	NA	2.0	IAL4 drainage swale	0.0016[e]
DDE	ND	--	NA	0.14	IAL4 drainage swale	0.0022
DDT	ND	--	0.001	0.15	IAL4 drainage swale	0.0016[e]
Dieldrin	ND	--	NA	0.015	IAL4 drainage swale	NA
Endosulfan II	0.0065	IAL2 marsh	NA	0.072	CFD tributary	NA
Endrin	ND	--	0.0023	0.022	CFD tributary	NA
Endrin ketone	0.0093	IAL2 marsh	0.0023[f]	ND	--	NA

a: Ambient water quality criteria for the protection of aquatic organisms. Freshwater chronic criteria presented (EPA 1993).
b: Effects range-low; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1995).
c: Hardness-dependent criteria; 100 mg/L $CaCO_3$ assumed.
d: Sampling location at IAL3 was not available.
e: Total DDT value used.
f: Endrin value used.
ND: Not detected; detection limit not available.
NA: Screening guidelines not available.
ASL: Active Sanitary Landfill
CFD: Clean Fill Dump
HHA: Helicopter Hangar Area
IAL1-4: Inactive Landfills 1-4

where the maximum concentrations were detected.

For trace elements in surface water, most of the AWQC exceedances were detected in a tributary near the Clean Fill Dump. Concentrations of trace elements in surface water of the Little Patuxent River did not exceed AWQCs. For sediment, the highest concentrations of trace elements were primarily found in a drainage swale at IAL4 and in a tributary near the Clean Fill Dump. In the Little Patuxent River, concentrations of arsenic (12 mg/kg) and silver (3.4 mg/kg) exceeded their respective ERL concentrations.

Pesticide screening guidelines for surface water and sediment were occasionally exceeded in drainages or tributaries but, overall, pesticides were infrequently detected. Pesticides that exceeded their sediment screening guidelines in the Little Patuxent River were DDD (0.012 mg/kg) and DDE (0.0079 mg/kg). Sediment samples collected from IAL4 and CFD contained the highest concentrations of pesticides relative to ERL concentrations. Gradients of contamination were not apparent. PAHs were not detected at concentrations above screening guidelines in surface water or sediment. Concentrations of PCBs in sediment infrequently exceeded the screening guidelines.

Summary

Several waste sites at Fort Meade have drainage pathways leading directly to the Little Patuxent River. Concentrations of a variety of contaminants in streams and wetlands associated with waste sites have been found to exceed screening guidelines, although exceedances were infrequent and sporadic. The Little Patuxent River and Patuxent River near the site are used by several anadromous fish, including white perch, hickory shad, alewife, and blueback herring. These species may be exposed to contamination from waste sites at Fort Meade.

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3

Norfolk Naval Base

Norfolk, Virginia
CERCLIS #VA6170061463

Site Exposure Potential

Norfolk Naval Base, part of the Sewells Point Naval Complex, occupies approximately 1900 ha directly northwest of Norfolk, Virginia (Figure 1). Mason Creek borders the area along the base's eastern boundary; the junction of the Elizabeth and James rivers (Hampton Roads) borders the site on the west; and the remnants of Bousch Creek and a network of ditches drain the central portion of the facility (Figure 2). Willoughby Bay forms the northern border of the site and enters Chesapeake Bay approximately 1.5 km northeast of Norfolk Naval Base.

Norfolk Naval Base began operating in 1917 as a support base for World War I activities. The base provides fleet support for the U.S. Atlantic fleet, shore facilities and support for U.S. military vessels and aircraft, and service and maintenance for ships and aircraft. Many hazardous substances have been used, generated, and discarded at the property. These substances include various chlorinated organic solvents, sludges from metal plating processes, parts cleaning and paint stripping wastes, acids, heavy metals, and pesticides (Baker Environmental, Inc. 1994).

Under the Department of Defense Installation Restoration Program, 22 sites on the base were identified as potentially contaminated. Data were available for four source areas: the Camp Allen

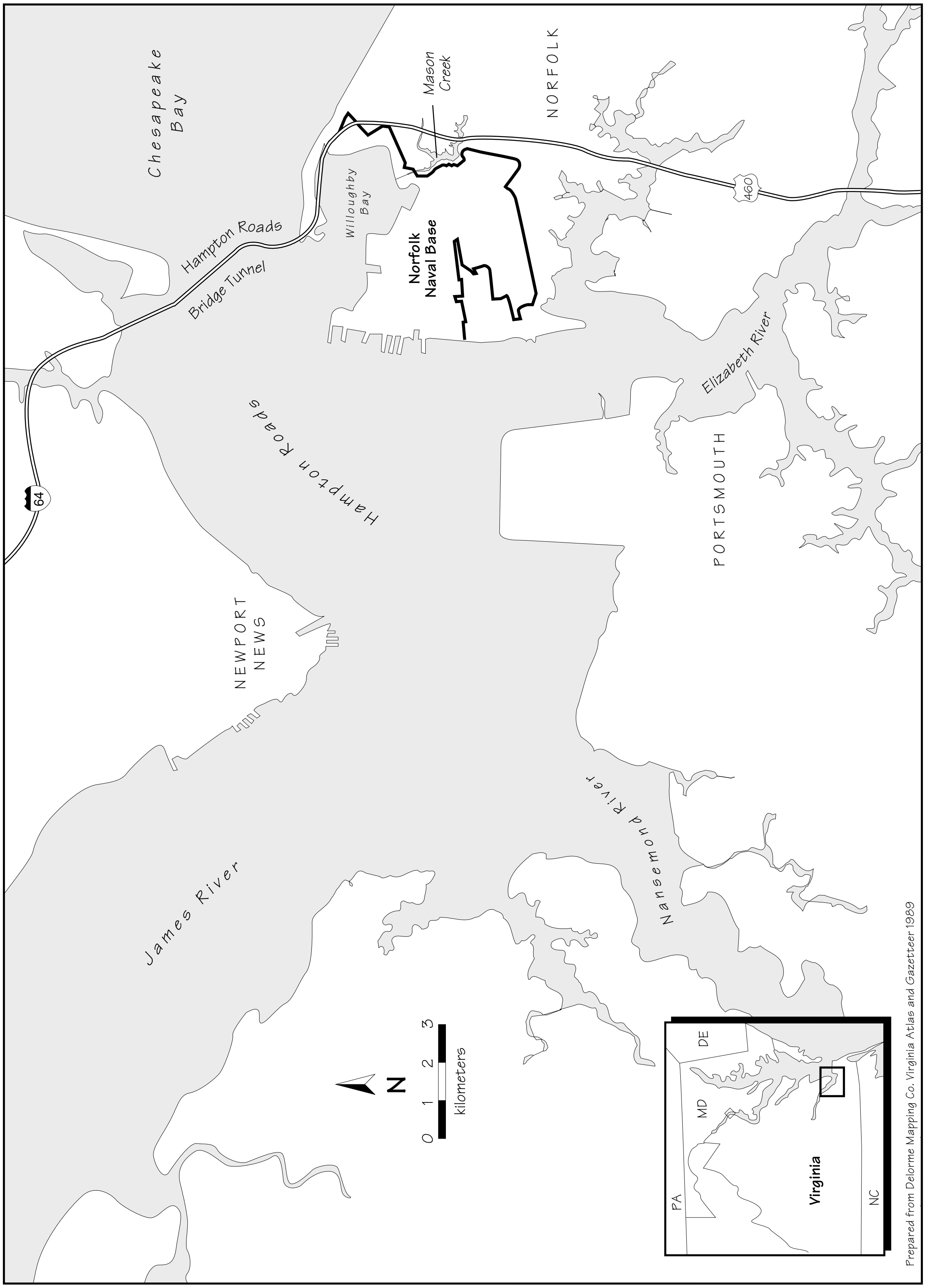

Figure 1. *Location of Norfolk Naval Base in Norfolk, Virginia.*

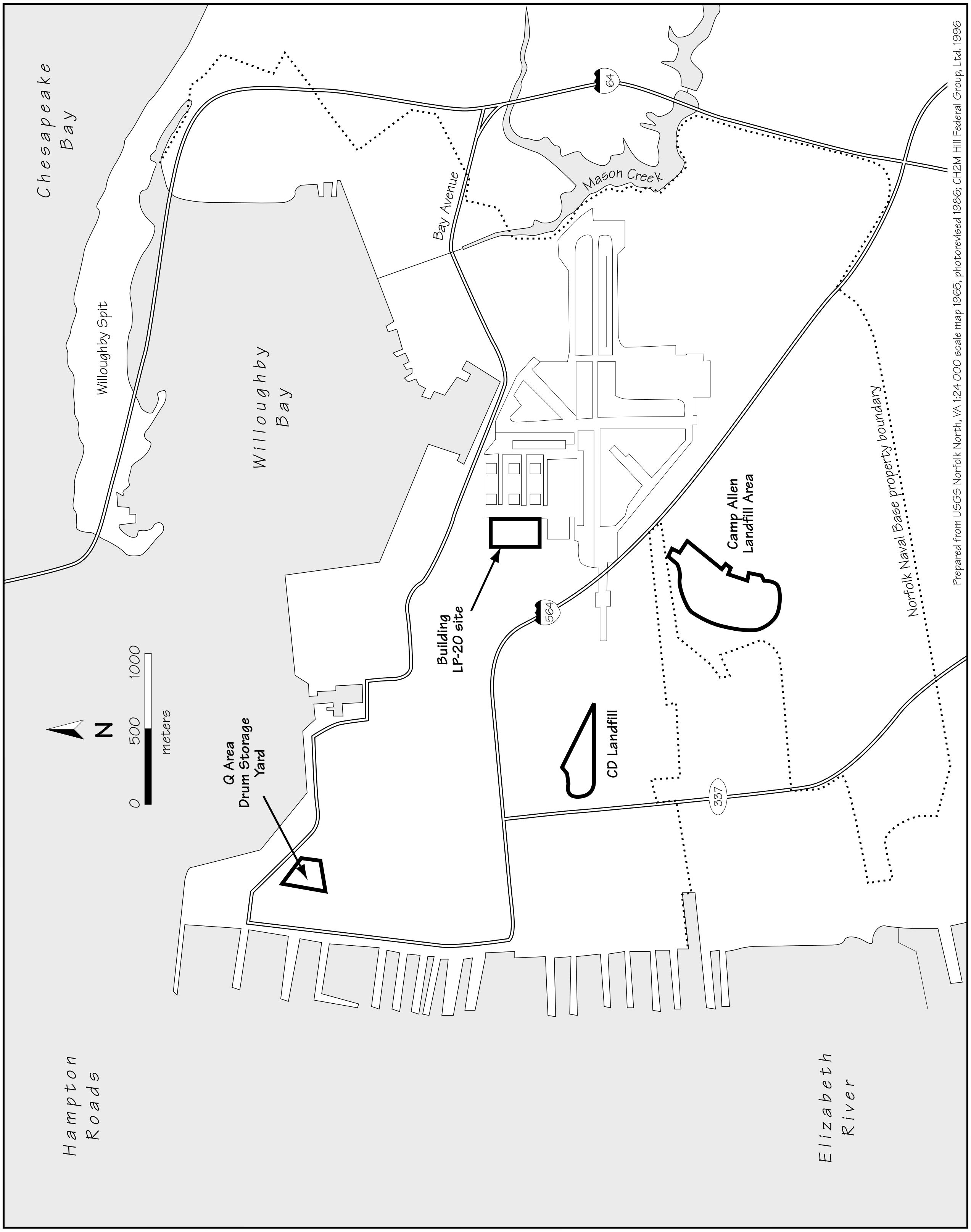

Figure 2. Detail of Norfolk Naval Base

Landfill, the Q Area Drum Storage Yard (QADSY), the CD Landfill, and the Building LP-20 site. Table 1 lists the dates of use, types of wastes disposed, and remediation activities for these sites. The limited information available for the remaining sites indicated that cleanup was completed on five sites, while ten areas were determined to require no cleanup action (CH2M HILL Federal Group, Ltd. 1996).

Surface water runoff and groundwater migration are the potential pathways for contaminant transport from site areas to NOAA resources and associated habitats. Norfolk Naval Base is located on a nearly level plain, with surface elevations ranging from sea level to about 5 m above sea level at the central portion of the facility. The principal surface drainage feature at the site is the network of drainage ditches rerouting and replacing the Bousch Creek system that once covered most of the base. The outfalls from this drainage system end in Mason Creek, the Elizabeth River, and Willoughby Bay. No diagrams of this drainage system were found in any of the reviewed reports, although Table 1 lists the specific surface water pathways that were identified for each source area.

Groundwater at the base is present at 2 to 2.5 m bgs in the unconfined Columbia aquifer, which consists of thin, discontinuous layers of heterogeneous sand and shell lenses. The underlying Yorktown aquifer is confined by beds of silt and clay, which may be breached or absent in localized areas of the site due to erosion by meandering streams and rivers. Area groundwater is tidally influenced. In the central and northern portions of the base, groundwater flows generally east and northeast. On the east side of the base, groundwater appears to flow west and northwest toward the main drainage culvert. In the southwestern quarter of the base, groundwater flows south and southeast, again toward surface drainage features (Baker Environmental, Inc. 1995a).

NOAA Trust Habitats and Species

Habitats of primary concern to NOAA are surface waters and associated bottom substrates of the lower Elizabeth River and Hampton Roads, an estuarine area where the Elizabeth, James, and Nansemond rivers meet Chesapeake Bay. Anadromous fish, estuarine fish, and invertebrates use the estuary and are the resources of concern to NOAA (Table 2). Estuarine waters of this area range from extensive shallow flats generally less than 3 m deep to trenches up to 30 m deep (USGS 1964, 1965). Salinities range from 15 to 20 ppt and sediments range from silts to sands (Majumdar et al. 1987).

The estuary provides nursery and adult habitat for many estuarine and marine fish. Estuarine residents include bay anchovy, oyster toadfish, sheepshead minnow, killifishes, silversides, pipefish, gobies and hogchoker. These species spend all life stages within the estuary; several are highly abundant. Species such as bluefish, mullet, pinfish, butterfish, and the sciaenids (croaker,

Table 1. Description of hazardous waste sites at Norfolk Naval Base.

Site Name	Dates	History of Use	Contaminants of Concern	Potential Migration Pathway
Camp Allen Landfill	early 1940s - 1974	Unlined landfill used to dispose of municipal, solid, and hazardous wastes. Soil removal completed and long-term groundwater pump and treatment being implemented. Most of area capped and revegetated to minimize surface erosion.	Chlorinated organic sovents, metals, pesticides, and an estimated 150 kg metals plating sludge, 230 kg parts cleaning sludge, and 1,500 kg paint stripping residue.	Surface water runoff is channelled into Willoughby Bay by drainage ditches surrounding the site. Groundwater flows north and northeast towards Willoughby Bay and Mason Creek. The Camp Allen Landfill is 1.5 km south of Willoughby Bay.
Q Area Drum Storage Yard	1950s - present	Storage of 55-gallon steel drums including an area for damaged and leaking drums.	Petroleum products (oil lubricants, hydraulic fluid), chlorinated organic solvents, paint thinners, pesticides, formaldehyde, and acids.	Surface runoff is directed into numerous open storm drains that lead directly to the Elizabeth River to the west and Willoughby Bay to the north. Groundwater discharge also flows to the Elizabeth River and Willoughby Bay. QADSY is about 350 m from both the Elizabeth River and Willoughby Bay.
CD Landfill	1974 - 1987	Unpermitted landfill from 1974 to 1979, used for disposal of ash residues, sandblasting grit, and spent rice hulls. Permitted landfill from 1979 to 1987 for disposal of demolition wastes and non-putrescible wastes. Closure plan submitted in 1988. Capped with thin layer of soil and vegetation.	Cadmium- and lead-contaminated sandblasting grit and rice hulls. Possibly, additional chemicals were disposed.	Two unlined drainage ditches surrounded by wetlands border the site to the north and south. They flow eastward into culverts beneath the Naval Air Station that convey surface water runoff to Willoughby Bay. Groundwater flow is northwest towards the Elizabeth River and Willoughby Bay. CD Landfill is about 1 km east of the Elizabeth River and 1.8 km south of Willoughby Bay.
Building LP-20 Site (Buildings LP-20, LP-22, LP-24, and U-132)	early 1940s - present	Aircraft paint shops, testing facilities, blasting booths, cleaning shop, repair shops, hazardous waste storage, and metal plating shops.	Heavy metals, acids, chlorinated solvents, VOCs, and petroleum products.	Storm sewers are used to drain the area to Willoughby Bay. Groundwater movement in this area is northeast towards Willoughby Bay, although the Bousch Creek culvert beneath the base may affect groundwater flow patterns. The Building LP-20 site is about 750 m southwest of Willoughby Bay.

Table 2. NOAA trust fish and invertebrate species that use the Elizabeth River, Hampton Roads and Chesapeake Bay.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS						
Alewife	*Alosa pseudoharengus*		♦			
American eel	*Anguilla rostrata*		♦		♦	
American shad	*Alosa sapidissima*		♦			
Atlantic sturgeon	*Acipenser oxyrhynchus*		♦	♦		
Blueback herring	*Alosa aestivalis*		♦			
Striped bass	*Morone saxatilis*		♦	♦	♦	
White perch	*Morone americana*		♦	♦		
MARINE/ESTUARINE FISH SPECIES						
Atlantic croaker	*Micropogonias undulatus*		♦	♦		♦
Atlantic herring	*Clupea harengus*		♦	♦		
Atlantic menhaden	*Brevoortia tyrannus*		♦	♦		
Bay anchovy	*Anchoa mitchilli*		♦	♦		
Black drum	*Pogonias cromis*		♦	♦		
Black sea bass	*Centropristis striata*		♦	♦		
Bluefish	*Pomatomus saltatrix*		♦	♦		♦
Butterfish	*Peprilus triacanthus*		♦	♦		
Cownose ray	*Rhinoptera bonasus*		♦	♦		
Gobies	*Gobiosama spp.*	♦	♦	♦		
Hogchoker	*Trinectes maculatus*	♦	♦	♦		
Killifish	*Fundulus spp.*	♦	♦	♦		
Mullets	*Mugil spp.*		♦			
Northern pipefish	*Syngnathus fuscus*	♦	♦	♦		
Northern searobin	*Prionotus carolinus*		♦			
Pinfish	*Lagodon rhomboides*		♦	♦		
Red drum	*Sciaenops ocellatus*		♦	♦		♦
Red hake	*Urophycis chuss*		♦			
Oyster toadfish	*Opsanus tau*	♦	♦	♦		
Scup	*Stenotomus chrysops*		♦			
Sheepshead minnow	*Cyprinodon variegatus*	♦	♦	♦		
Silversides	*Menidia spp*	♦	♦	♦		
Skates	*Raja spp.*		♦	♦		
Spot	*Leiostomus xanthurus*		♦	♦		♦
Spotted seatrout	*Cynoscion nebulosus*		♦	♦		♦
Summer flounder	*Paralichthys dentatus*		♦	♦		♦
Tautog	*Tautoga onitis*		♦	♦		
Weakfish	*Cynoscion regalis*		♦	♦		♦
Windowpane flounder	*Scophthalmus aquosus*		♦	♦		
INVERTEBRATE SPECIES						
Bay shrimp	*Crangon septemspinosa*	♦	♦	♦		
Blue crab	*Callinectes sapidus*	♦	♦	♦	♦	♦
Blue mussel	*Mytilus edulis*	♦	♦	♦		
Eastern oyster	*Crassostrea virginica*	♦	♦	♦		♦[1]
Grass shrimp	*Palaemonetes pugio*	♦	♦	♦		
Northern quahog	*Mercenaria spp.*	♦	♦	♦		♦[1]

[1]: Bivalve harvests in Hampton Roads are restricted in areas surrounding the Naval Station.

weakfish, seatrout, spot, drum) are coastal spawners; eggs and larval stages drift offshore and later juvenile stages migrate into the estuary. Because many of these species are long-lived, juveniles may spend several years in the estuary. Adults of several of the species also use the estuary seasonally. Bluefish, spot, and Atlantic croaker are particularly abundant in the area (Stone et al. 1994).

Several anadromous fish use the estuary as a migratory corridor, juvenile nursery, and adult habitat. Juvenile and adult white perch are abundant in the estuary. The adults spawn in freshwater upstream of the base, and both juveniles and adults reside in the estuary. Striped bass, particularly juvenile stages, are common in the estuary. Adults may spend time in the area as well, but many move seaward. American shad, blueback herring, and alewife spawn in the freshwater upstream of the base. Juveniles use the estuary as a nursery but usually migrate seaward as adults. Atlantic sturgeon are considered rare near the base and in Chesapeake Bay. The catadromous American eel is found throughout the Chesapeake basin, and juvenile life stages are present near the site (Stone et al. 1994).

Several invertebrates use the estuary, including blue crab, grass shrimp, eastern oyster, and northern quahog. Juvenile and adult blue crab are abundant; mating and larval stages are also seen in the estuary, although females usually migrate to coastal waters to brood and release eggs. Grass shrimp, oyster, and quahog spend all life stages in the estuary (Stone et al. 1994).

There are substantial commercial and recreational fisheries in the Hampton Roads portion of Chesapeake Bay. Popular recreational catches include bluefish, croaker, spot, weakfish, flounder, blue crab, oyster, and quahog (Majumdar et al. 1987). The total landings for 1996 for the Elizabeth River were over 100,000 kg. The bulk of the commercial harvest is for blue crab, but American eel and striped bass also support substantial commercial fisheries (O'Reilly 1997). Bivalves are harvested in other areas of Hampton Roads, but are restricted surrounding the base because of industrial runoff (Wright 1997).

Site-Related Contamination

Data collected during several site investigations indicate that soils, groundwater, surface water, and sediments at the Norfolk Naval Base are contaminated in varying degrees with trace elements, pesticides, and organic compounds, including PAHs, VOCs, and SVOCs. Separate investigations were conducted for each source area. The most recent data used to determine maximum contaminant concentrations for each area came from remedial investigations in 1990-1993 for the QADSY (Environmental Science & Engineering, Inc. 1994), in 1992-1993 for the Camp Allen Landfill (Baker Environmental, Inc. 1994), in 1993-1994 for the CD Landfill (Baker Environmental, Inc. 1995a), and 1994-1995 for the Building LP-20 site (Baker Environmental, Inc. 1995b). Table 3 summarizes maximum

Table 3. Maximum concentrations of contaminants in soils, groundwater, surface water, and sediments at Norfolk Naval Base.

	Soils (mg/kg)	Location	Mean U.S.[a] (mg/kg)	Ground-water (µg/L)	Location	Surface Water (µg/L)	Location	AWQC[b] (µg/L)	Sediment (mg/kg)	Location	ERL[c] (mg/kg)
Trace Elements											
Arsenic	270	QADSY	5.2	340	QADSY	64	CAL	36	590	CAL	8.2
Cadmium	89	CAL	0.06	96	QADSY	NA	--	1.1	180	CAL	1.2
Chromium	1,000	CDL	37	1,100	QADSY	300	CDL	11	3,000	CAL	81
Copper	3,100	CDL	17	380	CAL	450	CAL	12	500	CDL	34
Lead	3,200	CDL	16	1,000	CAL	800	CAL	3.2	1,000	CAL	46.7
Mercury	0.84	CDL	0.058	3	CAL	3.9	CAL	0.012	3	CAL	0.15
Nickel	520	CDL	13	430	CAL	250	CDL	8.3	340	CDL	20.9
Silver	180	CDL	0.05	12	LP20	12	CAL	0.12	110	CAL	1.0
Zinc	6,200	CDL	48	1,600	QADSY	2,600	CDL	86	700	CDL	150
Pesticides/PCBs											
Dieldrin	0.051	CDL	NA	0.04	CDL	0.035	CDL	0.002	0.12	CDL	NA
4,4'-DDE	0.035	CDL	NA	ND	--	ND	--	14[d]	0.18	CDL	0.0016[e]
4,4'-DDT	0.010	CDL	NA	0.02	CDL	ND	--	0.001	0.11	CDL	0.0016[e]
Total PCBs	3.4	CAL	NA	ND	--	ND	--	0.014	1.5	CAL	0.023
Other Organic Compounds											
Benzene	0.25	CAL	NA	860	LP20	12	CAL	700[d]	ND	--	NA
1,1-dichloroethene	0.42	CAL	NA	3,600	LP20	3	CAL	NA	ND	--	NA
1,2-dichloroethene	1.5	QADSY	NA	28,000	LP20	46	CAL	NA	ND	--	NA
Toluene	3,000	CAL	NA	4,400	LP20	ND	--	5,000[d]	ND	--	NA
Trichloroethene	3.1	CAL	NA	54,000	LP20	45	CAL	2,000[d]	0.013	CDL	NA
Vinyl chloride	ND	--	NA	15,000	LP20	22	CAL	NA	ND	--	NA
Acetone	5.4	LP20	NA	1,300	QADSY	ND	--	NA	0.27	CDL	NA
Dibenzofuran	1.7	CAL	NA	7	CAL	ND	--	NA	8.4	CDL	NA
Xylene (total)	340	CAL	NA	180	LP20	3	CAL	NA	0.002	CDL	NA
Total PAHs	55	LP20,CAL	NA	110	LP20, CAL, CDL	ND	--	NA	540	CDL	4.0

a: Shacklette and Boerngen (1984), except for cadmium and silver which represent average concentrations in the earth's crust from Lindsay (1979).
b: Quality Criteria for Water (EPA 1993). Lowest value was chosen from fresh and marine water criteria because stream is tidally influenced.
c: Effects range-low; the concentration representing the lowest 10 percentile value for the data in which effects were predicted in studies compiled by Long et al. (1995).
d: Lowest Observed Effect Level (EPA 1993).
e: ERL for total DDT.
ND: Not detected; detection limit not available.
NA: Screening guidelines not available; data not available.
CAL: Camp Allen Landfill.
CDL: CD Landfill.
LP20 Building LP-20 site.
QADSY: Q Area Drum Storage Yard.

concentrations of contaminants, as well as the source area where each contaminant was found in the greatest concentration, along with applicable screening guidelines.

Not all media were analyzed in all of the remedial investigations. No surface water samples were taken in the QADSY investigation, and no surface water or sediment samples were collected at the Building LP-20 site. All surface water and sediment data reported in Table 3 were collected from the Bousch Creek drainage system near the Camp Allen Landfill.

The highest concentrations of trace elements in soils were from the CD Landfill, except for arsenic and cadmium, which were found at the highest concentrations at the QADSY and Camp Allen Landfill, respectively. In groundwater, the highest concentrations were found at the QADSY, Camp Allen Landfill, and the Building LP-20 site. Maximum concentrations in surface water and sediments were detected at the Camp Allen Landfill and the CD Landfill. Maximum on-site concentrations of trace elements were greater than all screening guidelines for soils, surface water, and sediments. Groundwater concentrations were greater than ten times the AWQC for all reported inorganic substances except arsenic.

Maximum concentrations of pesticides in all media were found at the CD Landfill. Dieldrin concentrations exceeded AWQC guidelines by more than ten times in groundwater and surface water. DDT concentrations in groundwater were greater than ten times the AWQC, and concentrations of DDT and DDE in sediments exceeded the ERL guidelines. PCBs were found at elevated concentrations in soil and sediment samples taken from the Camp Allen Landfill area. Values for total PCBs represent the sum of Aroclors 1242, 1254, and 1260. The maximum concentration of total PCBs in sediment exceeded the ERL guideline; there is no screening guideline for total PCBs in soils.

A variety of other organic compounds were detected in all media. Total PAH results represent the sum of acenaphthene, anthracene, benz(a)anthracene, benzo(b) and/or (k)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. The highest concentrations of PAHs in soils were found at the Building LP-20 site and the Camp Allen Landfill. Maximum concentrations of other organic compounds in soils were from the Camp Allen Landfill, the QADSY, and the Building LP-20 site. There are no screening guidelines for any of the organic compounds detected in soils. Elevated concentrations of organic compounds were detected in groundwater samples from the Building LP-20 site, the QADSY, and the Camp Allen Landfill. Few organic compounds were detected in surface waters; those detected were found at the Camp Allen Landfill. Existing LOEL concentrations for organic compounds other than pesticides and PCBs were not exceeded in surface water, but were exceeded in groundwater by more than ten times for one contaminant, trichloroethene. Total PAH concentrations exceeding ERL guidelines were found in sediments from the CD

Landfill source area. All other PAH compounds detected in sediments were also from the CD Landfill, although no screening guidelines exist for these constituents.

Summary

Elevated concentrations of trace elements, PAHs, chlorinated solvents, pesticides, and PCBs have been detected in soils, groundwater, surface water, and sediments to varying degrees at Norfolk Naval Base. Several of these contaminants were detected at concentrations that far exceed their screening guidelines. NOAA trust habitats bordering the site include the lower Elizabeth River and Hampton Roads, both of which support many anadromous fish, estuarine fish, and invertebrate species. The resources of concern use the waterways as migratory corridors, juvenile nurseries, and adult habitats.

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3

Salford Quarry

Lower Salford Township, Pennsylvania
CERCLIS #PAD980693204

Site Exposure Potential

The Salford Quarry site covers about 1.2 ha in Lower Salford Township, Montgomery County, Pennsylvania (Figure 1). The quarry is excavated into the side of a hill about 100 m east of the West Branch Skippack Creek, which joins the mainstem Skippack Creek about 1 km downstream (Figure 2). Perkiomen Creek receives flow from Skippack Creek approximately 13 km downstream from the site and then flows an additional 4 km to the Schuylkill River (Figure 2). The Schuylkill River extends another 45 km to tidal portions of the lower Delaware River, which flows into the Atlantic Ocean approximately 160 km farther downstream.

The site was a shale quarry in the early 1900s. In the 1950s, the quarry was used to dispose of two to five truckloads per day of industrial, commercial, and residential wastes from the Ludwig & Son waste disposal business. In 1963, American Olean Tile (AOT) purchased the quarry to landfill waste from its Lansdale, Pennsylvania plant, and began accumulating waste sludges onsite in two 10,000-gallon fuel oil storage tanks (ENVIRON 1990). In 1973, AOT started bringing most of their lead-containing slurries to the quarry. During this time, an undetermined amount of fly ash cinders from a coal-fired power plant also were disposed at the site (Brown et al. 1992). AOT stopped using the quarry for waste

Figure available in hard copy

Figure available in hard copy

disposal in about 1980, and reported that about 6,500 tons of waste had been discarded at the site (Brown et al. 1992). In 1982, a clay cap was installed to reduce infiltration.

Wastes brought to the site include glaze wash-up sludge, settling pond sediment, and fired and unfired scrap tiles. These wastes contain trace elements and boron oxides (ENVIRON 1990; Brown et al. 1992).

Groundwater is the primary pathway of contaminant transport from the site to NOAA resources and associated habitats. Soils around the quarry are generally 0.6 to 1.8 m deep. Soils are underlain by the Brunswick Formation, which consists of shale, siltstone, and mudstone. The Lockatong Formation underlies the Brunswick Formation, and has a similar lithology and structure. The two formations are hydraulically connected, but groundwater within the two formations is restricted to secondary openings such as joints and fractures. As a result, water-bearing properties may vary greatly across the formations. At the site, hydraulic gradients of 0.01 to 0.03 (vertical/horizontal) to the southwest (Brown et al. 1992) indicate that groundwater flows toward the West Branch of Skippack Creek. Groundwater migration in the Brunswick and Lockatong formations is estimated at 0.003 to 0.55 m/day.

There is no surface water pathway from the site to the West Branch Skippack Creek. A small, standing-water body observed 30 m east of the West Branch may actually be a partially dried-up stream channel (Figure 2; ENVIRON 1990).

NOAA Trust Habitats and Species

The primary habitats of concern to NOAA are the surface waters, bottom substrates, and associated riparian zones of the Skippack Creek drainage and Schuylkill River. The Skippack Creek drainage is composed of the West Branch of Skippack Creek, the mainstem Skippack Creek, and Perkiomen Creek.

The West Branch of Skippack Creek is a small stream, averaging about 4.6 m wide and less than 1.5 m deep. The mainstem is a considerably wider stream, generally between 17 and 20 m wide and between 0.5 and 2 m deep. Both streams have moderate gradients with typical riffle-pool habitats. Gravel substrates dominate the riffles with finer sands and silts in pool environments. The streams have both warm and coldwater resident fish assemblages; the mainstem is fairly diverse with trout, largemouth bass, smallmouth bass, and panfish populations. Perkiomen Creek near the confluence with Skippack Creek is a lower-gradient warmwater stream approximately 30 m wide and 2.5 m deep (Kaufmann 1997a).

The only NOAA trust resource now in the Skippack Creek drainage is American eel. Eel have been documented in Perkiomen and the mainstem Skippack Creek. They have not been documented in the West Branch, but do have access to the smaller stream. There are no other NOAA trust resources found in the two streams because of impassable dams below the confluence of Skippack Creek and the Schuylkill River (Kaufmann 1997a).

The Schuylkill River near the Skippack Creek drainage is a large, low-gradient stream, generally about 100 m wide and 1 to 2 m deep. Substrates are predominantly gravel and cobble in riffles, and finer sands and silts in pool environments. Although its upper portions are classified as a scenic river, the Schuylkill receives considerable amounts of agricultural runoff and wastewater, and is generally considered to have low water quality. There are heavy aquatic plant beds throughout the river, with the dominant species being the non-indigenous and nuisance Eurasian milfoil (Kaufmann 1992; Arnold 1993; Kaufmann 1997b).

Four dams on the Schuylkill River downstream of the Skippack Creek drainage prevent anadromous fish from migrating into this reach of the river. The Norristown, Plymouth, Flatrock, and Fairmount dams are respectively located 10, 16, 24, and 36 km downstream of Skippack Creek drainage. A fish passage has been added to the Fairmount Dam. Fish passage construction on the remaining three dams has been delayed by legal and financial complexities, but is planned to begin by the year 2000. Dam restoration would allow alewife and blueback herring to use the Skippack Creek drainage to spawn. American shad also would increase their range, but probably would not migrate beyond the Schuylkill River because of their preference for large streams (Kaufmann 1997a).

A fish consumption advisory is now in effect for the Schuylkill River because of high concentrations of PCBs, chlordane, and DDT. This advisory does not affect the Skippack Creek drainage, and the mainstem of Skippack Creek is managed as a recreational trout fishery.

Site-Related Contamination

The Remedial Investigation Site Operations Plan presents results from sampling conducted by NUS in 1983 and by ENVIRON in 1989 (ENVIRON 1990). These data are compared to NOAA screening guidelines in Table 1. Reported sample analyses indicate that boron and other inorganic substances are the contaminants of concern to NOAA.

In 1983, the highest measured boron concentration in groundwater was 374,000 µg/L (NUS 1986, as cited in ENVIRON 1990). In 1989, the maximum boron concentration in groundwater was 241,000 µg/L. A groundwater plume contaminated with boron extends from the quarry approximately 1.2 km southwest from the site and may be 120 to 300 m wide (Figure 2; Brown et al. 1992). The extent of this plume is consistent with the probable range of hydraulic characteristics at the site area (Brown et al. 1992). No other inorganic substances were detected in groundwater at concentrations greater than ten times their respective AWQCs.

Table 1. Maximum concentrations of contaminants of concern to NOAA detected in groundwater, surface water, and sediment during investigations at the Salford Quarry site compared to NOAA screening guidelines.

Trace elements	Water (µg/L)				Sediment (mg/kg)		
	Groundwater	Spring Water	Creek Surface Water	Freshwater Chronic AWQC[a]	Spring Sediment	Creek Sediment	ERL[b]
Arsenic	12[c]	ND	ND	190	6[d]	12[d]	8.2
Boron	374,000[d]	139,000[d]	480[c]	NA	53[d]	ND	NA
Cadmium	ND	ND	ND	1.1+	2.2[d]	0.3[d]	1.2
Lead	16[c]	4[c]	6[d]	3.2+	120[d]	26[d]	46.7
Zinc	344[d]	43[d]	36[d]	110+	380[d]	81[d]	150

NA: Not available.
ND: Not detected; detection limits not available.
a: U.S. EPA 1993.
b: Effects range-low (Long and MacDonald 1995).
c: ENVIRON 1990.
d: NUS 1986 as cited in ENVIRON 1990.
+: Hardness-dependent criteria: 100 mg/L $CaCO_3$ assumed.

Water collected from the spring west of the quarry contained concentrations of boron as high as 139,000 µg/L. An AWQC for boron has not been developed. However, data collected by Birge and Black (1977, as cited in Eisler 1990) indicate that concentrations ranging from 1 to 100 µg/L may cause a reduction in the reproductive potential of rainbow trout, and concentrations greater than 200 µg/L may impair the survival of other fish species. Maximum boron concentrations in the creek and spring were 480 µg/L in surface water and 53 mg/kg in sediment. There are no ERLs or similar sediment screening guidelines for boron in sediment. Other contaminants that exceeded NOAA screening guidelines are lead in surface water and arsenic in sediment.

Summary

From 1963 to about 1980, wastes from a tile manufacturing company were discarded into Salford Quarry, about 100 m east of the Skippack Creek West Branch. Data indicate that trace elements, particularly boron, have migrated through the groundwater to the West Branch at concentrations that may pose a threat to NOAA trust resources. American eel is now the only trust species using the Skippack Creek drainage. However, if fish passage facilities are opened on the Schuylkill River, alewife and blueback herring may use Skippack Creek and its tributaries for spawning.

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4

Brunswick Wood Preserving

Brunswick, Georgia
CERCLIS #GAD981024466

Site Exposure Potential

The Brunswick Wood Treaters facility covers approximately 20 ha, 5 km northwest of Brunswick, in Glynn County, Georgia (Figure 1). Burnett Creek flows along the western boundary of the site and then continues southwest for 5.5 km before discharging into Cowpen Creek (Figure 2). Cowpen Creek continues 0.75 km to join the Turtle River, which joins the Brunswick River 16 km downstream. The Brunswick River is the major tributary to St. Simons Sound on the Atlantic Ocean. Tidal influence extends into Burnett Creek. Approximately 11 km of wetlands border Burnett Creek, and 27 km of wetlands are present from Cowpen Creek to St. Simons Sound.

The Brunswick facility was opened in 1958, under the name Escambia Treating Company, to preserve roundwood for utility poles and marine pilings. Logs were originally treated with creosote and PCP dissolved in diesel oil. Wood treatment with chromated copper arsenate (CCA) was added sometime between 1968 and 1970 (Woodall 1991). In 1986, the property was sold to Brunswick Treating Company, which continued the wood treating operations until the facility was closed in March 1991 (Black & Veatch Special Projects Corp. 1996).

Escambia-Brunswick Wood has a documented history of waste releases and spills. Large

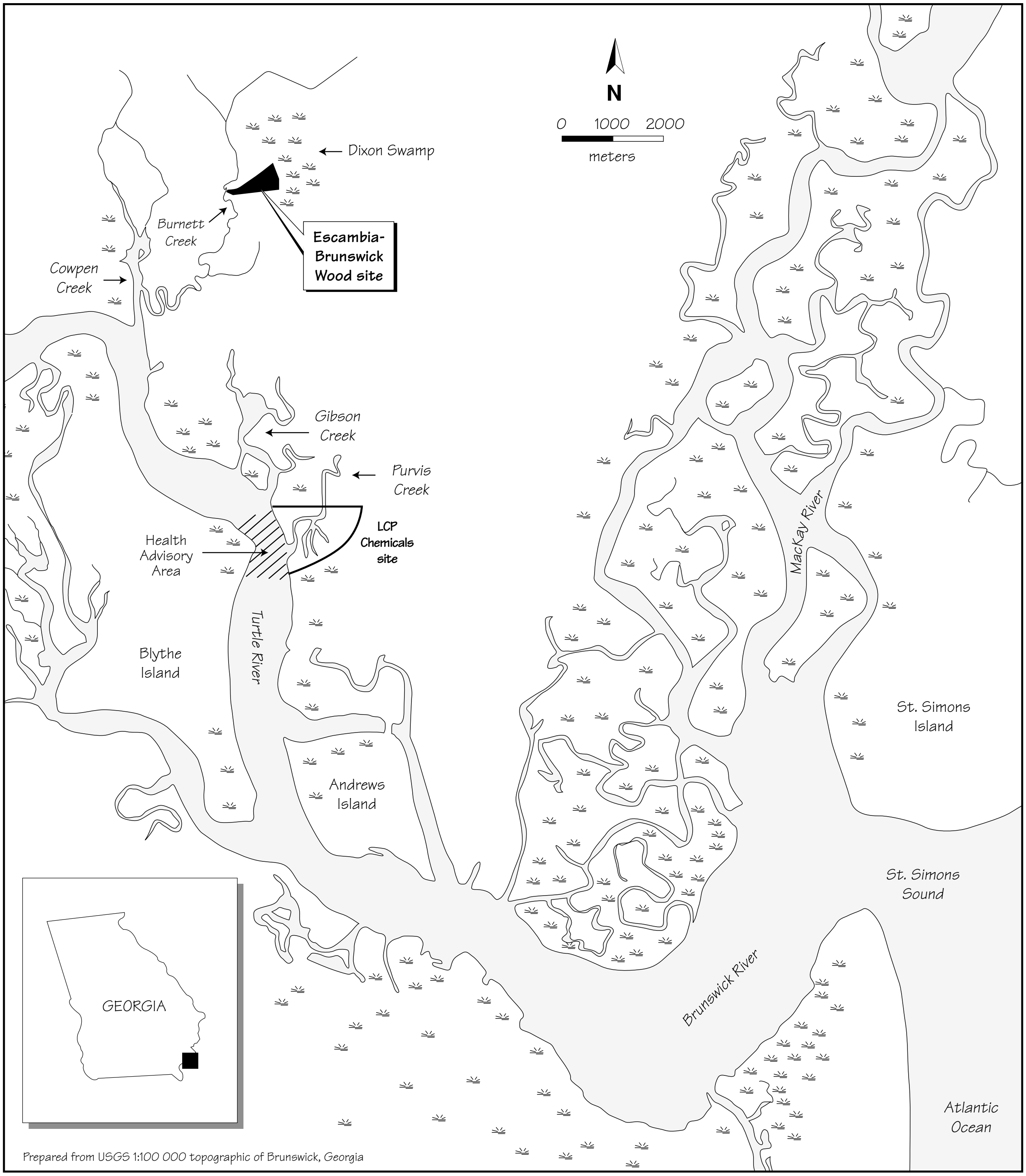

Figure 1. Location of the Escambia-Brunswick Wood site in Brunswick, Georgia.

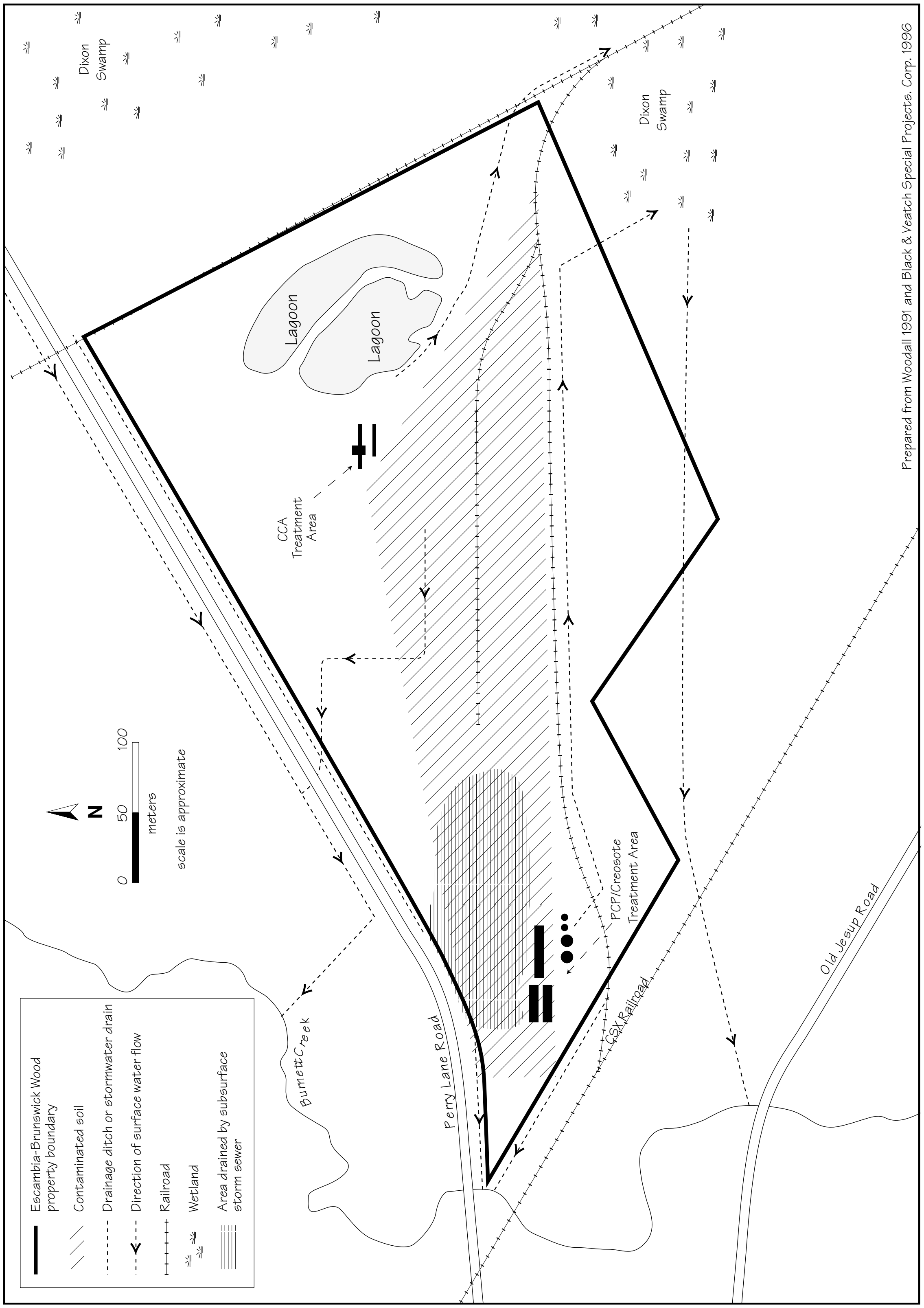

Figure 2. Detail of Escambia-Brunswick Wood site in Brunswick, Georgia.

amounts of diesel oil were released to Burnett Creek on two separate occasions in 1969; one spilling 1100 to 1500 L and the other spilling 3800 to 7600 L. Other incidents include a 2300 to 3000-L spill of PCP solution, of which approximately 100 to 200 L reached Burnett Creek. In 1989, more than 76,000 L of PCP solution was released to a storm sewer leading directly into Burnett Creek.

Following a fire in 1991, EPA began investigating contamination at the site. Several soil samples were found to have extremely high levels of PAHs and dioxins. In response, EPA excavated contaminated soil from the southern portion of the site down to groundwater for on-site containment. A groundwater pump and treating system was also installed. The Georgia Environmental Protection Division is removing the excavated soil (Farrier 1997).

Surface-water runoff and groundwater are the potential pathways of contaminant transport to NOAA trust resources and associated habitats. The general topography at the site drains to the west. A storm sewer system and a drainage ditch, both of which empty directly into Burnett Creek, collect contaminated runoff from the western portion of the site. Runoff from the northern portion of the site also enters Burnett Creek through a drainage ditch. Runoff from the southern and eastern portions of the site is collected and discharged to Dixon Swamp, which also drains to Burnett Creek (Figure 2).

Surface soils at the Brunswick Wood facility are poorly-drained to moderately-permeable sand and sandy loam. The unconfined surficial aquifer is composed of very-fine to fine sands, gravel, thin limestone, and thin clay beds, and extends to about 58 m deep. Recharge comes from direct infiltration of precipitation. There is a slight groundwater gradient to the west, which is altered intermittently by tidal influences and withdrawals from nearby wells.

The Brunswick Wood Treaters site lies within the 100-year floodplain.

NOAA Trust Habitats and Species

The primary habitats of concern to NOAA are surface water, bottom substrates, riparian zones, and wetlands associated with Burnett Creek, lower Cowpen Creek, and the Turtle River. Estuarine fish, invertebrate species, and anadromous fish are the resources of concern to NOAA (Table 1).

Burnett Creek is a small, tidally influenced, low-gradient stream with widely fluctuating salinities ranging from freshwater to about 20 ppt, depending upon the season and the amount of runoff discharging to the stream. Its width varies from less than 10 m near the site to 100 m near its confluence with Cowpen Creek. Depths are generally less than 1 m throughout the stream. Lower Cowpen Creek and the Turtle River also are low-gradient estuarine streams with salinities generally ranging from 15 to 20 ppt. Lower

Table 1. NOAA trust species using habitats associated with Burnett Creek, Cowpen Creek, and the Turtle River near the Escambia Brunswick Wood site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
American eel	*Anguilla rostrata*		♦	♦		
American shad	*Alosa sapidissima*		♦	♦		
Atlantic sturgeon	*Acipenser oxyrhynchus*		♦	♦		
Blueback herring	*Alosa aestivalis*		♦	♦		
MARINE/ESTUARINE SPECIES						
Atlantic croaker	*Micropogonias undulatus*		♦			♦
Atlantic menhaden	*Brevoortia tyrannus*		♦			
Bay anchovy	*Anchoa mitchilli*	♦	♦	♦		
Black drum	*Pogonias cromis*		♦	♦		♦
Bluefish	*Pomatomus saltatrix*		♦			
Ladyfish	*Elops saurus*		♦			
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Pinfish	*Lagodon rhomboides*		♦	♦		
Red drum	*Sciaenops ocellatus*		♦			♦
Sheepshead	*Archosargus probatocephalus*		♦	♦		♦
Sheepshead minnow	*Cyprinodon variegatus*	♦	♦	♦		
Silversides	*Menidia spp.*	♦	♦			
Southern flounder	*Paralichthys lethostigma*		♦	♦		♦
Southern kingfish	*Menticirrhus americanus*		♦			
Spanish mackerel	*Scomberomorus maculatus*		♦			
Spot	*Leiostomus xanthurus*		♦	♦		♦
Spotted sea trout	*Cynoscion nebulosus*		♦	♦		♦
Striped mullet	*Mugil cephalus*		♦	♦		♦
Summer flounder	*Paralichthys dentatus*		♦			
Weakfish	*Cynoscion regalis*		♦			
INVERTEBRATE SPECIES						
Blue crab	*Callinectes sapidus*		♦	♦	♦	♦
Brown shrimp	*Penaeus aztecus*		♦	♦	♦	♦
Eastern oyster	*Crassostrea virginica*	♦	♦	♦		
Grass shrimp	*Palaemonetes pugio*	♦	♦	♦	♦	♦
Pink shrimp	*Penaeus duorum*		♦	♦	♦	♦
White shrimp	*Penaeus setiferus*		♦	♦	♦	♦

Cowpen Creek is generally 100 to 150 m wide and 1 to 5 m deep. The Turtle River is 600 m to 1 km wide and 1 to 11 m deep (USGS 1993). The extensive tidal marsh wetlands along the banks of all three streams are largely composed of saltmarsh cord grass (*Spartina alterniflora*) and salt hay grass (*S. patens*). Sediments range from high organic silts to sands (Weston 1991).

A fish survey conducted in 1991 found killifish and blue crab in Burnett Creek (Weston 1991). Sheepshead minnow, Atlantic silversides, and striped mullet are periodically found both in low salinities and tidal freshwaters within the estuary and in Burnett Creek . Anadromous species have not been found in Burnett Creek (Nelson et al. 1991).

Lower Cowpen Creek and the Turtle River provide deeper, larger, more marine-influenced habitats for numerous estuarine fish and invertebrates. Estuarine fish that commonly use these two waterways for juvenile rearing and adult residence include Atlantic menhaden, spotted sea trout, weakfish, Atlantic croaker, southern kingfish, black drum, spot, sheepshead, pinfish, and southern flounder. Anadromous species that use the Turtle River as a migratory corridor and juvenile nursery include Atlantic sturgeon, blueback herring, and American shad. The catadromous American eel is found throughout the basin and uses lower-salinity portions of the Turtle River as a nursery. Invertebrates found in Lower Cowpen Creek and the Turtle River include American oyster, hard clam, brown shrimp, grass shrimp, and blue crab (Nelson et al. 1991).

Five aquatic species that may occur near the site are listed as threatened or endangered under the Federal Endangered Species Act. The endangered West Indian manatee (not a NOAA trust species) frequently forages in the Turtle River during the spring and fall. Four species of sea turtle—loggerhead, Kemp's Ridley, leatherback, and green—have been regularly sighted in St. Simons Sound, but sightings in the Turtle River have not been confirmed. On the other hand, Atlantic bottlenose dolphin are commonly sighted in the Turtle River. Though not threatened or endangered, dolphins are afforded certain protections under the Federal Marine Mammal Protection Act (DOI 1995; NOAA 1995).

Bait shrimp and blue crab are commercially harvested from Burnett Creek below the Highway 341 bridge, approximately 1 km south of the site. Both finfish and shellfish are recreationally harvested for local consumption on all parts of the stream. There are also commercial and recreational fisheries in the Turtle River (Weston 1991).

A Georgia Department of Natural Resources health advisory cautions against consumption of recreationally captured seafood for Purvis Creek, Gibson Creek, and the Turtle River extending approximately 800 m upstream and downstream of the mouth of Purvis Creek. Commercial fisheries are prohibited in this area. The advisories and closures posted in the area are the result of mercury and PCB contamination associated with the LCP Chemicals National Priorities List site (Weston 1991). In addition, the harvest of bivalves is restricted in the Turtle River estuary because of contamination from urban runoff originating in the city of Brunswick (NOAA 1995).

Site-Related Contamination

The initial data collected in 1991 were supplemented in 1993 with additional soil and groundwater samples and eleven sediment samples from Burnett Creek. Data collected in the 1991 and 1993 site evaluations show elevated concentrations of trace elements, PAHs, dioxins, and furans in surface water, groundwater, soils, and sediments at the facility (Weston 1991; B&V Waste Science and Technology Corp. 1994). Table 2 lists maximum concentrations of the major contaminants at the site along with the appropriate screening guidelines for each medium. Data in Table 2 were obtained from the 1993 study, except for surface water data, which were not collected in 1993. Surface water data presented in this table were collected in 1991. Although surface water samples were analyzed for metals, PCP, and creosote compounds, only arsenic, chromium, copper, PCP, and fluoranthene concentrations were reported (Weston 1991).

Various trace elements were detected in surface soils at concentrations exceeding average U.S. soil concentrations; and levels of arsenic, chromium, and copper were greater than 100 times their respective screening guidelines. The highest concentrations of trace elements in surface soil samples came from near the CCA treatment area in the center of the site. Of the trace elements measured in subsurface soils, only silver exceeded the average U.S. concentration. Arsenic, cadmium, copper, mercury and nickel concentrations in subsurface soil samples were not reported.

All trace elements measured in groundwater were more than ten times the AWQC. The data reported here for inorganic substances in groundwater were collected as background data, although the sampling location was on-site, and concentrations were higher than at any other sampling location reported for the site. Concentrations of chromium and copper in surface water samples from Burnett Creek were both above freshwater AWQC concentrations. Arsenic and copper in sediment samples taken in Burnett Creek downstream from the site were found to exceed ERL screening guidelines.

Polynuclear aromatic hydrocarbons were found at high concentrations in both surface and subsurface soil samples, although no screening guidelines exist for these contaminants in soil. Groundwater samples exceeded AWQC or LOEL concentrations by at least 85 times for naphthalene, phenanthrene, and fluoranthene. Surface waters contained PCP, although there is no screening guideline for this compound in water. For all PAH compounds with sediment screening guidelines, except for naphthalene, measured concentrations were substantially higher than ERLs.

Dioxins and furans were both found in surface soils, and a total toxic equivalency value was calculated. Subsurface soils, groundwater, and surface water were not analyzed for dioxins or furans. 2,3,7,8-TCDD and 2,3,7,8-TCDF were found in sediments. The total TCDD toxicity equivalents in sediments greatly exceeded the

Table 2. Maximum concentrations of selected contaminants in groundwater, surface water, soils, and sediments detected on and near the Escambia Brunswick Wood facility.

	Water			Soil			Sediment	
	Ground-water (µg/l)	Surface[a] Water (µg/l)	AWQC[b] (µg/l)	Surface Soils (mg/kg)	Subsurface Soils (mg/kg)	Mean U.S. [c] (mg/kg)	Sediment (mg/kg)	ERL[d] (mg/kg)
Trace Elements								
Arsenic	420	12	36	8800	NA	5.2	9.5	8.2
Cadmium	79	NA	1.1	1.3	NA	0.06	ND	1.2
Chromium	570	62	11	4000	9	37	24	81
Copper	NA	23	12	9800	NA	17	53	34
Lead	47	NA	3.2	41	5.8	16	11	46.7
Mercury	NA	NA	0.012	0.64	NA	0.058	ND	0.15
Nickel	760	NA	8.3	ND	NA	42	ND	20.9
Silver	NA	NA	0.12	ND	5.4	0.05	ND	1.0
Zinc	1200	NA	86	160	8.4	48	36	150
Organic Compounds								
Naphthalene	39000	NA	620 [e]	0.17	1800	NA	0.14	0.16
2-Methylnaphthalene	14000	NA	NA	180	480	NA	0.18	0.07
Acenaphthylene	370	NA	NA	0.31	NA	NA	ND	0.04
Acenaphthene	560	NA	520 [e]	460	720	NA	0.62	0.02
Dibenzofuran	9800	NA	NA	440	600	NA	0.61	NA
Fluorene	12000	NA	NA	510	740	NA	1	0.02
Pentachlorophenol	11000	5	NA	5000	650	NA	0.57	NA
Phenanthrene	33000	NA	4.6p	1200	1800	NA	3.10	0.24
Anthracene	4000	NA	NA	3600	340	NA	2.90	0.09
Fluoranthene	14000	7	16 [e]	490	870	NA	3.70	0.60
Pyrene	7800	NA	NA	320	380	NA	1.60	0.67
Chrysene	1700	NA	NA	100	96	NA	0.69	0.38
Benzo(b,k)fluoranthene	1200	NA	NA	64	67	NA	0.73	NA
Benz(a)anthracene	2400	NA	NA	95	62	NA	ND	0.26
Indeno(1,2,3-cd)pyrene	NA	NA	NA	1.20	NA	NA	ND	NA
Tetrachlorophenol	2000	NA	NA	200	NA	NA	ND	NA
Dioxins/Furans								
2,3,7,8-Tetrachloro-dibenzo-p-dioxin	NA	NA	NA	4.6×10^{-6}	NA	NA	3.8×10^{-5}	NA
2,3,7,8-Tetrachloro-dibenzo -furan	NA	NA	NA	2.7×10^{-5}	NA	NA	1.0×10^{-5}	NA
Total Equivalency Value	NA	NA	NA	1.1×10^{-2}	NA	NA	4.9×10^{-4}	6.0×10^{-5} [f]

a: Weston (1991). All other data from B&V Waste Science and Technology Corp. (1994).
b: Quality Criteria for Water (EPA 1993a). Lowest value was chosen from fresh and marine water criteria because stream is tidally influenced.
c: Shacklette and Boerngen (1984), except for cadmium and silver which represent average concentrations in the earth's crust from Lindsay (1979).
d: Effects range-low ; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long, et al. (1995).
e: Lowest Observed Effect Level (EPA 1993a).
f: EPA toxic equivalency guideline for low-risk to fish from sediment exposure (1993b).
ND: Not detected; detection limit not available.
NA: Screening guidelines not available; data not available.
p: Proposed criteria.

EPA toxic equivalency guideline for risk to fish from sediment exposure (EPA 1993b).

Remedial Investigation data were provided to NOAA in August 1997, before release of the RI report. These new data indicate maximum concentrations of all trace elements exceeding respective sediment ERLs, except nickel and silver. These data also indicate higher sediment concentrations of 2,3,7,8-TCDD equivalents (1.2 µg/kg), individual PAHs (1600 mg/kg), and PCP (2900 mg/kg) than previous studies (which are shown in Table 2). The RI data indicate maximum concentrations of PCP (78 µg/L), arsenic (96 µg/L) and zinc (160 µg/L) above their chronic AWQCs (Farrier 1997).

Summary

Results from site investigations indicate that previous activities at the Brunswick Wood Treaters site have contaminated soil, groundwater, surface water, and sediments with trace elements, PAHs, dioxins, and furans. Surface runoff and groundwater discharge flow directly into Burnett Creek adjacent to the site. Primary habitats of concern to NOAA include surface water, bottom substrates, wetlands and riparian areas of Burnett Creek, Cowpen Creek, and the Turtle River. These water bodies support estuarine, anadromous, and catadromous fish species, and numerous invertebrates. Federally listed threatened or endangered species of concern to NOAA that may be present near the site include four species of sea turtle.

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4

MRI Corporation

Tampa, Florida
CERCLIS #FLD088787585

Site Exposure Potential

The MRI Corporation site occupies 2.5 ha in an industrial area of Tampa, Hillsborough County, Florida. Drainage from the facility flows 0.35 km southeast to Sixmile Creek. Sixmile Creek flows approximately 2 km to the Palm River, which travels approximately 4.5 km to the west before reaching McKay Bay. McKay Bay extends about 5 km before joining Hillsborough Bay, an embayment of Tampa Bay and the Gulf of Mexico (Figure 1).

From 1971 until 1986, the MRI Corporation operated a scrap metal reclamation and chemical detinning facility, which is now inactive and listed for sale. The detinning process included physical and chemical treatment of tin-coated scrap steel. The scrap metal was submerged in a series of four heated alkali baths and then sent to washing tanks. Chemical treatment and wash solutions were stored in on-site lagoons to settle solids and collect residual tin. The liquids from the alkali baths were filtered and electrowinned before acid treatment and additional settling in the lagoons. Stormwater runoff also collected in these lagoons. The lagoon bottoms containing mud and process sludges have neither been removed nor contained (Figure 2; NUS 1990).

Waste products generated at the site included scrap metal, process sludges, and treated effluent.

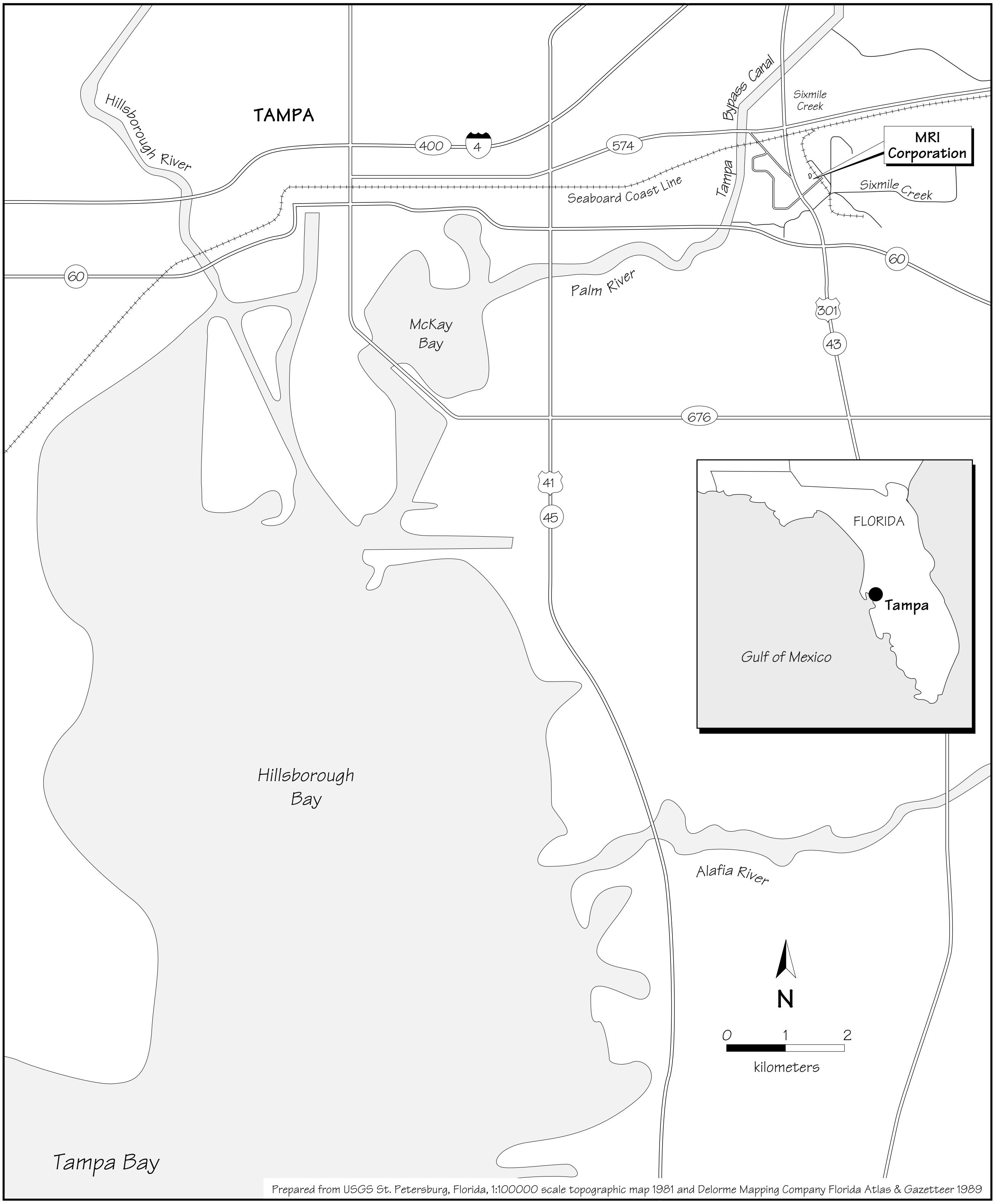

Figure 1. Location of MRI Corporation in Tampa, Florida.

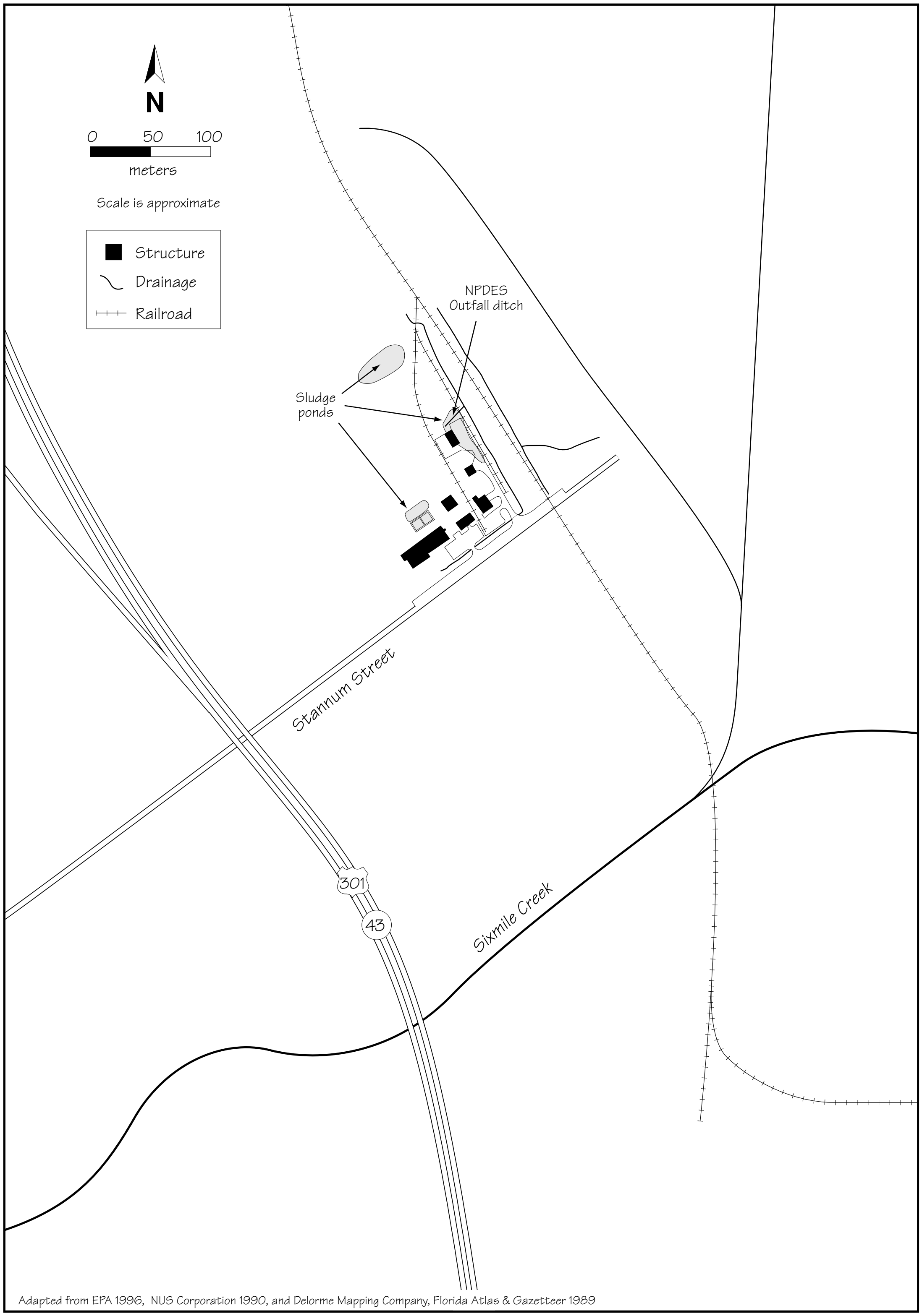

Figure 2. Detail of MRI Corporation site.

The scrap metal was compressed into 180-kg bales for off-site reuse. Process sludges were filtered, accumulated on-site, and sold for metal reclamation. Approximately 91,000 kg/year of process sludges were reclaimed and sold out of state. In 1974, waste sludge sampling detected copper, iron, lead, mercury, nickel, sodium, tin, zinc, oil, and grease (NUS 1990).

Wastewater, treated with chlorine to oxidize cyanides, was discharged to an on-site drainage ditch. Discharges to the ditch at rates of up to 19,000 L/week were allowed under a NPDES permit (NUS 1990). However, this facility had a documented history of NPDES violations. During 1984, for example, effluent monitoring indicated that zinc and mercury exceeded permit limits during January; oil and grease and both total and free cyanide exceeded permit limits during February; and total cyanide and cadmium permit limits were exceeded during March (NUS 1990).

Surface-water transport and groundwater discharge are the potential pathways of contaminant migration from the site to NOAA trust resources and associated habitats. Surface runoff from the site reportedly flows into Sixmile Creek, but no detailed information was available on surface flow. Groundwater at the site migrates to the southwest. The two principal aquifers in the area are the surficial and the Upper Floridan aquifers, which are hydraulically connected near the site. Site groundwater is encountered 2.4 m bgs.

NOAA Trust Habitats and Species

Habitats of primary concern to NOAA are estuarine surface waters and associated bottom substrates of the lower Palm River and McKay Bay, a shallow embayment within the Tampa Bay estuary. Many estuarine fish and invertebrates use the embayment and are the resources of concern to NOAA (Table 1).

McKay Bay is generally less than 8 m deep and salinities generally range from 22 to 25 ppt, fluctuating throughout the year depending upon rainfall, saltwater intrusion, and runoff (Estevez 1989). Silty sands dominate bottom substrates (Dial and Deis 1986).

The Palm River has low water quality; between 1980 and 1983, annual average dissolved oxygen varied from 1.8 to 3.2 mg/L. In addition, coliform counts, nutrient concentrations, and biological oxygen demand all were elevated. Water-quality conditions tend to worsen toward McKay Bay, where urbanization is greater and more point sources are present (Wolfe 1990).

The lower Palm River and McKay Bay provide nursery and adult habitat for numerous fish and invertebrate species (Kunneke and Palik 1984; Nelson et al. 1992). Most of the estuarine species spawn offshore or in coastal waters. Tidal currents carry the larvae inshore to estuarine water. Juveniles remain in protected estuaries until sexual maturity (Kunneke and Palik 1984). For example, snook and red drum juveniles are

Table 1. NOAA trust fish, invertebrate, and reptile species that use McKay Bay and the Palm River.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
MARINE/ESTUARINE FISH SPECIES						
Atlantic croaker	*Micropogonias undulatus*			◆		
Atlantic thread herring	*Opisthonema oglinum*		◆	◆		
Bay anchovy	*Anchoa mitchilli*		◆	◆		
Black drum	*Pogonias cromis*		◆	◆		
Bluefish	*Pomatomus saltatrix*		◆	◆		
Crevalle jack	*Caranx hippos*		◆	◆		
Florida pompano	*Trachinotus carolinus*		◆			
Gray snapper	*Lutjanus griseus*			◆		
Gulf flounder	*Paralichthys albigutta*		◆	◆		
Gulf killifish	*Fundulus grandis*	◆	◆	◆		
Gulf menhaden	*Brevoortia patronus*		◆	◆	◆	
Lady fish	*Elops saurus*		◆	◆		
Pigfish	*Orthopristis chrysoptera*		◆	◆		
Pinfish	*Lagodon rhomboides*		◆	◆		
Red drum	*Sciaenops ocellatus*		◆	◆		◆
Sand seatrout	*Cynoscion arenarius*		◆	◆		
Sheepshead minnow	*Cyprinodon variegatus*	◆	◆	◆		◆
Silver perch	*Bairdiella chrysoura*	◆	◆	◆		
Snook	*Centropomus undecimalis*		◆	◆		◆
Southern flounder	*Paralichthys lethostigma*		◆	◆		
Southern kingfish	*Menticirrhus americanus*			◆		
Spanish mackerel	*Scomberomorus maculatus*		◆	◆		
Spot	*Leiostomus xanthurus*		◆	◆	◆	
Spotted seatrout	*Cynoscion nebulosus*		◆	◆	◆	◆
Striped mullet	*Mugil cephalus*		◆	◆	◆	
Tarpon	*Megalops atlanticus*		◆	◆		
Tidewater silverside	*Menidia peninsula*	◆	◆	◆		
INVERTEBRATE SPECIES						
Bay squid	*Lolliguncula brevis*	◆	◆	◆		
Blue crab	*Callinectes sapidus*	◆	◆	◆	◆	
Common rangia	*Rangia cuneata*	◆	◆	◆		
Eastern oyster	*Crassostrea virginica*	◆	◆	◆		
Grass shrimp	*Palaemonetes pugio*	◆	◆	◆		
Hard shell clam	*Mercenaria spp.*	◆	◆	◆		
Pink shrimp	*Penaeus duorarum*		◆		◆	
MARINE REPTILES						
Green sea turtle	*Chelonia mydas*			◆		
Hawksbill sea turtle	*Eretmocheyls imbricata*					
Kemp's Ridley sea turtle	*Lepidocheyls kempi*			◆		
Leatherback sea turtle	*Dermochelys coriacea*			◆		
Loggerhead sea turtle	*Caretta caretta*			◆		

commonly found in brackish streams and canals and tidal freshwater streams, and may be found in the lower Palm River (Gilmore et al. 1983; Peters and McMichael 1987).

Highly abundant finfish species in the Tampa Bay Estuary include Gulf menhaden, sheepshead minnow, tidewater silversides, striped mullet, red drum, bay anchovy, spot, and pinfish (Nelson et al. 1992).

Blue crab are abundant in the estuary. Both juveniles and adults use the estuary, and mating may occur in tidal portions of the Palm River. After mating, the females return to full seawater to brood eggs while the males usually remain in low-salinity waters. Crab larvae are released in full seawater zones, such as upper Tampa Bay, and are transported by currents to McKay Bay and other, lower -salinity portions of the estuary. The larvae settle and metamorphose to juveniles in the low-salinity estuary (Nelson et al. 1992).

Grass shrimp are abundant and spend their entire life cycle in the estuary. The bivalves rangia, hard shell clam, and oyster are also commonly found in the estuary (Nelson et al. 1992).

Commercial and recreational fishing activities concentrate in the outer estuaries of Tampa Bay and Old Tampa Bay. Commercial and recreational fisheries are not extensive in either McKay Bay or the lower Palm River. However, blue crab, Gulf menhaden, mullet, pink shrimp, spot, and spotted seatrout are commercially harvested in nearby Hillsborough Bay.

Recreational anglers occasionally fish available species in McKay Bay. Species typically sought are red drum, sheepshead, snook, and spotted seatrout. There are no restrictions on these fisheries other than general regulations regarding take limit and minimum size. Periodically, blue crab are also harvested from McKay Bay (McMichael 1992).

The surface waters of Hillsborough and Tampa bays provide habitat for several threatened and endangered species. A non-NOAA trust species, the federally endangered West Indian manatee *(Trichechus manatus)* uses these bays as seasonal habitat. Several federally protected species of turtles also are found in the area. These include the threatened green and loggerhead sea turtles, along with the endangered hawksbill, Kemp's Ridley, and leatherback sea turtles (McMichael 1992).

Site-Related Contamination

1990 and 1992 site inspections documented elevated concentrations of trace elements in soil, groundwater, and sediment at the site (NUS 1990; EPA 1992). Surface-water samples were not collected in either of these site inspections. Consequently, groundwater concentrations are compared to EPA Ambient Water Quality Criteria (Table 2).

Table 2. Maximum concentrations of selected contaminants detected at the MRI Corporation site.

	Soil (mg/kg)			Water (µg/L)		Sediment (mg/kg)	
Inorganic Substance	Surface Soils	Sub-Surface Soils	Mean U.S. [a]	Ground-water	AWQC[b] (µg/L)	On-site Sediment	ERL[c]
Chromium	71	38	37	930	11	41	81
Copper	370	90	17	NA	12	69	34
Lead	8700	3800	16	340	3.2	1700	46.7
Mercury	2	ND	0.06	1.4	0.012	2.6	.15
Nickel	80	20	13	160	8.3	21	209
Zinc	1800	590	48	750	86	500	150
Cyanide	1.5	1.5	NA	52,000	5.2	0.84	NA

a: Shacklette and Boerngen (1984)
b: Ambient Water Quality Criteria for Water (U.S. EPA 1993); data presented are lowest chronic marine or freshwater criteria.
c: Effects range-low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long et al. (1995).
ND Not detected; detection limit not available.
NA Screening guidelines not available.

Maximum concentrations of the major contaminants are listed in Table 2 along with the appropriate screening guidelines for each medium. Data reported here for soil and sediment are from the 1992 inspection. None of the samples from the 1990 or 1992 investigations were analyzed for tin.

During the 1990 site inspection, soil and sediment samples were analyzed for VOCs, pesticides, PCBs, and PAHs. In 1990, Aroclor 1254 was detected in one surface soil sample at a concentration of 1.4 mg/kg. In addition, dieldrin was detected in one groundwater sample at a concentration of 0.028 µg/L, which exceeds the AWQC for this compound.

Summary

Limited site investigations indicate that previous activities at the MRI site caused trace element contamination of site soils, groundwater, and sediments. Surface water has not been sampled. Surface runoff and groundwater are potential transport pathways from the site to Sixmile Creek, which flows into the Palm River. Habitats of primary concern to NOAA are estuarine surface waters and associated bottom substrates of the lower Palm River and McKay Bay. These habitats support numerous estuarine fish and invertebrate species, as well as threatened and endangered sea turtles.

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4

Terry Creek Dredge Spoil/ Hercules Outfall

Brunswick, Georgia
CERCLIS #GAD982112658

Site Exposure Potential

The Terry Creek Dredge Spoil Areas/Hercules Outfall site is located on coastal estuarine marshlands approximately 1 km northeast of downtown Brunswick, Glynn County, Georgia. The site is bordered by Dupree Creek, Terry Creek, and the Back River (Figure 1). Dupree Creek flows south along the western edge of the site into Terry Creek, which continues approximately 2 km east until it merges with the Back River. The Back River then flows 3 km southeast and enters St. Simons Sound approximately 5 km from the site. St. Simons Sound joins the Atlantic Ocean about 5 km farther downstream.

From 1948 to 1981, the principal product of Hercules, Inc. (formerly Hercules Powder Plant), located on Dupree Creek, was the pesticide toxaphene. From 1966 to 1972, Hercules discharged 100-140 kg of toxaphene daily to Dupree Creek via a wastewater outfall (Figure 2). In 1972, installation of a wastewater treatment system reduced toxaphene discharges to less than 0.5 kg per day. By 1975, Hercules had obtained an NPDES permit for its Dupree Creek outfall that restricted discharge to a daily maximum of about 0.5 kg of toxaphene, and a monthly average of about 0.2 kg toxaphene per day. Subsequent permit renewals gradually reduced permitted discharges. The current permit allowance is

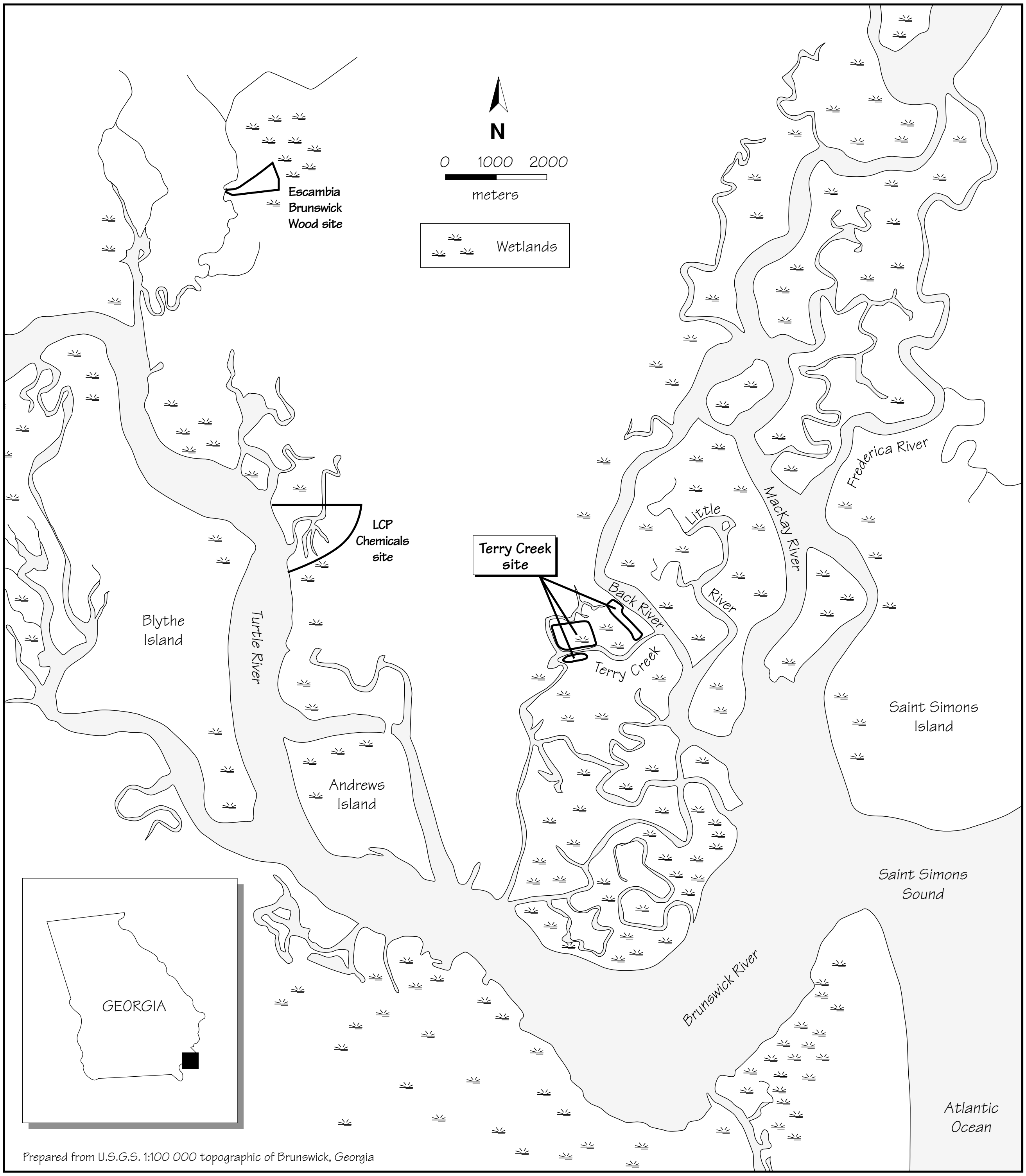

Figure 1. Location of the Terry Creek Dredge Spoil Areas/Hercules Outfall Superfund site in Brunswick, Georgia.

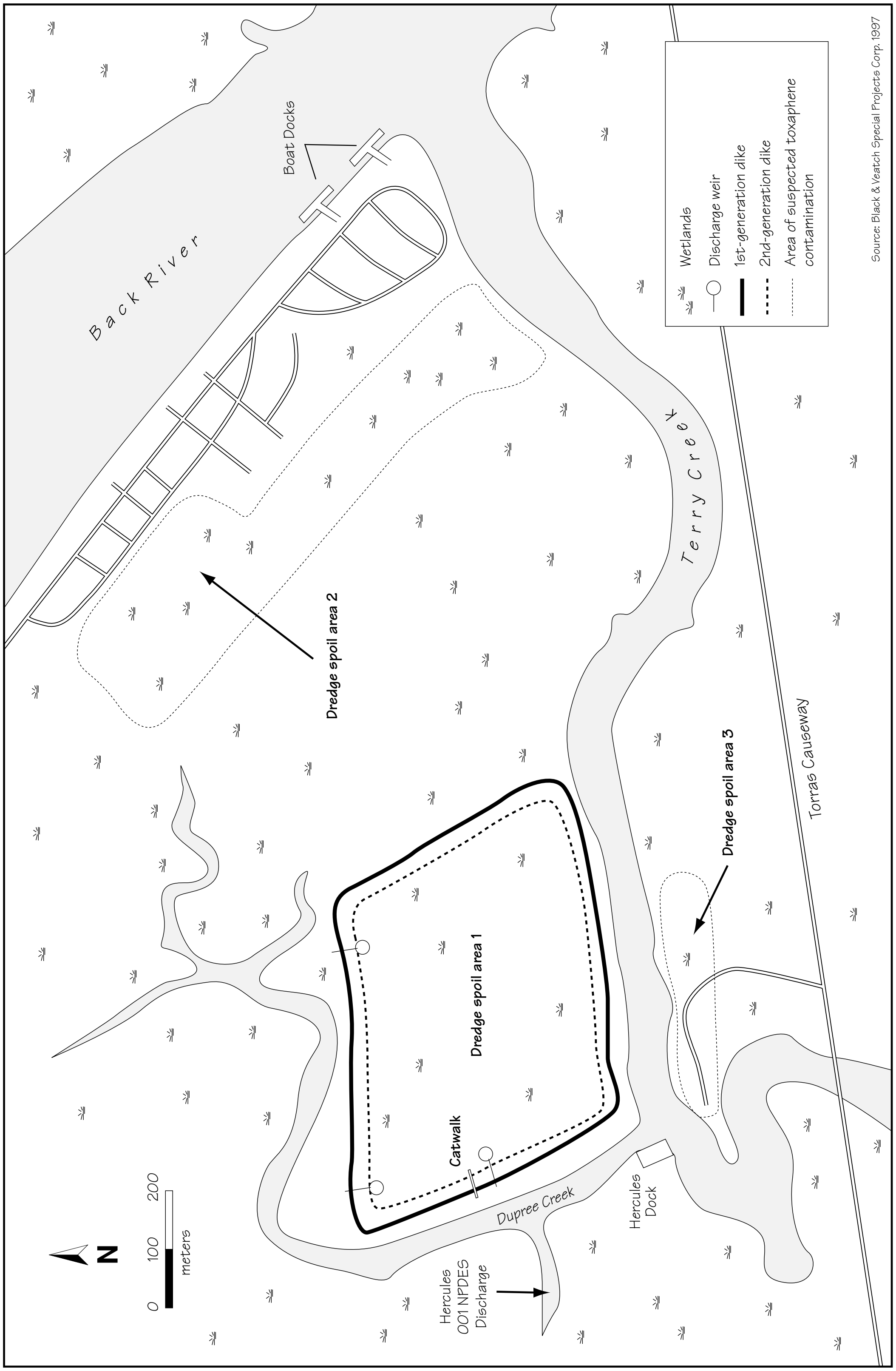

Figure 2. Detail of Terry Creek Dredge Spoil Areas/Hercules Outfall site.

an average of about 0.025 kg per day. There were six documented violations of the NPDES permit between 1988 and 1993 (Black & Veatch Special Projects Corp. 1997).

The U.S. Army Corps of Engineers (USACE) began dredging Terry Creek in 1938. Three tracts of land were set aside to accommodate the dredge spoils; these areas are identified as Dredge Spoil Area 1 (29 ha), Area 2 (23 ha), and Area 3 (3 ha; Figure 2). In 1972, Hercules, EPA, and the Georgia Environmental Protection Division agreed to restrict future disposal of dredge spoils to Area 1 following a spill of an unknown quantity of toxaphene into Dupree Creek from a barge at the Hercules dock. While Area 1 continues to receive dredge spoils, Areas 2 and 3 have been converted to residential property. Maintenance dredging of Terry Creek occurred in 1940, 1942, 1946, 1972, 1978, 1982, 1986, 1987, and 1988 (Black & Veatch Special Projects Corp. 1997).

Surface runoff, direct discharge to surface waters, and tidal transport are the contaminant pathways of primary concern to NOAA. When dredged sediments and water are placed into Dredge Spoil Area 1, solids settle out, and the excess water drains into Dupree Creek via three weirs on the north and west sides. Although the dredge spoils are contained by a two-generation, 7-m high dike, the second-generation dike was constructed using contaminated dredge material. Aerial photos of the impoundment show many complete and partial breaches of the dike, and contaminated water and sediments flowing into Dupree and Terry creeks (Bionetics 1991). Tidal currents have carried toxaphene upstream 1.2 km to the origin of Dupree Creek (U.S. EPA 1997a). There is an unmapped pipeline that extends from inside the southwest corner of the dike to Terry Creek (Taylor 1995).

Areas 2 and 3 have no features restricting surface runoff and associated contaminants from entering the waterways. Runoff from Dredge Spoil Areas 2 and 3 flows northeast and north to the Back River and Terry Creek, respectively (U.S. EPA 1997a).

NOAA Trust Habitats and Species

The habitats of concern to NOAA are surface water, bottom substrates, wetlands, and riparian zones associated with Dupree Creek, Terry Creek, the Back River, and St. Simons Sound. Estuarine fish, anadromous fish, and invertebrate species are the primary resources of interest to NOAA (Table 1).

Dupree and Terry Creeks are low-gradient, tidal streams of intermediate salinities (15-30 ppt). Both streams are typically 50 to 70 m wide and less than 1 m deep. Near the site the lower Back River is between 200 and 500 m wide and up to 9 m deep, with salinities generally ranging from 20 to 30 ppt. Sediments range from organically enriched silts to fine sands. Vast salt marsh wetlands are next to all three tidal streams. The wetlands near the site are dominated by smooth

Table 1. NOAA trust species using habitats associated with Dupree and Terry creeks, the lower Back River, and St. Simons Sound near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS FISH						
American eel	*Anguilla rostrata*		◆	◆		
American shad	*Alosa sapidissima*		◆	◆		
Atlantic sturgeon	*Acipenser oxyrhynchus*		◆	◆		
Blueback herring	*Alosa aestivalis*		◆	◆		
MARINE/ESTUARINE FISH						
Atlantic croaker	*Micropogonias undulatus*		◆			◆
Atlantic menhaden	*Brevoortia tyrannus*		◆			
Bay anchovy	*Anchoa mitchilli*	◆	◆	◆		
Black drum	*Pogonias cromis*		◆	◆		◆
Bluefish	*Pomatomus saltatrix*		◆			
Mummichog	*Fundulus heteroclitus*	◆	◆	◆		
Pinfish	*Lagodon rhomboides*		◆	◆		
Red drum	*Sciaenops ocellatus*		◆			◆
Sheepshead	*Archosargus probatocephalus*		◆	◆		◆
Sheepshead minnow	*Cyprinodon variegatus*	◆	◆	◆		
Silversides	*Menidia spp.*	◆	◆			
Southern flounder	*Paralichthys lethostigma*		◆	◆		◆
Southern kingfish	*Menticirrhus americanus*		◆			
Spanish mackerel	*Scomberomorus maculatus*		◆			
Spot	*Leiostomus xanthurus*		◆	◆		◆
Spotted sea trout	*Cynoscion nebulosus*		◆	◆		◆
Striped mullet	*Mugil cephalus*		◆	◆		◆
Summer flounder	*Paralichthys dentatus*		◆			
Tarpon	*Megalops atlanticus*		◆			
Weakfish	*Cynoscion regalis*		◆			
INVERTEBRATE SPECIES						
Blue crab	*Callinectes sapidus*		◆	◆	◆	◆
Brown shrimp	*Penaeus aztecus*		◆	◆	◆	◆
Eastern oyster	*Crassostrea virginica*	◆	◆	◆		
Grass shrimp	*Palaemonetes pugio*	◆	◆	◆	◆	◆
Pink shrimp	*Penaeus duorum*		◆	◆	◆	◆
White shrimp	*Penaeus setiferus*		◆	◆	◆	◆
MARINE REPTILES						
Green sea turtle	*Chelonia mydas*			◆		
Kemp's Ridley sea turtle	*Lepidocheyls imbricata*			◆		
Leatherback sea turtle	*Dermochelys coriacea*			◆		
Loggerhead sea turtle	*Caretta caretta*			◆		
MARINE MAMMALS						
Atlantic bottlenose dolphin	*Tursiops truncatus*			◆		
West Indian manatee	*Trichechus manatus*			◆		

cordgrass (*Spartina alterniflora*) and needlerush (*Juncus roemerianus*; U.S. DOI 1995). St. Simons Sound is a small, shallow (generally less than 20 m) coastal embayment that empties into the Atlantic Ocean (USGS 1993).

A variety of estuarine, anadromous, and catadromous fish species and several invertebrates use Dupree and Terry creeks, the lower Back River, and St. Simons Sound.

Species of fish known to use the Terry Creek site and associated salt marsh habitats include Atlantic croaker, red drum, spotted sea trout, tarpon, striped mullet, Atlantic menhaden, killifish, and American eel. Most of these species use the salt marsh and tidal stream habitats as a nursery. Invertebrates include American oyster, panaeid shrimp, and blue crab (U.S. DOI 1995).

Compared to the tidal streams, the lower Back River and St. Simons Sound provide deeper, larger, more saline habitats for numerous estuarine fish and invertebrates. Common estuarine fish that use the area for juvenile rearing and adult residence include Atlantic menhaden, spotted sea trout, weakfish, Atlantic croaker, southern kingfish, black drum, spot, sheepshead, pinfish, and southern flounder. Anadromous species that use the Back River as a migratory corridor and juvenile nursery include Atlantic sturgeon, blueback herring, and American shad. The catadromous American eel is found throughout the basin using lower-salinity portions of the river as a nursery. Invertebrates found in the area include American oyster, hard clam, brown shrimp, white shrimp, grass shrimp, and blue crab (Nelson et al. 1991).

Five aquatic species that may occur near the site are listed as threatened or endangered under the Federal Endangered Species Act. The endangered West Indian manatee, which is not a NOAA trust resource, has been observed feeding on smooth cordgrass near Terry Creek. Four species of sea turtle—loggerhead, Kemp's Ridley, leatherback, and green—have been regularly observed in St. Simons Sound, but sightings in the Back River have not been confirmed. In addition, the Atlantic bottlenose dolphin has been reported near the site. Dolphins are not listed as threatened or endangered, but are protected under the Federal Marine Mammal Protection Act (DOI 1995).

Commercial crab pots have been observed in both Dupree and Terry creeks (U.S. DOI 1995). There are commercial fisheries for blue crab and bait shrimp, and recreational fisheries for several finfish and crab throughout the estuary. Bivalve harvest is closed in the estuary, prompted by potential contamination from industrial discharges and urban non-point source contamination from Brunswick (NOAA 1995).

Site-Related Contamination

Field data collected since late 1995 indicate that soils, surface water, sediments, and biota near the Hercules outfall and the dredge spoil areas contain elevated concentrations of site-related contaminants (Black &Veatch Special Projects Corp. 1997, U.S. EPA 1997b). The primary on-site contaminants of concern to NOAA are toxaphene and other pesticides, although trace elements and PAHs also were detected in elevated concentrations. Maximum concentrations of these contaminants are summarized in Table 2 along with the appropriate screening guidelines.

Blue crab, mummichog, and larger fish captured in the spring of 1997 for a screening risk assess-

Table 2. Maximum concentrations of selected contaminants detected at the Terry Creek Dredge Spoil Areas/Hercules Outfall.

	Soil			Water		Sediment	
	On-site soils (mg/kg)	Community soils (mg/kg)	Mean U.S. [a] (mg/kg)	Surface water (µg/L)	AWQC[b] (µg/L)	On-site sediment (mg/kg)	ERL[c] (mg/kg)
Trace Elements							
Arsenic	16	19	5.2	13	36	19	8.2
Chromium	43	150	37	11	11	55	81
Copper	84	22	17	79	12	69	34
Lead	97	89	16	3	3.2	70	46.7
Mercury	0.32	0.21	0.058	1.8	0.012	0.59	0.15
Silver	7.3	NA	0.05	NA	0.12	<3	1.0
Zinc	73	120	48	NA	86	160	150
Pesticides							
Endrin	NA	NA	NA	0.11	0.002	<5.7	NA
4,4' DDD	NA	NA	NA	0.89	0.6[e]	<5.7	NA
4,4' DDE	0.18	0.008	NA	<0.1	NA	0.10	0.0022
4,4' DDT	1.5	NA	NA	0.09	0.001	<5.7	0.0016t
Toxaphene	330[d]	37[d]	NA	<5	0.0002	230[d]	NA
Organic Compounds							
Total PAHs	0.42	27	NA	5	NA	3	4.02

a: Shacklette and Boerngen (1984), except for silver which represents average concentration in the earth's crust from Lindsay (1979).
b: Quality Criteria for Water (U.S. EPA 1993). Lowest value was chosen from fresh and marine water criteria because stream is tidally influenced.
c: Effects range-low; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long, et al. (1995).
d: Toxaphene analyses performed by EPA - ESD per method determined by EPA Toxaphene Task Force June 4, 1993.
e: Lowest Observed Effect Level (U.S. EPA 1993).
t: DDT total
ND: Not detected; detection limit not available.
NA: Screening guidelines not available; data not available.

ment also show evidence of contamination. Maximum toxaphene concentrations (27 ppm) were found in forage fish collected near the Hercules outfall. In larger fish, contaminants that appear to be toxaphene were found in all samples, with fish from Dupree Creek most affected at concentrations of 3.9 ppm (U.S. EPA 1997b).

All “on-site” soil samples were collected from within the boundaries of Areas 1, 2, and 3 (Figure 2). Additional soil samples were collected from nearby areas (some residential) and labeled as “community” soils. These samples were mainly collected to the west and northwest of Area 1 on the opposite side of Dupree Creek and northwest of Area 2. Groundwater samples were collected from three wells in Area 3. Surface water and sediment samples were retrieved from the Back River, Terry Creek, and Dupree Creek, and wetland sediment samples were collected near the banks of these waterways (Black & Veatch 1997).

The trace elements arsenic, lead, mercury, and zinc in on-site soils, and in soils from the community surrounding the site, were found to exceed average U.S. soil concentrations. Copper and silver were also detected at elevated concentrations in on-site soils, while chromium exceeded the mean U.S. soil concentration in community soil samples. However, mercury was the only inorganic substance detected in groundwater samples at concentrations exceeding the AWQC by a factor greater than 10. In surface water, copper exceeded its AWQC in Terry Creek, as did mercury in Dupree Creek. Arsenic, copper, lead, mercury, and zinc concentrations all exceeded ERL guidelines in sediment samples taken from Terry Creek and the Hercules outfall area. Sediment samples from wetlands to the east of Area 1 contained arsenic, copper, lead, and mercury concentrations at least twice the ERL guideline (Long et al. 1995).

Toxaphene and 4,4’-DDE were detected in both on-site and community soils, with the highest concentrations in on-site soils. Screening guidelines are not available for these pesticides in soil. Toxaphene was not detected in groundwater or surface water samples. Detection limits for toxaphene in surface water were not stated in the 1995-96 investigation, but a 1987 study reported a detection limit of 0.3 µg/L, far exceeding the AWQC chronic guidelines of 0.0002 µg/L (Costello 1987). On-site sediments contained concentrations of 4, 4’-DDE over 45 times the ERL. Toxaphene was measured at 29 mg/kg in on-site sediments and 31 mg/kg in wetland sediments from the upper reaches of Dupree Creek. A screening guideline for toxaphene in sediment was not available. In a 1995 study, toxaphene was measured at concentrations of 19 and 27 mg/kg in tissues from two fish samples collected in Terry Creek (Parsons and Auwarter 1997). Concentrations above 0.4 to 0.6 mg/kg wet weight may be hazardous to fish (Eisler and Jacknow 1985).

Concentrations of PAHs, including acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b and/or k) fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, and benzo(g,h,i)perylene, were detected in both on-site and community soils, but screening guidelines for PAHs in soils have not been developed. No organic compounds were detected in groundwater samples. PAHs were detected in surface water, but an AWQC guideline for total PAHs has not been developed. Total PAHs were also measured in sediment samples, but did not exceed the ERL.

Summary

Terry Creek, Dupree Creek, the lower Back River, and St. Simons Sound provide important nursery and adult forage habitat for numerous trust species in the area of the Terry Creek Dredge Spoil Areas/Hercules Outfall site. Soils, surface water, sediments, and fish are contaminated to varying degrees with trace elements, pesticides, and PAHs. Surface water and sediments contain contaminants at concentrations that pose a threat to NOAA trust resources.

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4

Tyndall Air Force Base

Bay County, Florida
CERCLIS #FL1570024124

Site Exposure Potential

Tyndall Air Force Base occupies 11,650 ha at the end of a 26-km peninsula in Bay County, western Florida (Figure 1). The site is surrounded by East Bay, St. Andrew Bay, St. Andrew Sound, and the Gulf of Mexico.

Tyndall Air Force Base is an Air Combat Command facility activated in 1941. Many operations at the site involved the use of hazardous substances. Of the 29 CERCLA sites identified during the base-wide Installation Restoration Program (IRP), 16 require further action (Rust E&I 1997). EPA and Florida DEP approved determinations of no further action for the remaining 13 CERCLA sites. Table 1 describes the 16 sites requiring further action; Figure 1 shows their locations.

Tyndall Air Force Base was added to the National Priorities List based on the presence of DDT and its breakdown products in sediments of Shoal Point Bayou, also known as Fred Bayou (EPA 1995). The bayou, designated Site OT-29, is next to the Old Pesticide Building, where DDT and other pesticides were stored, and possibly discarded. Documentation for the start of DDT use at the base has not been found. About 80 drums containing approximately 45 metric tons of DDT were removed from the Old Pesticide

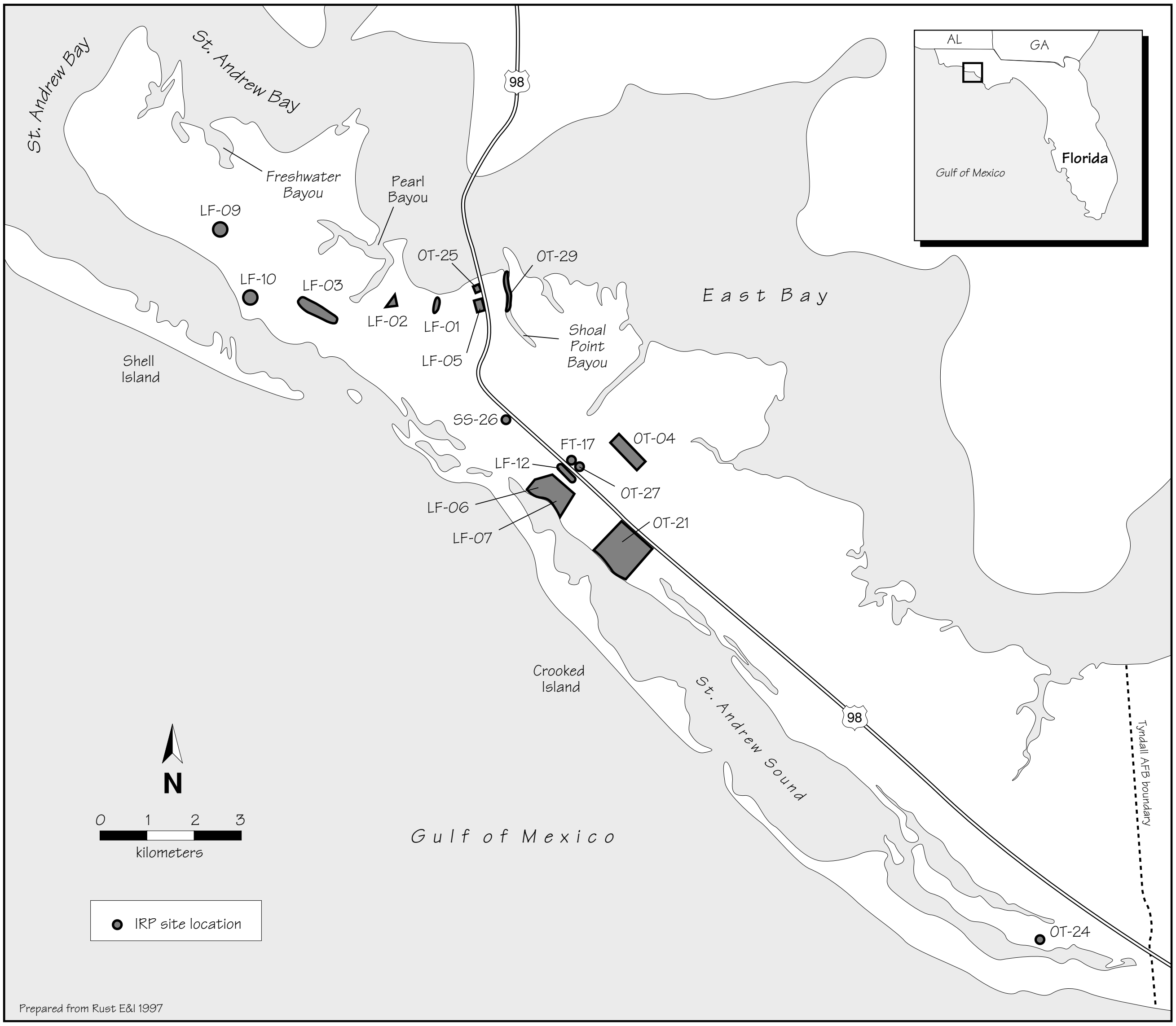

Figure 1. Location of Tyndall Air Force Base and IRP sites in Bay County, Florida.

Building in the mid-1970s. An unspecified number of these drums were leaking. Somewhat later, the Old Pesticide Building either burned down or was demolished, and the remaining debris was buried on the facility at an unspecfied location (EPA 1995). DDT also may have been discarded in two landfills on the facility; the 6000 Area Landfill (Site LF-05) and a waste disposal area near the sewage treatment plant (Site LF-06; EPA 1995).

Surface water runoff and groundwater discharge are potential contaminant migration pathways to NOAA trust resources. The topography of

Table 1. Sixteen CERCLA sites at Tyndall Air Force Base requiring further action.

IRP Number	Description	Disposed Materials	Date of Operation	Site Status
LF-01	Wherry Landfill	General refuse and mess hall waste landfill.	1943-1948	SI Required
LF-02	Sabre Drive Landfill	General refuse landfill.	1943-1965	SI Required
LF-03	Beacon Beach Road Landfill	General refuse landfill.	1952-1965	SI Required
OT-04	Southeast Runway Extension Burial Site	Containers, drums, batteries, and parts.	1945-1965	RI Required
LF-05	6000 Area Landfill	Containers, drums, batteries, and parts.	1945-1965	RI Required
LF-06	Sewage Plant Vicinity Landfill	Main sanitary landfill. Also concrete-encased asbestos, wrecked drones, and receptacles containing waste oils and solvents.	1965-1973	RI Required
LF-07	Spray Field Vicinity Landfill	Main sanitary landfill. Also, other unidentified materials.	1973-1977	RI Required
LF-09	Capehart Burial Site	Buried rubble and burned debris from about 40 houses destroyed in the 1962 tornado.	1962	SI Required
LF-10	Capehart Marina Rubble Storage	Concrete rubble stored above ground.	1962	SI Required
LF-12	Highway 98 Burial Site	Building rubble and debris from burial of demolished base housing.	1960s	SI Required
FT-17	Highway 98 Fire Training Area	Waste petrroleum, oil , and lubicants stored in two 20,000-gallon tanks and later burned in the burn pit area. Leaks from stored PCB transformers.	1952-1968	RI/FS In Progress
OT-21	Explosive Ordnance Range Burn/Burial Pits Site	Buried residue from incineration or detonation of unused ordnance.	1950s-1980s	IRA In Progress
OT-24	9700 Area Batch Asphalt Plant	Asphalt production waste.	1975-1988	RI Required
OT-25	Small Arms Repair Area	Waste paints and solvents poured into an open pit and then covered with soil.	1965-1972	RI Required
SS-26	Vehicle Maintenance Area	Two 10,000-gallon fuel USTs, hazardous waste accumulation area, waste oil tank, and oil/water separators. Small spills associated with normal vehicle maintenance.	1950s-present	RI/FS In Progress
OT-29	Shoal Point Bayou	DDT and breakdown products in bayou sediments.	1970s	RI/FS In Progress

IRA: Interim Remedial Action
RI: Remedial Investigation
SI: Site Investigation

Tyndall Air Force Base is relatively flat with a maximum elevation of approximately 9 m. No detailed information on surface water flow from each of the sites was available. In general, runoff from areas on the north side of U.S. Highway 98 flows into East Bay and St. Andrew Bay, and runoff from the south and west sides of U.S. Highway 98 flows into St. Andrew Sound, St. Andrew Bay, and the Gulf of Mexico (CH2M Hill 1981).

The surficial aquifer near the base is composed of highly transmissive, well-sorted, fine- to medium-grained sands, extending to 34 m deep, where clayey-sand strata are encountered (Rust E&I 1997). No information was available regarding the continuity of this unit. Groundwater depths typically range from 0.3 to 0.9 m bgs. The water table is relatively flat throughout Tyndall Air Force Base, but fluctuates up to 1.5 m in response to seasonal rainfall and tidal cycles. A groundwater divide beneath Highway 98 separates areal flows to the northeast and southwest, but shallow groundwater flows toward nearby bayous, streams, and ditches. The surficial aquifer is the principal concern with regard to contaminant transport because it is both highly permeable and shallow (Rust E&I 1997).

NOAA Trust Resources and Habitats

The primary habitats of concern to NOAA are surface water and bottom substrates of the St. Andrew Bay estuary, of which East Bay, St. Andrew Bay, and St. Andrew Sound are next to the base. Of particular concern are several tidal bayous and associated wetlands that receive drainage from the base. The Gulf of Mexico lies beyond St. Andrew Bay and St. Andrew Sound. The many estuarine fish and invertebrates that use the embayments and nearshore Gulf are the resources of concern to NOAA. Table 2 lists those species most abundant in the area.

East Bay and St. Andrew Bay are protected, shallow embayments generally less than 15 m deep with moderate salinities of 20 to 30 ppt. Shoal Point Bayou, Pearl Bayou, and Freshwater Bayou, which drain from Tyndall Air Force Base into East Bay, range from less than 1 m deep to 4 m deep, with highly variable salinities depending upon precipitation and runoff. St. Andrew Sound is predominantly shallow, with a maximum depth of 10 m, and more marine salinities of 32-35 ppt (USGS 1982a; USGS 1982b; Schafer 1997).

Sediments in the estuary range from fine sands to silts. Quartz sand sediments predominate next to the beach and dune areas of St. Andrew Sound and lower St. Andrew Bay. Sandy silts to silts predominate in East Bay, particularly in Shoal Point Bayou (Rust E&I 1993; Schafer 1997). There are large salt-marsh wetlands, dominated by *Spartina* spp., along the East Bay shore of the base (CH2M Hill 1981).

Over 120 species of finfish and invertebrates have been reported in the St. Andrew Bay estuary near the base (Geraghty & Miller, 1991). Table 2

Table 2. NOAA trust species that use the St. Andrew Bay estuary next to Tyndall Air Force Base.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
MARINE/ESTUARINE FISH						
Atlantic croaker	*Micropogonias undulatus*		♦	♦		♦
Bay anchovy	*Anchoa mitchilli*	♦	♦	♦		
Blue runner	*Caranx crysos*		♦	♦		♦
Bluefish	*Pomatomus saltatrix*		♦	♦		♦
Code goby	*Gobiosoma robustum*	♦	♦	♦		
Gulf flounder	*Paralichthys albigutta*		♦	♦		♦
Gulf menhaden	*Brevoortia patronus*		♦	♦		
Hardhead catfish	*Arius felis*	♦	♦	♦		
Pinfish	*Lagodon rhomboides*		♦	♦		
Red drum	*Sciaenops ocellatus*		♦	♦		♦
Sand seatrout	*Cynoscion arenarius*		♦	♦		♦
Sheepshead minnow	*Cyprinodon variegatus*	♦	♦	♦		
Silver perch	*Bairdiella chysoura*	♦	♦	♦		
Silversides	*Menidia spp*	♦	♦	♦		
Spanish mackerel	*Scomberomorus maculatus*		♦	♦		♦
Spot	*Leiostomus xanthurus*		♦	♦		♦
Spotted seatrout	*Cynoscion nebulosus*		♦	♦		♦
Striped mullet	*Mugil cephalus*		♦	♦		♦
INVERTEBRATE SPECIES						
Bay scallop	*Argopecten irradians*	♦	♦	♦	♦	♦
Bay squid	*Lolliguncula brevis*	♦	♦	♦		
Blue crab	*Callinectes sapidus*	♦	♦	♦	♦	♦
Brown shrimp	*Penaeus aztecus*		♦	♦	♦	♦
Eastern oyster	*Crassostrea virginica*	♦	♦	♦	♦	♦
Grass shrimp	*Palaemonetes pugio*	♦	♦	♦		
Pink shrimp	*Penaeus duorum*		♦	♦	♦	♦

presents the NOAA trust species considered abundant in the estuary. The smaller species of fish, such as bay anchovy, code goby, sheepshead minnow, silversides, and silver perch, spend their entire lives within the estuary. Most of the other fish found in the bay spawn in coastal areas and use East Bay, St. Andrew Bay, and St. Andrew Sound as juvenile nurseries. Non-spawning adults use the estuary seasonally (Nelson et al. 1992).

Both adult and juvenile blue crab are highly abundant in the St. Andrew Bay estuary. Crab mate in low-salinity areas, such as the bayous of East Bay. After mating, the males remain in low-salinity waters, while the females migrate to undiluted seawater zones to brood eggs. Larvae are released in areas of undiluted marine salinities. The planktonic larvae are subsequently transported back into the estuary, where they settle to the bottom and metamorphose.

Grass shrimp, an abundant nearshore species, spend their entire life within the estuary, in salt marshes and oyster reef habitats. Brown and pink shrimp are also abundant, particularly the juvenile stages. Adults use the estuary seasonally. Although not as abundant, eastern oyster and bay scallop also use the estuary (Nelson et al. 1992).

There are two federally threatened or endangered sea turtles near the base. The federally threatened Atlantic loggerhead sea turtle (*Caretta caretta*) and the endangered green sea turtle (*Chelonia mydas*) use the coastal waters of St. Andrews Bay and St. Andrew Sound seasonally (CH2M Hill 1981).

There are both commercial and recreational fisheries for finfish, blue crab, oyster, and scallop in East Bay, St. Andrew Bay, and St. Andrew Sound (Schafer 1997). In 1993, Tyndall Air Force Base posted a catch-and-release advisory for Shoal Point Bayou (EPA 1995). East Bay, along the northeast boundary of Tyndall Air Force Base, is classified by the State of Florida as Class II water, designated for shellfish propagation and harvesting. The waters at the northwest end of the base are a designated Aquatic Preserve. The rest of the estuary around the base is designated Class III waters for recreation and propagation of fish and wildlife (Geraghty and Miller 1991).

Site-Related Contamination

Site OT-29, Shoal Point Bayou, is the only active CERCLA site for which data were available for comparison with NOAA screening guidelines. At Site OT-29, elevated concentrations of DDT and its breakdown products have been measured in sediment and surface water. DDT contamination in Shoal Point Bayou was first observed in 1985 during area-wide sediment sampling conducted by the U.S. Fish and Wildlife Service (EPA 1995). One sediment sample composited from five cores taken along the centerline of Shoal Point Bayou contained substantially higher concentrations of DDT (4400 µg/kg) and its breakdown products, DDE and DDD, than did any of the other 36 sediment samples collected throughout the St. Andrew Bay estuarine complex.

In 1990, the U.S. Fish and Wildlife Service collected an additional 28 sediment samples from Shoal Point Bayou to follow up on the 1985 sediment sampling (Brim 1990). DDT and/or its breakdown products were detected in 54% of the samples at a detection limit of 97 µg/kg, considerably higher than the ERL of 1.58 µg/

kg. Measured concentrations ranged from 100 to 1300 µg/kg of DDT and metabolites in Shoal Point Bayou sediments.

In 1992, groundwater samples were collected from six on-site monitoring wells and analyzed for DDT and its breakdown products. None of these pesticides was detected, but the detection limit of 0.1 µg/L was two orders of magnitude higher than the marine chronic AWQC of 0.001 µg/L. Ten soil samples were collected in 1993 and analyzed for pesticides (USACE 1993; EPA 1995). In addition to DDT and its breakdown products, elevated concentrations of chlordane were detected. Table 3 shows maximum concentrations in soil. Screening guidelines for pesticides in soil have not been developed.

A preliminary assessment/site investigation was completed for Site OT-29 in 1992 (Rust E&I 1993). Higher concentrations of DDD, DDE, and DDT were detected in sediment during this study than in any of the previous studies (Table 3). Of the seven sediment samples collected, one sample contained 1,000 to 12,000 µg/kg of DDT and breakdown products; five of the seven samples had concentrations ranging from 62 to 910 µg/kg; and in one sample concentrations were not detected above the detection limit of 26 µg/kg. Surface water samples were collected in 1992, but DDT and/or breakdown products were not detected at the detection limit of 0.1 µg/L, which is two orders of magnitude higher than the marine chronic AWQC of 0.001 µg/L.

Table 3. Maximum concentrations of pesticides in soil and sediment collected from Site OT-29 at Tyndall Air Force Base.

Contaminant	Soil (µg/kg)	Sediment (µg/kg)	
	1993[a]	1992[b]	ERL[c]
DDD	1,600	2,600	1.58[d]
DDE	860	1,100	2.2
DDT	1,200	12,000	1.58[d]
alpha Chlordane	14	NA	NA
gamma Chlordane	9.1	NA	NA
Technical Chlordane	4,200	NA	NA

NA: Not analyzed
a: USACE 1993
b: Rust E&I 1993
c: Effects-range low concentration; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long et al. (1995).
d: ERL for total DDT.

Summary

There are many potential hazardous waste areas at Tyndall Air Force Base although data from only OT-29, Shoal Point Bayou, were available for screening against NOAA guidelines. Very high concentrations of DDT and its breakdown products were detected in soil and sediment from the Shoal Point Bayou area. Concentrations in bayou sediment, four orders of magnitude higher than screening guidelines, threaten the many NOAA trust species that use the estuary surrounding Tyndall Air Force Base.

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6

Madisonville Creosote Works

Madisonville, Louisiana
CERCLIS #LAD981522998

Site Exposure Potential

The Madisonville Creosote Works site covers approximately 12 ha in a predominantly wooded, rural area in St Tammany Parish about 3 km west of Madisonville, Louisiana. The facility is 2 km north of Lake Pontchartrain, a coastal tidal water body (Figure 1). Drainage from the site enters an unnamed, intermittent stream that empties into the Black River and farther downgradient into a series of large, perennial wetlands. This wetland is contiguous with Lake Pontchartrain, a shallow estuary which flows into Mississippi Sound approximately 90 km from the site. Mississippi Sound is an embayment of the Gulf of Mexico.

The Madisonville Creosote Works facility was opened in 1956; wood products were treated with creosote at the facility until operations ceased in 1984. From the 1960s to 1984, creosote sludge and wastewater were concentrated by sprinkler evaporation. Residual process waste liquids were stored in two process water ditches and two evaporation ponds (Figure 2). Waste creosote and wastewater drained from the process water ditches into Evaporation Pond No.1. Solids settled in Pond No.1 and water overflowed through a depression in the dike to Evaporation Pond No. 2. The Rainwater Pond provided backup containment of overflow from Evaporation Pond No. 2. The Fish Pond was

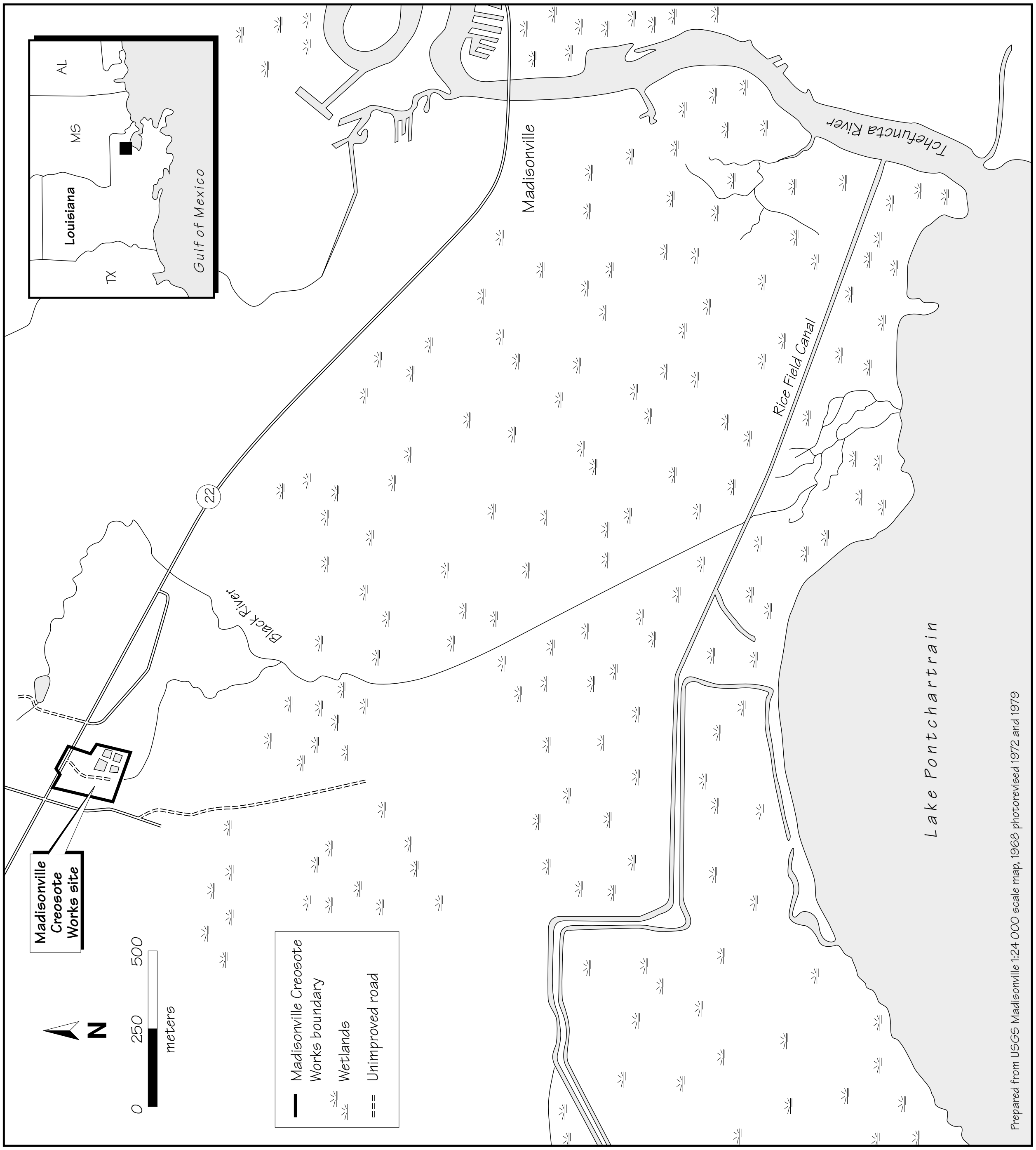

Figure 1. Location of the Madisonville Creosote Works site in Madisonville, Louisiana.

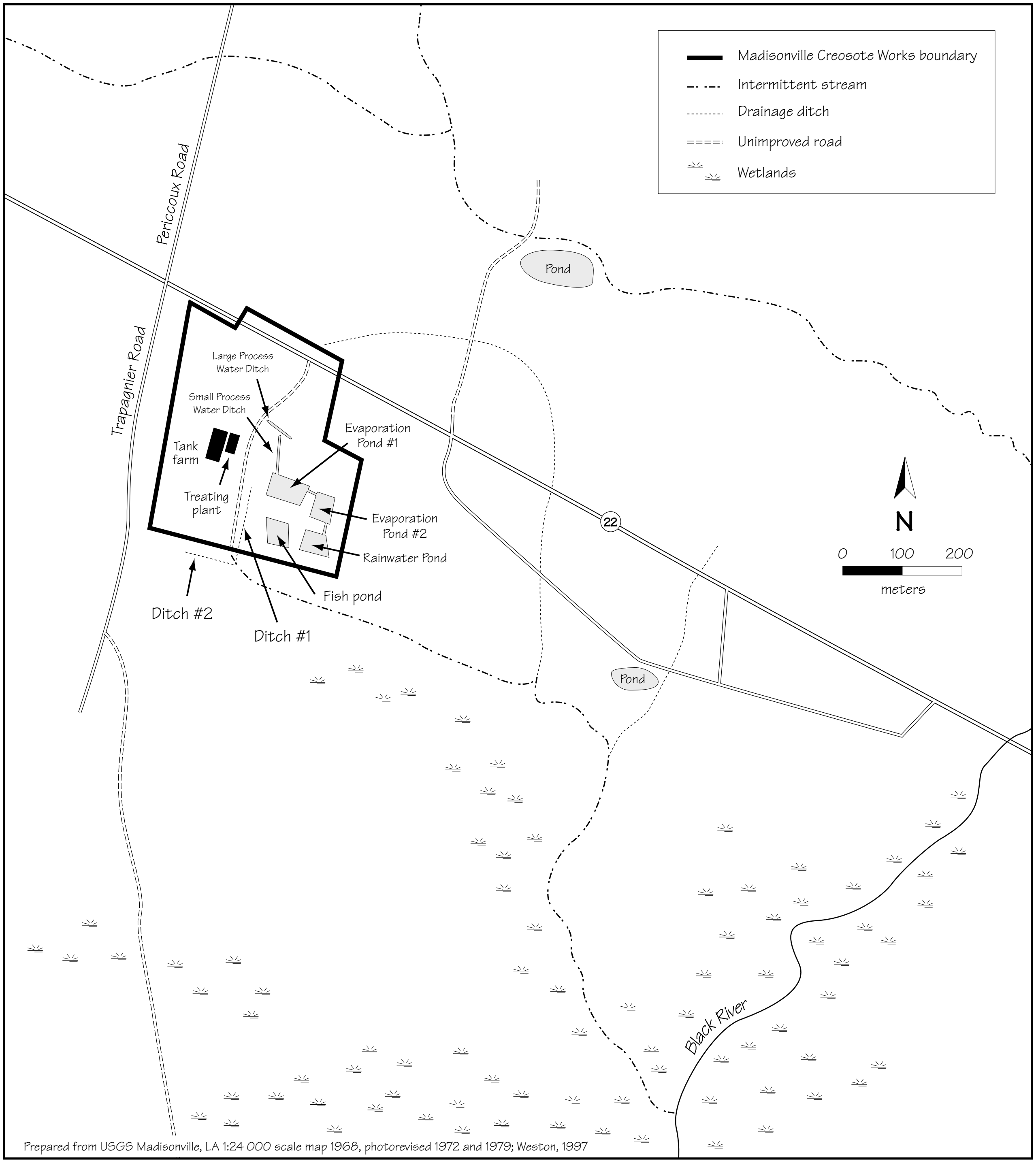

Figure 2. Detail of the Madisonville Creosote Works site.

intended for expansion of the evaporation ponds. Approximately 15 aboveground storage tanks (ASTs) that were used to store creosote and wastewater remain on-site. During a site inspection in 1995, eleven of these tanks still contained liquids.

The four surface impoundments and the process ditches were closed as hazardous waste management units in 1986. Closure activities included the removal and off-site incineration of contaminated sludge and soil. The units were then backfilled with a 0.6-m clay layer and vegetated. Post-closure sampling indicated the presence of residual creosote contamination in soils collected from these areas (Weston 1996).

Creosote contamination has been measured at the site in soils, sediments, and groundwater. Primary source contamination is in the form of liquid creosote or creosote sludge. Chemically, creosote consists primarily of PAHs. Past releases of PAHs from site source areas to site soil and groundwater and off-site ditches has been visually observed and confirmed by laboratory analysis. Secondary source contamination is in the form of contaminated soil (dried creosote particles in the soil or soil saturated with liquid creosote), pooled dense nonaqueous phase liquids (DNAPL) in subsurface soil, and dissolved contamination in groundwater.

Groundwater discharge, DNAPL migration, and surface water runoff are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. A drainage ditch immediately west of the former evaporation ponds (Ditch #1) drains surface water to the south where it joins a second drainage ditch (Ditch #2) to form an intermittent stream that flows from the northwest to the southeast approximately 1.2 km before its confluence with the Black River (Figure 2). After the confluence, the Black River crosses a large, perennial wetland beginning approximately 1.1 km southeast of the site and intersects the Rice Field Canal before continuing to Lake Pontchartrain (Figure 1).

The Madisonville Creosote Works is located on the Pleistocene prairie terrace in poorly drained, gently sloping, loamy soils. There are three aquifers below the site: the Shallow Aquifer, the Upper Ponchatoula Aquifer, and the Lower Ponchatoula Aquifer, all of which are thought to be hydraulically connected. A groundwater investigation at the site showed that creosote contamination was greatest at the center of the site. The groundwater in the upper alluvial deposits was shown to mound and flow radially from the center of the facility (Weston 1997).

NOAA Trust Habitats and Species

The primary habitats of concern to NOAA are the downstream surface waters, riparian wetlands, and bottom substrates of the Black River and Lake Pontchartrain. Numerous fish and invertebrate species use the estuary and are the NOAA trust resources of concern (Table 1).

Table 1. Representative NOAA trust species found in Lake Pontchartrain.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
American eel	*Anguilla rostrata*		◆			
Gizzard shad	*Dorosoma cepedianum*		◆			
Gulf sturgeon	*Acipenser oxyrhynchus*		◆	◆		
MARINE/ESTUARINE SPECIES						
Atlantic croaker	*Micropogonias undulatus*		◆	◆		◆
Bay anchovy	*Anchoa mitchilli*	◆	◆	◆		
Black drum	*Pogonias cromis*		◆	◆		◆
Code goby	*Gobiosoma robustum*	◆	◆	◆		
Crevalle jack	*Caranx hippos*		◆			
Gulf killifish	*Fundulus grandis*	◆	◆	◆		
Gulf menhaden	*Brevoortia patronus*		◆			
Hardhead catfish	*Arius felis*	◆	◆	◆		
Pinfish	*Lagodon rhomboides*		◆	◆		
Red drum	*Sciaenops ocellatus*		◆			◆
Sand seatrout	*Cynoscion arenarius*		◆	◆		◆
Sheepshead	*Archosargus probatocephalus*		◆	◆		◆
Sheepshead minnow	*Cyprinodon variegatus*	◆	◆	◆		
Silver perch	*Bairdiella chrysoura*		◆	◆		
Silversides	*Menidia spp.*	◆	◆			
Southern flounder	*Paralichthys lethostigma*		◆	◆		◆
Spot	*Leiostomus xanthurus*		◆	◆		◆
Spotted sea trout	*Cynoscion nebulosus*		◆	◆		◆
Striped mullet	*Mugil cephalus*		◆	◆		◆
Tarpon	*Megalops atlanticus*		◆			
INVERTEBRATE SPECIES						
Bay squid	*Lollinguncula brevis*		◆			
Blue crab	*Callinectes sapidus*		◆	◆	◆	◆
Brown shrimp	*Penaeus aztecus*		◆	◆	◆	◆
Eastern oyster	*Crassostrea virginica*	◆	◆	◆		◆
Grass shrimp	*Palaemonetes pugio*	◆	◆	◆		
Rangia	*Rangia cuneata*	◆	◆	◆	◆	◆
White shrimp	*Penaeus setiferus*		◆	◆	◆	◆

Lake Ponchartrain is a shallow, enclosed estuary of low salinity (0.5-5.0 ppt). The Lake depths are generally less than 5 m, and sediments range from fine sand to silt (USGS 1968a,b; Gosselink 1984). Drainage from the site runs into the Black River, which empties into a large Cypress-Tupelo swamp. Farther downgradient, the swamp is dominated by bull-tongue (*Sagitaria* sp.), and eventually saltmarsh hay (*Spartina patens*) before joining Lake Ponchartrain (Day et al. 1989).

The estuary is used by numerous fish for adult habitat, juvenile nurseries, and spawning; and as a migratory corridor to several rivers within the watershed. Small estuarine fish such as bay anchovy, code goby, Gulf killifish, silversides, and sheepshead minnow spend their entire lives within the estuary (Table 1). Larger species are present in the estuary primarily during estuarine-dependent juvenile life stages. Adults of these species are present in the estuary seasonally. Like most of the marine species listed in Table 1, tarpon and crevalle jack spawn along the coast, but the juveniles require estuarine environments for survival (Nelson et al. 1992).

Lake Pontchartrain is a migratory corridor for the anadromous Gulf sturgeon and gizzard shad. Both species migrate up the Tchefuncta River, located approximately 5 km east of the site. The catadromous American eel also migrates to most larger streams that drain into the estuary. Anadromous species are not expected to use the Black River around the site because of its small size (Rogilio 1997).

Blue crab are abundant in Lake Pontchartrain. Juvenile stages of brown shrimp and white shrimp are abundant in the estuary on a seasonal basis. After mating, the females return to full seawater zones to brood eggs while the males often remain in low-salinity waters. Larvae are released by females offshore, and are subsequently transported back into the estuary where they settle to the bottom.

Grass shrimp spend their entire lives within the estuary and are commonly found in saltmarsh and oyster reef habitats. Juvenile stages of brown shrimp and white shrimp are abundant in the estuary on a seasonal basis. Of the bivalve species, rangia are most abundant, followed by eastern oyster. All life stages of these bivalves are found within the estuary (Nelson et al. 1992).

Several species are commercially harvested in Lake Pontchartrain; the largest fisheries are for brown shrimp, white shrimp, and blue crab. Substantial recreational fisheries are also present in the estuary; the most commonly harvested species include seatrout, croaker, red drum, blue crab, and rangia (Burdon 1997).

Site-Related Contamination

Data collected in a series of site investigations show elevated concentrations of trace elements and organic compounds (PAHs and pesticides) in groundwater and surface soils collected at the site (LDEQ 1993; E&E 1996) and in surface water and sediment samples collected from off-site areas (ESE 1991; E&E 1995, E&E 1996). Creosote contamination in two off-site areas was investigated during a 1991 remedial investigation (RI; ESE 1991). Soils collected from the drainage ditch located north of the facility and the intermittent stream southeast of the facility were reported to be contaminated with creosote (Figure 2). The RI identified creosote contamination in 90 m of the drainage ditch and in 700 m of the unnamed intermittent stream south of the site. A subsequent remedial action resulted in the removal and disposal of substrates from 290 m of the intermittent stream. The remaining contamination has not been removed. Maximum concentrations of the major contaminants at the site are listed in Table 2 along with the appropriate screening guidelines.

Lead concentrations in both groundwater and surface water, and mercury in surface water, exceeded chronic AWQCs (Table 2). Concentrations of arsenic, barium, lead, and mercury in site soils exceeded mean U.S. concentrations. Lead and mercury in sediment from the drainage ditch exceeded the ER-L values for these trace elements. However, concentrations of trace elements in sediment and surface water of the Black River near the site (Weston 1997) did not exceed screening values.

PAH concentrations measured in on-site groundwater, surface water, soils, and sediments were high compared to the screening concentrations for these media (Table 2). However, the available data suggest that PAH contamination is now limited to the site and off-site drainage ditches. The concentrations of PAHs reported in surface water and sediments collected from the Black River in the vicinity of the site (Weston 1997) did not exceed screening values for these compounds.

Some limited exceedances of screening criteria were observed for pesticides in surface water and sediments in the drainage ditch. The maximum surface water concentration of endrin exceeded the AWQC and the sediment concentrations of 4,4'-DDE in the drainage ditch exceeded the ER-L concentration. However, pesticides were not detected in either the water or sediments of the Black River.

Summary

A series of site investigations indicate that soil and groundwater collected at the Madisonville Creosote site, and the sediments and surface waters in drainage ditches near the site, are contaminated with trace elements, PAHs, and pesticides. Surface runoff, DNAPL migration, and groundwater discharge are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. The primary habitats of concern to NOAA are estuarine surface waters, riparian wetlands, and bottom substrates of Black River and Lake Pontchartrain.

Table 2. Maximum concentrations of contaminants of concern at the Madisonville Creosote Works site.

	Water			Soil		Sediment	
	Ground-water[a] (µg/L)	Surface Water[a,b] (µg/L)	AWQC[c] (µg/L)	Surface Soils[a] (mg/kg)	Mean U.S.[d] (mg/kg)	Sediment[a,b] (mg/kg)	ERL[e] (mg/kg)
TRACE ELEMENTS							
Arsenic	NA	12.3	36	14.3	5	6.5	8.2
Barium	202	650	NA	774	440	376	NA
Lead	30.7	54	8.5	273	16	181	46.7
Mercury	NA	0.24	0.012	7.0	0.058	0.490	0.150
ORGANIC COMPOUNDS							
PAHs							
Naphthalene	30500	ND	620 [f]	85.0	NA	4990	0.16
2-Methylnaphthalene	7200	ND	NA	8.5	NA	21900	0.07
Acenaphthylene	440	ND	NA	180	NA	37.3	0.04
Acenaphthene	8200	5.3	520 [f]	1260	NA	30900	0.02
Fluorene	6470	ND	NA	1450	NA	5300	0.02
Phenanthrene	14800	32.9	4.6p	2360	NA	14500	0.24
Anthracene	1710	2.00	NA	1180	NA	16300	0.09
Fluoranthene	8200	40.1	16 [f]	2190	NA	3010	0.60
Pyrene	5000	31.1	NA	2120	NA	3940	0.67
Chrysene	1610	13.1	NA	1570	NA	2760	0.38
Benz(a)anthracene	1680	1.00	NA	412	NA	834	0.26
Benzo(b)fluoranthene	1240	2.00	NA	350	NA	295	NA
Benzo(k)fluoranthene	1400	10.1	NA	33	NA	470	NA
Benz(a)pyrene	594	1.00	NA	393	NA	242	0.43
Benzo(g,h,i)perylene	220	ND	NA	57	NA	24	NA
Indeno(1,2,3-cd)pyrene	250	ND	NA	69	NA	31	NA
Dibenz(a,h)anthracene	80	ND	NA	27	NA	10	0.063
Pesticides							
alpha-Chlordane	NA	ND	0.0043	ND	NA	0.038	NA
4,4'-DDE	NA	ND	0.014[f]	0.83	NA	0.058	0.0022
4,4'-DDT	NA	ND	0.001	0.0073	NA	0.091	0.0016t
Endrin	NA	0.10	0.0023	ND	NA	0.0082	NA

a: Maximum concentrations cited in Weston (1997).
b: Surface water and sediment concentrations reported for off-site drainage ditches.
c: Ambient Water Quality Criteria (U.S. EPA 1993). Lowest value was chosen from fresh- and marine-water criteria because river is estuarine.
d: Shacklette and Boerngen (1984).
e: Effects range-low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long et al. (1995).
f: Lowest Observed Effect Level (U.S. EPA 1993).
ND: Not detected; detection limit not available.
NA: Screening guidelines not available; data not available.
p: Proposed criterion.
t: DDT total.

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10

Oeser Company

Bellingham, Washington
CERCLIS #WAD008957243

Site Exposure Potential

The Oeser Company (Oeser) site is a 9-ha wood treating facility operating in Bellingham, Whatcom County, Washington (Figure 1). Surrounding land use is mixed residential and industrial. The topography is generally flat with a gentle slope toward the southeast, except due south of the site, where the terrain drops steeply for approximately 12 m to a ravine and Little Squalicum Creek. Approximately 500 m downstream, Little Squalicum Creek enters Bellingham Bay.

The Oeser Company has had a wood-preserving operation at this location since 1948. From 1948 to 1973, Oeser treated utility poles with creosote to retard deterioration of the wood. Oeser began using a pentachorophenol (PCP) in oil treatment in the 1960s, and PCP is the only preservative now used. The wood treatment processes generate process wastewater and a waste sludge material. Until 1986 waste sludge was accumulated on-site and then transported to an approved landfill. The quantity of sludge generated, the frequency of removal, and the method of on-site storage are not known (URS Consultants Inc. 1994).

Until 1973, wastewater from both the PCP and creosote processes was discharged to gravel percolation beds. From 1973 until 1991, process

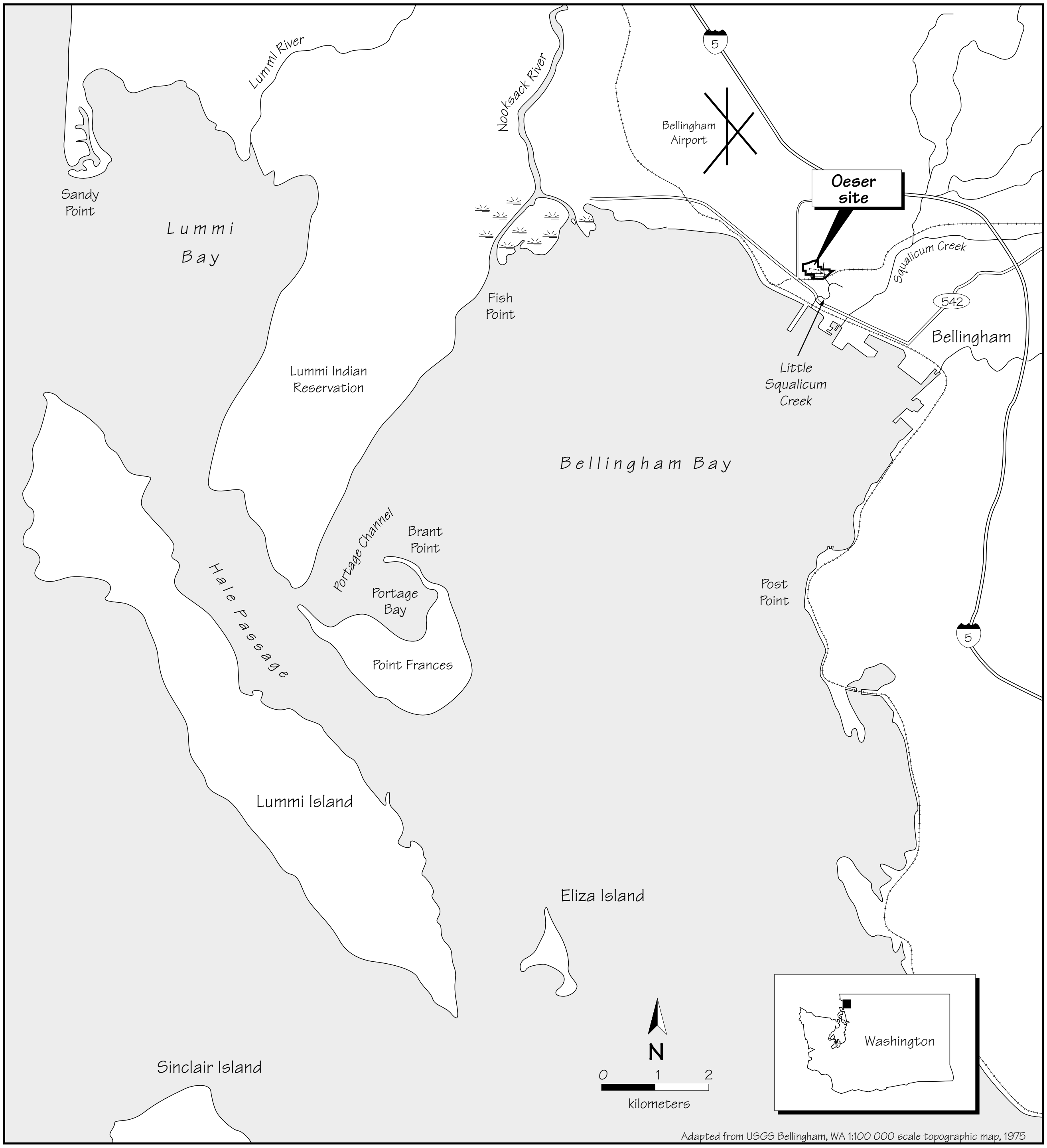

Figure 1. Location of Oeser site in Bellingham, Washington.

wastewater was discharged to an oil/water separator, and subsequently to a storm sewer under an NPDES permit (Figure 2). Since 1991, a zero-discharge wastewater treatment system has been in use (URS Consultants Inc. 1994).

Two spills of PCP preservative have been reported at the site, one in 1971 and another in 1975. In 1971, 190 L or more of the PCP and oil preservative spilled into Little Squalicum Creek. In 1975, the sump pump for an oil/water separator failed, causing overflow of PCP-oil to a drain field and, ultimately, to Little Squalicum Creek. An estimated 110 L of PCP-oil entered the creek from this spill (Ecology and Environment Inc. 1996).

The primary contaminant transport pathways are the storm sewer system, surface water runoff, and groundwater migration. Precipitation that does not infiltrate on-site flows overland to the south or southeast toward Little Squalicum Creek. Excess surface-water runoff is collected by on-site storm drains and subsequently discharged via the Oeser Outfall into Little Squalicum Creek (Figure 2; Ecology and Environment Inc. 1996).

Site geology is predominantly alluvial deposits of glacial outwash sands and gravels (URS Consultants Inc. 1994). Groundwater is present in several shallow zones and in a deeper, unconfined aquifer. Shallow groundwater is encountered 1.5 to 5 m below ground surface (bgs). This shallow groundwater is situated within deposits consisting of stratified sand and gravel, silt, and clay, which extend to approximately 8 m bgs. The deeper aquifer is encountered 7 to 12 m bgs. Groundwater in this deeper aquifer flows in a southwesterly direction in the northern portion of the site, and south-southwest to south in the southern portion of the site (Ecology and Environment Inc. 1996). Groundwater seeps have been observed downgradient from the site near the banks of Little Squalicum Creek.

NOAA Trust Habitats and Species

Habitats of primary concern to NOAA are the surface waters and bottom substrates of Little Squalicum Creek and Bellingham Bay. NOAA trust species of concern include anadromous fish that use Little Squalicum Creek and marine species found in Bellingham Bay (Table 1).

Little Squalicum Creek is located in an abundantly vegetated ravine surrounded by industrial and residential properties. Seasonal palustrine scrub-shrub wetlands are found along 0.8 km of the creek, upgradient from the site. The creek ranges from approximately 0.9 to 2.5 m wide. Near the site, the creek is generally less than 0.3 m deep, with a continuous flow ranging from less than 1 cubic foot per second (cfs) to 10 cfs (Ecology and Environment Inc. 1996).

There are no wetlands on the shore of Bellingham Bay near the mouth of Little Squalicum Creek. However, there are a variety of shoreline habitats in other parts of the Bay, including

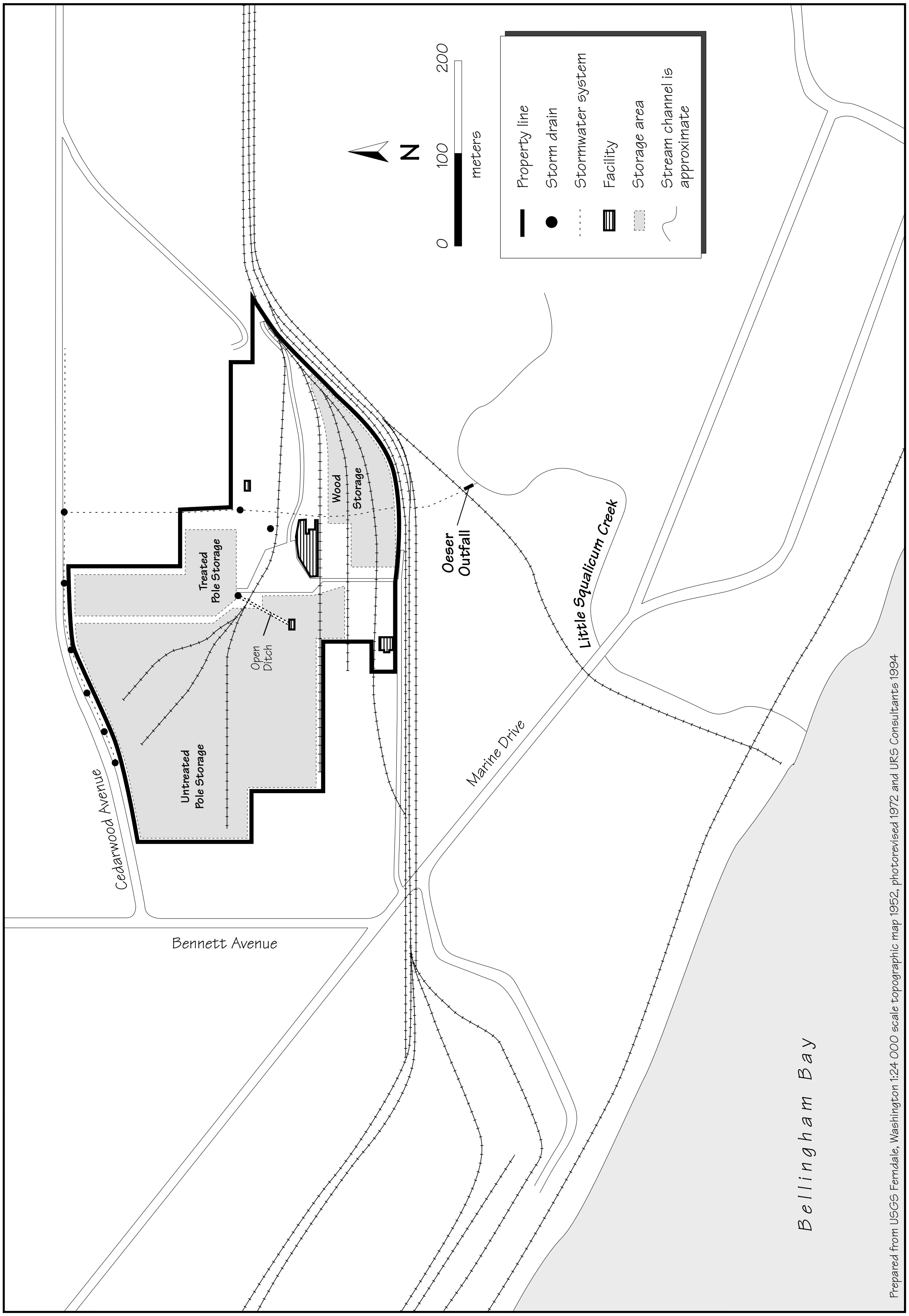

Figure 2. Detail of the Oeser site.

Table 1. NOAA trust species that use Little Squalicum Creek and Bellingham Bay (Ecology 1992).

Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning ground	Nursery ground	Adult forage	Commer cial.	Recrea-tional
ANADROMOUS FISH						
Chinook salmon	*Oncorhynchus tshawytscha*	♦	♦	♦	♦	♦
Chum salmon	*Oncorhynchus keta*	♦	♦	♦	♦	♦
Coho salmon	*Oncorhynchus kisutch*	♦	♦	♦	♦	♦
Cutthroat trout	*Oncorhynchus clarki*	♦	♦	♦		♦
Pink salmon	*Oncorhynchus gorbuscha*	♦	♦	♦	♦	♦
Sockeye salmon	*Oncorhynchus nerka*		♦	♦	♦	♦
Steelhead trout	*Oncorhynchus mykiss*		♦	♦		♦
MARINE FISH						
Cabezon	*Scorpaenichthys marmoratus*	♦	♦	♦	♦	♦
English sole	*Parophyrs vetulus*		♦	♦	♦	♦
Lingcod	*Ophidon elongatus*	♦	♦	♦		
Pacific cod	*Gadus macrocephalus*		♦	♦	♦	♦
Pacific herring	*Clupea harengus pallasi*	♦	♦	♦		
Pile perch	*Rhacochilus vacca*	♦	♦	♦	♦	♦
Rock sole	*Lepidopsetta bilineata*		♦	♦	♦	♦
Rockfish	*Sebastes spp.*	♦	♦	♦		♦
Sablefish	*Anoplopoma fimbris*			♦		♦
Sand sole	*Psettichthys melanostictus*		♦	♦		
Sculpin	*Cottus spp.*	♦	♦	♦		
Starry flounder	*Platichthys stellatus*		♦	♦	♦	
INVERTEBRATE SPECIES						
Blue mussel	*Mytilis galloprovincialis*	♦	♦	♦	♦	♦
Butter clam	*Saxidomus giganteus*	♦	♦	♦	♦	♦
Dungeness crab	*Cancer magister*	♦	♦	♦	♦	♦
Geoduck clam	*Panope generosa*	♦	♦	♦		
Hardshell clam	*Mercenaria mercenaria*	♦	♦	♦		♦
Horse gaper clam	*Tresus spp.*	♦	♦	♦		
Kelp crab	*Pugettia productus*	♦	♦	♦		
Native littleneck clam	*Protothaca staminea*	♦	♦	♦	♦	♦
Octopus	*Octopus dofleini*	♦	♦	♦		
Pacific oyster	*Crassostrea gigas*	♦				
Pink shrimp	*Pandalus spp.*	♦	♦	♦		
Softshell clam	*Mya arenaria*	♦	♦	♦		
Spot shrimp	*Pandalus platyceros*	♦	♦	♦		
MARINE MAMMALS						
California sea lion	*Zalophus californianus*			♦		
Gray whale	*Eschrichtius robustus*			♦		
Harbor seal	*Phoca vitulina*	♦	♦			
Killer whale	*Orcinus orca*			♦		
Minke whale	*Balaenoptera acutorostrata*			♦		

extensive wetlands surrounding the mouth of the Nooksack River, less than 5 km northwest of the site (Figure 1). The shoreline at the mouth of the Nooksack River consists of fine-grained sands with exposed tidal flats in the eastern channel. From this point south-southeast to the town of Bellingham, the shoreline is primarily a wave-cut platform, with some interspersed areas of gravel/cobble/riprap, exposed rocky shorelines, and seawalls. The mid-to-lower eastern portion of the bay consists primarily of exposed rocky shorelines or seawalls. From the mouth of the Nooksack River south-southwest along the Lummi Indian Reservation, the shoreline is primarily gravel/cobble/riprap with sand/gravel beaches located along the southeastern portion of the reservation and along the inner shoreline of Point Frances, just off the southern tip of the Lummi Reservation. Tidal flats are located at the very southern tip of the reservation, as well as surrounding Brant Point at the northern tip of Point Frances (Ecology 1992).

Coho and chum salmon have been observed in Little Squalicum Creek (Chapman 1997). Juvenile salmonids in Little Squalicum Creek probably use favorable areas in the lower reaches as nursery habitat before migrating to more open marine environments (Steel 1997).

Bellingham Bay also supports numerous NOAA trust resources, including chinook, chum, pink, coho, and sockeye salmon. Juvenile salmonids from the Nooksack River may use habitats along Bellingham Bay, including areas near Little Squalicum Creek, for nursery habitat (Steel 1997).

Bellingham Bay supports a variety of marine species common to Puget Sound. Common demersal residents include English and rock sole; several rockfish, sculpin, and sea perch species; and Pacific cod and lingcod. Pelagic residents include Pacific herring and sablefish. Most of these species spawn within the bay or nearby areas of Puget Sound and use the bay as a nursery.

The complex habitats within Bellingham Bay also support numerous shellfisheries (Table 1). Dungeness crab are harvested from most of the bay, as well as from areas surrounding the bay. Hardshell clams are harvested from Portage Bay, Portage Channel, offshore along the entire eastern side of Point Frances, from a small area south-southeast of Point Frances in Hale Passage, and along the eastern edge of Lummi Island (Chapman 1997).

There are marine mammals in Bellingham Bay (Table 1). The Washington State Coastal Sensitive Areas Map for Bellingham shows a harbor seal haulout offshore of Brant Point on Point Frances. Two nearby areas have designated marine mammal sightings, east and southwest of Brant Point, respectively. Species observed for these two areas were not identified, but are probably harbor seals or California sea lions. Cetaceans that migrate through the area include minke whale and gray whale (Ecology 1992).

Bellingham Bay supports important subsistence, commercial, and recreational fisheries. Commercial fishing and sportfishing areas, set net areas, and reef net areas, are mapped within and surrounding the bay in the Washington State Coastal Sensitive Areas Map for Bellingham (Ecology 1992). A large area in the northern portion of Bellingham Bay is used for set netting; this area extends from the mouth of the Nooksack River south to an unnamed point south of Fish Point and across to Post Point in the east-southeastern portion of the bay. Sportfishing takes place around Lummi Island and within Hale Passage.

Bald eagles are resident species of the Bellingham coastal zone that are federally protected under the Endangered Species Act (Ecology 1992). Bald eagles are not a NOAA trust resource, but are known to feed on migrating salmon and other NOAA trust species.

Site-Related Contamination

Investigations at the site indicate that PCP, PAHs, and dioxins/furans are the contaminants of concern to NOAA trust resources. Table 2 illustrates the maximum concentrations of these contaminants from samples collected during a 1996 site inspection. PCPs and PAHs were observed at elevated concentrations in soils, groundwater, surface water, and sediments. Trace elements sometimes associated with wood-treating (e.g., arsenic, copper, and zinc) were not reported to have been used at this site, and did not exceed screening guidelines for environmental media (Ecology and Environment Inc. 1996).

Soil samples were extensivly contaminated with PAHs and PCP. Maximum total PAH concentrations exceeded 1000 mg/kg, while maximum PCP concentrations exceeded 100 mg/kg.

Table 2. Maximum concentrations of selected contaminants detected at the Oeser Company site (Ecology and Environment Inc. 1996; U.S. EPA 1997).

		Water (µg/L)				Sediment (mg/kg)	
Organic Compound	Soil (mg/kg)[a]	NAPL (mg/kg)[b]	Ground-water	Surface Water	Marine Chronic AWQC[c]	Little Squalicum Creek	ERL[d]
Total PAHs	10,300	92,500	6,200	3.0	300[e]	97	4.0
PCP	560	13,000	NR	NR	7.9	2.2	0.36[f]
Dioxins/ Furans	0.03	NR	NR	NR	NA	NR	NA

a Screening guidelines for organic contaminants in U.S. soils are not available.
b Non-aqueous phase liquid in subsurface soils
c Ambient Water Quality Criteria (U.S. EPA 1993)
d Effects range-low (Long and MacDonald 1995)
e Lowest Observable Effect Level
f Apparent Effects Threshold (PTI 1988)
NR Not Reported
NA Not analyzed

Preliminary data indicate widespread contamination, with highest concentrations in subsurface soils south of the treated pole storage area.

PAHs and PCP were detected in both shallow and deep groundwater beneath the site. PAHs and PCP were observed in nine of thirteen wells in shallow groundwater and in all five wells screened in the deeper aquifer. Maximum concentrations of PAHs and PCP each exceeded 10,000 µg/L in the shallow groundwater. Maximum floating NAPL thickness was 2 feet (EPA 1997)

Sediment and surface-water samples collected from Little Squalicum Creek confirmed the presence of PAHs and PCP. Six sediment samples were collected in Little Squalicum Creek downstream of the site; one sample was collected upstream. Downstream sediment stations were 75 to 150 m apart, extending from the storm drain outfall to the mouth of the creek. Total PAHs were observed at all six downgradient sediment samples, ranging from 0.55 to 97 mg/kg. PCP concentrations ranged from 0.039 to 2.2 mg/kg. The highest concentration of PCP was detected in a sediment sample collected near the Oeser outfall. Three surface-water samples were collected downstream from the site at locations corresponding to the three sediment stations farthest downstream. PAH concentrations ranged from 0.031 µg/L to 3.04 µg/L total PAH. PCP concentrations in surface water were not reported. The highest PAH concentrations in surface water were at a creek station located near a groundwater seep.

Summary

High concentrations of PAHs and PCP were found in soil and groundwater at the Oeser site and in sediments of Little Squalicum Creek. PAHs were found in water samples from Little Squalicum Creek, but PCP was not reported. Adult coho and chum salmon have been observed in Little Squalicum Creek. Juvenile salmon likely use the area for nursery habitat. Numerous additional trust resources use nearby areas of Bellingham Bay. Additional information is needed regarding the extent of contamination in Little Squalicum Creek to determine the threat posed to salmon and to better characterize contaminant sources, and potential contaminant pathways, to other trust resources found in Bellingham Bay.

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