N00181.AR.001416
NORFOLK PORTS NSY
5090.3a

FINAL EXISTING CONDITIONS REPORT AND PRELIMINARY CLEAN-UP LEVEL EVALUATION NSY PORTSMOUTH VA

7/1/2000

CH2M HILL

FINAL

Existing Conditions Report
and
Preliminary Clean-up Level Evaluation

Atlantic Wood Industries, Inc.
Portsmouth, Virginia

July 2000

Prepared for

Atlantic Wood Industries, Inc.

Prepared by

CH2MHILL

Herndon, Virginia

WDC003670367/1/RPL

FINAL

Existing Conditions Report
and
Preliminary Clean-up Level Evaluation

Atlantic Wood Industries, Inc.
Portsmouth, Virginia

July 2000

Prepared for

Atlantic Wood Industries, Inc.

Prepared by

CH2MHILL

Herndon, Virginia

WDC003670367/1/RPL

Contents

List of Exhibits

1.0 Introduction

This report summarizes the available information related to the existing environmental conditions at the Atlantic Wood Industries (AWI) site in Portsmouth, Virginia as well as the soil and sediment clean-up levels that have been developed for this site. The report also provides a preliminary evaluation of the technical validity of these clean-up levels and a compilation of available soil and sediment screening values from the literature. The report was first issued in draft form for review by AWI and the Navy. This final report reflects the comments in the body of the text and response to comments (Appendix A).

1.1 Objectives

The primary objective of the overall ecological evaluation at the site (of which this report is the first part) is to evaluate the technical validity of the soil and sediment clean-up levels developed for the site in the 1995 Record of Decision (ROD) and to develop alternative site-specific clean-up levels, where appropriate, using current ecological risk assessment (ERA) methodologies. The primary objective of this report is to summarize the relevant available information on the existing conditions (e.g., habitats, chemical concentrations) at the site in order to provide the necessary data (or identify key data needs) to conduct the initial step of the site-specific ERA (problem formulation). A secondary objective of this report is to summarize available ecologically-based soil and sediment screening values from the literature for the Chemicals of Potential Concern (COPCs) identified in the ROD.

1.2 Scope

The scope of this report encompasses on-site surface soils and sediments, although it should be noted that any alternative clean-up levels developed for these media based on a site-specific ERA would need to consider the potential effects on chemical concentrations in groundwater (a potential transport medium to the Elizabeth River but not considered a source of drinking water exposures). Alternative clean-up levels developed during a site-specific ERA would also need to consider their protectiveness of human receptors.

The scope of the report is also limited to the six COPCs identified in the 1995 ROD for soils and sediments. These are arsenic, copper, zinc, total polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), and dioxin/furans. Documents reviewed for this report were provided by AWI and included the:

- Final Remedial Investigation (RI) report (March 1992), which included a public health and environmental assessment (PHEA). The public health assessment was quantitative while the environmental assessment was brief and qualitative

- Qualitative ERA conducted by the National Oceanic and Atmospheric Administration (NOAA) under an interagency agreement with the U.S. Environmental Protection Agency (USEPA) Region III (April 1992)

- Final Feasibility Study (FS) report (April 1995), which included additional human health risk assessment
- ROD for Operable Unit 1 (September 1995)
- Various correspondence (letters) related to the above documents

The specific tasks related to the existing site conditions include:

- Review available site characterization, history, and background information
- Review relevant analytical data
- Review biological information collected to date at the site
- Review input information for human health evaluation
- Review risk assessments and backup material developed for the 1995 ROD

The specific tasks related to the existing soil and sediment clean-up levels include:

- Evaluate the appropriateness and limitations of the clean-up levels in the ROD
- Develop procedures to revise soil clean up levels
- Professional judgement on the potential for upward adjustment of the existing clean-up levels based on site-specific testing

Clean-up values evaluated include:

- ROD clean-up levels
- Values from the NOAA ecological risk assessment process
- Current soil and sediment screening values from the literature
- Estimates (from simple calculations) of clean-up levels for upper trophic level receptors
- ROD and subsequent state human health risk-based numbers
- Professional judgement on the soil values needed to protect groundwater quality

Some of these tasks (e.g., reviewing biological data from the site) and evaluations (e.g., soil values needed to protect groundwater quality) will be performed in later steps of the ERA process.

1.3 Report Organization

This report is divided into the following sections:

- **Section 1.0 - Introduction.** Describes the objectives and scope of the evaluation and outlines the report organization.
- **Section 2.0 - Facility Background.** Describes the environmental setting of the site and the sources of analytical data available for use in an ERA.

- **Section 3.0 - Document Summary.** Summarizes the relevant data from the documents reviewed.
- **Section 4.0 - Preliminary Clean-up Level Evaluation.** Provides an evaluation of the existing clean-up levels for the site (both for human health and ecological receptors) and a preliminary identification of literature-based screening values for the COPCs.
- **Section 5.0 - References.** Lists the citations for all references cited in the report.

2.0 Facility Background

This section describes the general environmental setting (e.g., habitats and biota) of the AWI Portsmouth, Virginia site as well as the analytical data (surface soils and sediments) available for use in an ERA. The description of the environmental setting was developed from available site documents and from a site visit conducted in October 1999. Analytical data collected from ecologically-relevant media were limited to the RI studies.

Nine areas have been delineated on the site in the FS and ROD:

- Area 1 - Wood Treating Area East
- Area 2 - Wood Treating Area West
- Area 3 - Historical Disposal Area
- Area 4 - Wood Storage Yard
- Area 5 - Inlet Area
- Area 6 - Stormwater Run-off Ditch
- Area 7 - Western Ditch
- Area 8 - Southeastern Ditch
- Area 9 - Acetylene Sludge Area

These nine areas are shown on Figure 1 and the area designations will be used throughout this report.

2.1 Environmental Setting

The AWI facility occupies 47.5 acres of land in Portsmouth, Virginia. The site is bounded on the north by Elm Avenue and Navy facilities associated with the Norfolk Naval Shipyard (NNSY), on the west by a Virginia Electric Power Company right-of way (ROW), on the southeast by the Southgate Annex of the NNSY, on the southwest by land occupied by the Portsmouth City School Board, and on the east by the Southern Branch of the Elizabeth River. The site is split into eastern and western portions by the Norfolk and Portsmouth Beltline Railroad and Burtons Point Road (Figure 1). The eastern portion of the site formerly contained the active wood processing facilities and the wood storage areas. The wood treatment facilities are no longer operating although some limited amounts of treated wood are still stored in this area. The western portion of the site was used for the storage of treated and untreated wood and currently contains a prestressed concrete manufacturing facility. Just west of the power line ROW, several closed landfills and waste pits occur on Navy property.

The site is situated in a highly industrial area along the Southern Branch of the Elizabeth River. In this general area, the shorelines of the river are highly developed with a variety of industries, including several other facilities that use or have used wood preserving chemicals. The river in this area is tidal, with salinities varying from 10 to 22 parts per thousand (ppt). Intertidal mudflats occur along the eastern site boundary and at the mouths of the two drainage ditches (Areas 5 and 8; Figure 1). These mudflats are small and essentially devoid of macrophytes. Both recreational and commercial fishing is conducted along the Southern Branch, with blue crabs and American eel the most commercially important species. Chesapeake Bay is located about 4 miles north of the site while the Great Dismal Swamp National Wildlife Refuge is located about 7 miles to the south. Paradise Creek, a tributary to the Southern Branch, is located south of the site. The nearest residence is located approximately one mile southwest of the site.

The site is relatively flat with elevations ranging from mean sea level (MSL) to about 15 feet above MSL at the western property boundary. Surface runoff from the southeastern portion of the site (east of Burtons Point Road) flows to a drainage ditch (Area 8) to Outfall 001, where it enters the Southern Branch of the Elizabeth River (Figure 1). Surface runoff from the northeastern portion of the site (east of Burtons Point Road) drains to a drainage ditch (Area 5) or to the storm sewer along Elm Avenue and ultimately discharges to the Southern Branch of the Elizabeth River via Outfall 002. Surface runoff from the portion of the site west of Burtons Point Road discharges via Outfall 003 to a ditch that runs north (Area 7) and eventually discharges into Paradise Creek. All three of these outfalls are NPDES-permitted outfalls at which chemical and biological monitoring is conducted periodically.

All but the extreme western portion of the site is within the 100-year floodplain of the river. The river shoreline is unvegetated and is composed of the remains of the barge pier, chunks of concrete, and coarse sand and gravel. Portions of the eastern part of the site, especially along the shoreline, are composed of fill.

Two water-bearing zones have been identified beneath the site, the upper Columbia Aquifer and the lower Yorktown Aquifer. A semi-containing unit of clay is located below the Columbia Aquifer, which is recharged primarily from precipitation. Depth to groundwater is generally only one to three feet over the entire site. Within the eastern portion of the site, the flow of shallow groundwater is mainly to the east (towards the river) at an average linear velocity of 91 feet per year. The flow of shallow groundwater in the western portion of the site is radial due to the presence of a groundwater mound.

Five small wetland areas currently exist on the site. These wetlands have minimal ecological value due to their small size, disturbed nature, low vegetative diversity, and minimal wildlife usage. The first wetland area is located in the tidal zone of the southeastern ditch (Area 8; Figure 1) and is dominated by groundsel tree with some small patches of saltmarsh cordgrass present near the mouth. The second wetland is a small depression along the southern site boundary in and near Area 9 and is dominated by common reed. The third wetland area is located within a small depression created when four above-ground tanks were removed (see Section 2.2). The fourth wetland is a small tidal wetland that encompasses the inlet area (Area 5) and portions of the drainage ditch along Elm Avenue. This wetland is composed of intertidal mudflats and some small areas of saltmarsh cordgrass (inlet), and groundsel tree and common reed (ditch). The last wetland area occurs along the western ditch (Area 7) and is composed mostly of common reed with some woody shrubs (e.g., sumac) also present.

The terrestrial habitats present on the site are very limited. Most of the undeveloped area is covered with herbaceous growth of varying densities. Typical plant species include grasses, goldenrod, and common reed. These areas are periodically mowed. Woody shrubs are generally limited to the area immediately adjacent to the drainage ditches (Areas 5, 7, and 8). The primary woody species are groundsel tree (Areas 5 and 8) and staghorn sumac (Area 7).

The only actively used areas are some wood storage areas in the east-central portion of the site (east of Burtons Point Road), the administration building on Elm Avenue, and the southwestern portion of the site (west of Burtons Point Road and north of Area 3) which is used as a prestressed concrete manufacturing facility. This latter area is mostly bare dirt or gravel. Some unused structures associated with the former wood treatment operations remain on the eastern portion of the site.

Wildlife species observed during the October 1999 site visit in upland areas were limited to common urban-adapted species such as mourning doves, rock doves (pigeons), crows, blue jays, grackles, starlings, and mockingbirds. No mammal tracks were observed except for dog tracks near the extreme northwestern corner of the site by Outfall 003. Grasshoppers and crickets were common in vegetated areas. An adult red fox with kits was reportedly observed on site near the time of the October 1999 site visit.

Birds species observed along the river included great egret, double-crested cormorant, gulls, and belted kingfisher. Egrets were observed foraging on small fish near the mouth of the northern inlet (Area 5). An adult yellow-crowned night-heron, with a recently fledged young, was observed in the southeastern ditch (Area 8) near its mouth. Pellets left by this young bird contained mostly crab shells.

Small fish were observed in both eastern ditches (Areas 5 and 8) and along the river shoreline. Snails and periwinkles were observed on rocks along the river shoreline, as were barnacles and at least two species of mussels.

No threatened or endangered species are known to occur on or near the site. Similarly, no critical habitats are known to occur on or near the site.

2.2 Site History

The original wood treatment plant was constructed in 1926. The site has been used as a possible coal tar refinery, creosote treating plant, PCP treating plant, and storage area for treated lumber. Wood was never treated with chromated copper arsenic (CCA) at the site but CCA-treated wood has been stored at the site.

The original site configuration consisted of two wood treatment retorts, an office building, several maintenance and storage buildings, and an above-ground tank farm that was located adjacent to Elm Avenue. This tank farm was installed on or about 1926 and consisted of four steel above-ground tanks. These tanks were used to store wood preserving chemicals and/or process water. Two of these tanks were removed in 1985 and the remaining two were removed in 1986. Some of the piping associated with these tanks is still present. A tar distillation unit present on the site was dissembled in the 1940s.

A third and fourth treatment retort were constructed in 1959 and 1974, respectively. PCP was first used at the site in 1972 and its use continued until 1985, when the use of this preservative was discontinued. Creosote treatment has occurred over the life of the facility.

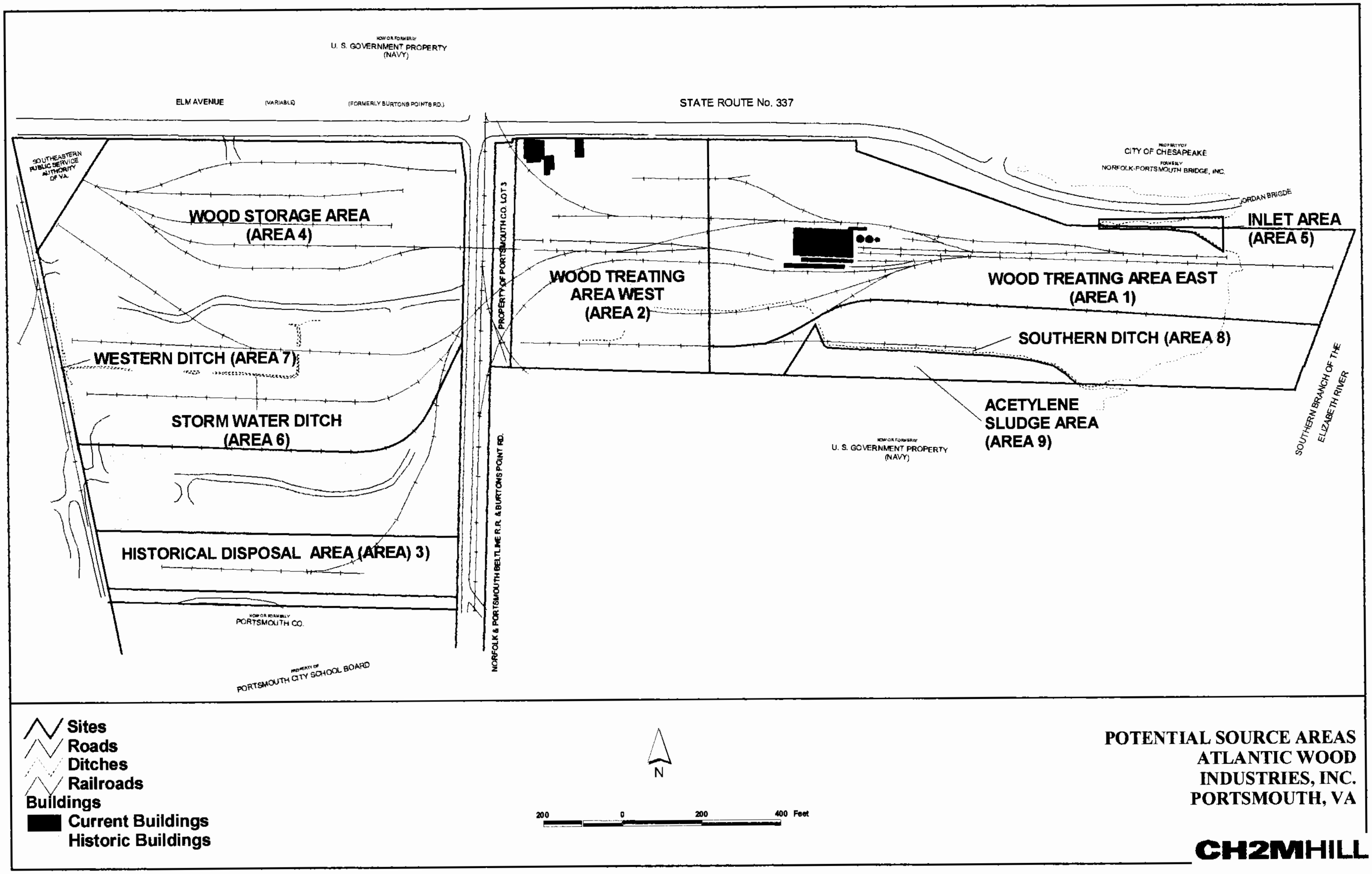
Until the early 1970s, operations included an open streaming process that generated process water. In the early 1970s, a closed system was installed to reduce the amount of process water produced and to recover preservative in the excess process water that was discharged. From about 1966 until 1982, an area in the southwestern corner of the property west of Burtons Point Road was used for the disposal of debris and process wastes. This area, termed the historical disposal area, may contain up to 20,000 cubic feet of waste material and was covered with soil in 1983.

The site was listed on the National Priorities List (NPL) on 15 February 1990. The site is no longer used for treating wood; wood treatment activities stopped in August 1991. The manufacture of prestressed concrete currently occurs on the western portion of the site.

2.3 Available Analytical Data

The available analytical data for the site is generally limited to those data collected just prior to, and during, the RI. The relevant data for this evaluation are for surface soils (generally defined as depths of 0 to 1 foot) and sediment. The relevant surface soil data are provided in Tables 1 and 2. The relevant sediment data are provided in Table 3. Although sediment data were collected in Area 5, these data are not included in Table 3 since approximately 660 cubic yards of contaminated sediments were excavated from the drainage ditch and inlet in May 1995. Table 4 provides a summary of these soil and sediment data for the six COPCs identified in the 1995 ROD.

Additional information from the Data Evaluation Report/Sites 3 and 9 of the NNSY, prepared for the Navy by Baker Environmental in May 1998, will be considered for inclusion in the analytical data set during later stages of the ERA process. In addition, analytical data from soil sampling activities conducted on the site by CDM for USEPA (Spring 2000) will be considered during later stages of the ERA process.



POTENTIAL SOURCE AREAS
ATLANTIC WOOD INDUSTRIES, INC.
PORTSMOUTH, VA

CH2MHILL

Table 1
Relevant Surface Soil Data From the RI

	Area 1							
	Soils				Borings			
Sample ID:	1-2	1-3	1-4	1-5	1-A	1-B	1-C	1-D
Depth:	0-6"	0-6"	0-6"	0-6"	0-2 ft	0-2 ft	0-2 ft	0-2 ft
Metals (mg/kg)								
Arsenic	NA	88.6	68.4	NA	NA	NA	NA	NA
Copper	NA	162	153	NA	NA	NA	NA	NA
Zinc	475	221 J	138 J	295	339	114	2780	148
Organics (ug/kg)								
Pentachlorophenol	2200 J	11000 R	11000 R	9400 U	7800	1800	2100	140 J
2-Chloronaphthalene	2400	2200 R	2300 R	1900 U	1600	360	440	380 U
2-Methylnaphthalene	2400	88000 DJ	260000 J	1900 U	3300	360	440	380 U
Acenaphthene	2400	16000 J	210000 DJ	940 J	6500	360	440	240 J
Acenaphthylene	830 J	880 J	3500 J	1900 U	180 J	360	440	1200
Anthracene	2800	1100000 DJ	600000 DJ	2300	5500	52	440	1600
Benzo(a)anthracene	7800	15000 J	36000 J	5000	1200 J	64 J	440	21000 D
Benzo(a)pyrene	8400	6800 J	15000 J	4100	620 J	51 J	440	9900 D
Benzo(b)fluoranthene	19000 X	16000 XJ	36000 XJ	7600 X	1100 X	110 J	440	30000 X
Benzo(g,h,i)perylene	6200	3100 J	5000 J	2100	380 J	360	440	2600
Benzo(k)fluoranthene	19000 X	16000 XJ	36000 XJ	7600 XJ	1100 X	53 J	440	30000 XJ
Chrysene	11000	24000 J	81000 DJ	5100	1200 J	68 J	440	30000 D
Dibenz(a,h)anthracene	2000 J	1100 J	2100 J	900 J	1600	360	440	300 J
Fluoranthene	21000	110000 DJ	280000 DJ	7500	5400	170 J	440	100000 D
Fluorene	300 J	380000 DJ	790000 DJ	980 J	4800	360	440	290 J
Indeno(1,2,3-cd)pyrene	6100	2900 J	5300 J	2100	310 J	360	440	3200
Naphthalene	260 J	82000 DJ	230000 J	370 J	8800	360	440	380 U
Phenanthrene	2800	620000 DJ	1300000 DJ	6200	9900	40 J	440	3700
Pyrene	13000 J	31000 J	250000 DJ	5700 J	3300 J	170 J	440	85000 D

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 2							
	Soils						Borings	
Sample ID:	2-1A	2-2A	2-3A	2-4A	2-5A	2-10A	2A	2C
Depth:	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	1-3ft	1-2ft
Metals (mg/kg)								
Arsenic	188	199	51.1 J	103	314	280	9.7	31.1 K
Copper	1080 J	491 J	221 J	251	186 J	1210 J	1160	22.2 K
Zinc	674	1050	248	328	296	1780	287	67.3 J
Organics (ug/kg)								
Pentachlorophenol	2100	790 J	1200 J	13000	430 J	2000	1900	9100
2-Chloronaphthalene	430	420	890	2700	2100 U	420	400	1900
2-Methylnaphthalene	430	140 J	990	2700	2100 U	420	400	310 J
Acenaphthene	120 J	450	5700	2700	2600	48 J	69	2500
Acenaphthylene	73 J	450	1500	1300	400 J	48 J	400	300 J
Anthracene	520	1700	12000	1300	5100	290	140	5800
Benzo(a)anthracene	820	5300	33000	11000	25000	470	320	14000
Benzo(a)pyrene	880	5600	30000	10000	22000	560	300	13000
Benzo(b)fluoranthene	970	13000	62000	21000	33000 D	510	570	11000
Benzo(g,h,i)perylene	700	2900	14000	5100	6800	450	170	2700
Benzo(k)fluoranthene	800	13000	62000	21000	33000 DJ	720	570	11000 J
Chrysene	870	7300	38000	13000	26000	630	420	14000
Dibenz(a,h)anthracene	210 J	420	3500	2100	3700	130 J	48	1300 J
Fluoranthene	1500	8300	72000	26000	52000 D	870	730	30000
Fluorene	110 J	430	5700	2700	2200	45 J	56	2400
Indeno(1,2,3-cd)pyrene	710	3000 J	11000 J	5100	7500	460	140	3500
Naphthalene	430	330 J	3000	2700	360 J	420	42	500 J
Phenanthrene	1400	3700	33000	3600	29000	640	490	23000
Pyrene	1700	8100	54000	23000	32000	1000	770	20000

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 3									
	Soils							Borings		
Sample ID:	3-1A	3-2A	3-3A	3-4A	3-5A	3-6A	3-7A	3B	3D	3E
Depth:	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	1-2ft	1-4ft	0-2ft
Metals (mg/kg)										
Arsenic	369 J	227	136	143 J	133	60.6 K	24.1 K	3 JK	21.3	35.7
Copper	736	1130 J	602 K	94.2	67.5 K	80 K	52.7 K	9.5	9 J	56.8
Zinc	773 J	1380	861 J	193 J	89.3 KJ	158 J	220 J	36.2 JK	30.1	155
Organics (ug/kg)										
Pentachlorophenol	7700	580000	27000	150000	200000 D	18000 J	3600	1800 U	340 J	110 J
2-Chloronaphthalene	12000 U	120000	49000	13000	22000 U	4000	390	360 U	390	390 U
2-Methylnaphthalene	770 J	4800	23000	510	430 J	220 J	390	360 U	390	390 U
Acenaphthene	3900	74000 J	53000	300 J	550 J	1200	53 J	460	69 J	390 U
Acenaphthylene	11000	360 J	2900	3100	3300	530 J	390	360 U	390	390 U
Anthracene	15000	190000	110000	3100	13000	3300	180 J	360 U	330 J	83 J
Benzo(a)anthracene	58000 D	410000	220000	7100 J	15000	15000	690	360 U	1000	270 J
Benzo(a)pyrene	54000 D	300000	170000	13000 J	21000	14000	600	360 U	950	260 J
Benzo(b)fluoranthene	47000 D	220000	300000	34000	64000 D	25000	1100 X	360 U	1600 X	320 J
Benzo(g,h,i)perylene	16000	91000 J	69000	6500	8600	7400	380 J	360 U	500	220 J
Benzo(k)fluoranthene	57000 D	250000	300000	34000	64000 D	25000	1100 X	360 U	1600 X	250 J
Chrysene	77000 D	390000	210000	12000 J	23000	15000	680	360 U	1300	380 J
Dibenz(a,h)anthracene	6600	33000 J	21000	2700	3800	1400	180 J	360 U	240 J	54 J
Fluoranthene	140000 D	890000	470000	9400 J	23000	24000	1200	360 U	2300	560
Fluorene	4400	70000 J	55000	310 J	840 J	920	40 J	360 U	52 J	390 U
Indeno(1,2,3-cd)pyrene	15000	100000 J	76000	6400	9700	7800	360 J	360 U	490	180 J
Naphthalene	1100 J	5300	30000	1200	1100 J	260 J	390	360 U	390	390 U
Phenanthrene	48000 D	850000	440000	2800	6900	13000	750	360 U	1200	260 J
Pyrene	120000 D	650000	410000	10000 J	12000	29000	1100	360 U	1900	540

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 4							
	Soils					Borings		
Sample ID:	**4-1A**	**4-2A**	**4-3A**	**4-4A**	**4-5A**	**4C**	**4D**	**4E**
Depth:	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**1-2ft**	**0-2ft**	**0-1ft**
Metals (mg/kg)								
Arsenic	92.8 K	NA	NA	NA	NA	NA	NA	59.4 J
Copper	125	NA	NA	NA	NA	NA	NA	313
Zinc	213 J	444	1410 J	409 J	274 J	69.6	701	560 J
Organics (ug/kg)								
Pentachlorophenol	7300 U	4900 J	120000 DJ	940 J	600 J	9100	9200	4400 U
2-Chloronaphthalene	1500 U	3100 U	2500 U	6100 U	2100	1900	1900	920 U
2-Methylnaphthalene	1500 U	1200 J	1600 J	670 J	460 J	710000	1900	440 J
Acenaphthene	1500 U	1700 J	2600	750 J	400 J	1600000	1900	700 J
Acenaphthylene	1500 U	2800 J	5500	3400 J	1300 J	17000	200	680 J
Anthracene	1500 U	19000	19000	4700 J	3700	860000	370	4400
Benzo(a)anthracene	1500 U	18000	30000 D	24000	7800	350000 J	1500	9400
Benzo(a)pyrene	1500 U	16000	34000 D	34000	8400	96000 J	2100	4000
Benzo(b)fluoranthene	1500 U	43000 X	91000 D	69000 X	22000 X	250000 X	5700	12000 X
Benzo(g,h,i)perylene	1500 U	14000	20000	12000	6400	16000 J	1800	2100 J
Benzo(k)fluoranthene	1500 U	43000 X	91000 JD	69000 XJ	22000 X	250000 X	5700	12000 X
Chrysene	1500 U	23000	52000 D	33000	9900	450000	2700	7900
Dibenz(a,h)anthracene	1500 U	4100	8800 J	5000 J	2200	3700 J	610	1000 J
Fluoranthene	1500 U	30000	95000 D	41000	10000	2500000	2600	12000
Fluorene	1500 U	2300 J	2800	6100 U	330 J	1600000	1900	1000
Indeno(1,2,3-cd)pyrene	1500 U	14000	21000	13000	5700	18000	1600	2000 J
Naphthalene	1500 U	1500 J	2500 J	1600 J	760 J	1000000	270	690 J
Phenanthrene	1500 U	11000	19000	5500 J	4000	4700000	1200	3900
Pyrene	1500 U	27000	110000 D	37000	8300	2100000	2300	9700

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 5						
	Soils						
Sample ID:	5-1A	5-2A	5-3A	5-4A	5-5A	5-6A	5-7A
Depth:	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"
Metals (mg/kg)							
Arsenic	NA	NA	NA	NA	NA	NA	9.2
Copper	NA	NA	NA	NA	NA	NA	53.8
Zinc	1380 J	702 J	233 J	173	223	62.5	79.6 J
Organics (ug/kg)							
Pentachlorophenol	5400 J	2800 J	16000	4500 J	5100	1400 B	1400 BJ
2-Chloronaphthalene	2400	2300 U	2000 U	1300	760	2100	2100 U
2-Methylnaphthalene	3500	24000	2800	2800	2300	10000	4100
Acenaphthene	6300	17000	2200	15000	2300	11000	6100
Acenaphthylene	20000	6000	4900	16000	7600	3900	2000 J
Anthracene	74000	520000 D	6800	38000	44000	330000	160000 D
Benzo(a)anthracene	150000	140000 D	45000 D	77000	50000	120000	78000 D
Benzo(a)pyrene	100000	53000 DJ	42000 D	62000	33000 J	41000 D	41000 D
Benzo(b)fluoranthene	220000	130000 D	95000 D	83000	85000	65000	61000 D
Benzo(g,h,i)perylene	33000	14000	15000	28000 J	11000 J	7800	11000
Benzo(k)fluoranthene	220000 X	130000 XD	95000 XD	54000	85000	45000 D	23000
Chrysene	170000	160000 D	46000 D	110000	64000	150000	95000 D
Dibenz(a,h)anthracene	6800	6900	6300	11000 J	6600	4200	4700
Fluoranthene	450000	460000 D	72000 D	180000	130000	520000	240000 D
Fluorene	12000	43000 DJ	1700 J	14000 J	8300	29000 D	13000
Indeno(1,2,3-cd)pyrene	35000	17000	16000	27000 J	12000 J	10000	13000
Naphthalene	5100	12000	4800	1800	2100	7400	2200
Phenanthrene	89000	150000 D	17000	93000	22000 J	190000	62000 D
Pyrene	390000	340000 D	62000 D	190000 D	10000	480000	200000 D

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 5					
	Soils			**Borings**		
Sample ID:	**5-8A**	**5-10A**	**5-100A**	**5A**	**5C**	**5D**
Depth:	**0-6"**	**0-6"**	**0-6"**	**0-2ft**	**0-2ft**	**1-2ft**
Metals (mg/kg)						
Arsenic	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA
Zinc	206	111	126	64.6 J	250	1030
Organics (ug/kg)						
Pentachlorophenol	15000 B	1700 J	1300 J	22000 D	12000 DJ	680 J
2-Chloronaphthalene	2100	1800	1900 U	2300 U	780 U	920
2-Methylnaphthalene	7300	2700	1600 J	760 U	860	4200
Acenaphthene	26000	50000 D	290000 DJ	7800	4400	4200
Acenaphthylene	16000	5100	4100	4500	4300	1400
Anthracene	360000	170000 D	91000 D	39000 D	11000	220000
Benzo(a)anthracene	460000	170000 D	890000 D	58000 D	30000 D	25000
Benzo(a)pyrene	200000	50000	340000 JX	32000	29000 D	13000
Benzo(b)fluoranthene	290000	140000 D	570000 D	95000 D	78000 X	37000 X
Benzo(g,h,i)perylene	84000 J	160000 J	14000 J	14000	10000	5000
Benzo(k)fluoranthene	190000	140000 D	340000 JX	95000 D	78000 X	37000 X
Chrysene	500000	410000 D	1100000 D	68000 D	40000 D	29000
Dibenz(a,h)anthracene	14000	4400 J	5900 J	2900	4600	2400
Fluoranthene	1700000	110000 D	4800000 D	210000 D	93000 D	80000
Fluorene	51000 J	50000 D	460000 D	13000	5100	14000 J
Indeno(1,2,3-cd)pyrene	79000 J	18000 J	15000 J	14000	11000	5700
Naphthalene	5500	1700 J	1100 J	1100 J	1700	2500
Phenanthrene	410000	400000 D	260000 D	71000 D	33000 D	43000
Pyrene	1400000	470000 D	2100000 DJ	170000 D	67000 D	55000

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 6									
	Soils									Borings
Sample ID:	6-1A	6-2A	6-3A	6-4A	6-5A	6-6A	6-7A	6-8A	6-9A	6A
Depth:	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	1-3ft
Metals (mg/kg)										
Arsenic	NA	NA	NA	NA	NA	36	NA	NA	8.4	445 J
Copper	NA	NA	NA	NA	NA	162	NA	NA	143	715
Zinc	344	352	203	129	321	354	128	195	408	740 J
Organics (ug/kg)										
Pentachlorophenol	9500 J	2400 J	3200 J	2900	2100 U	20000 J	1600 J	8800 U	290 J	7100 J
2-Chloronaphthalene	2300 U	2400 U	1900 U	390 U	430 J	5200 U	800 U	1800 U	410 U	2300 U
2-Methylnaphthalene	630 J	1200 J	810 J	670	5400	5100 J	850	1800 U	99 J	50000 DJ
Acenaphthene	1500 J	3500	82000 D	1800	17000 J	21000	2500	1800 U	200 J	1000000 D
Acenaphthylene	11000	18000	10000	2700	430 U	14000	5400	480 J	1100	23000
Anthracene	30000	31000	45000 D	5600	80000 D	150000 D	15000 J	900 J	1900	2000000 D
Benzo(a)anthracene	51000 D	160000 D	130000 D	28000 D	130000 D	180000 D	70000 D	8800	15000	620000 D
Benzo(a)pyrene	52000 D	130000 D	74000 D	29000 D	73000 D	140000 D	41000 D	7300	9200	190000 DJ
Benzo(b)fluoranthene	120000 X	320000 X	170000 X	64000 X	180000 X	350000 D	100000 X	19000 X	14000	460000 X
Benzo(g,h,i)perylene	27000	56000 D	24000	11000 D	32000 J	39000	21000 D	2300	2700 J	35000
Benzo(k)fluoranthene	120000 X	320000 X	170000 X	64000 X	180000 X	350000 D	100000 XJ	19000 X	16000	460000 X
Chrysene	66000 D	190000 D	130000 D	24000 D	160000 D	240000 D	82000 D	12000	18000	610000 D
Dibenz(a,h)anthracene	4700	22000	4700	6000 D	9600 J	14000	8200	400 J	420 J	7800
Fluoranthene	94000 D	290000 D	550000 D	40000 D	560000 D	740000 D	180000 D	20000	45000	4300000 D
Fluorene	2200 J	4900	72000 D	2400	30000	31000	3600	1800 U	190 J	1200000 D
Indeno(1,2,3-cd)pyrene	29000	58000 D	25000	12000 D	31000 J	41000	22000 D	2400	3000 J	270000 U
Naphthalene	1200 J	2600	790 J	880	3500	3200 J	1300	1800 U	170 J	85000 DJ
Phenanthrene	26000	71000 D	320000 D	12000 D	200000 D	160000 D	27000 D	4100	5700	4300000 D
Pyrene	110000 D	350000 D	420000 D	33000 D	430000 D	450000 D	NA D	15000 J	35000	2300000 DJ

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 7						
	Soils						
Sample ID:	**7-1A**	**7-2A**	**7-3A**	**7-4A**	**7-5A**	**7-6A**	**7-7A**
Depth:	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**
Metals (mg/kg)							
Arsenic	NA	NA	NA	NA	17.5	NA	NA
Copper	NA	NA	NA	NA	184	NA	NA
Zinc	337 J	235 J	190 J	40 J	615 J	170 J	579 J
Organics (ug/kg)							
Pentachlorophenol	1100 J	14000	60000 DJ	110000 U	37000 J	22000	2700 U
2-Chloronaphthalene	4500 U	2500 U	2400 U	22000 U	120000 U	2600 U	22000 U
2-Methylnaphthalene	2800 J	2600	3000	22000 U	140000	5700	1200
Acenaphthene	6700	2300 J	2900	22000 U	530000	18000	2800
Acenaphthylene	1500 J	4700	14000	22000 U	20000 J	4600	5800
Anthracene	26000	7200	22000	22000 U	570000	75000 D	44000 D
Benzo(a)anthracene	20000	13000	36000	22000 U	300000	71000 D	73000 D
Benzo(a)pyrene	13000	21000	72000 D	22000 U	140000	39000	54000 D
Benzo(b)fluoranthene	32000 X	57000 EX	230000 X	22000 U	330000 X	91000 XD	140000 D
Benzo(g,h,i)perylene	4800	13000	22000	22000 U	58000 J	11000	30000 D
Benzo(k)fluoranthene	32000 X	57000 XJ	230000 X	22000 UJ	330000 XJ	91000 DJ	140000 XD
Chrysene	23000	21000	71000 D	22000 U	380000	91000 D	91000 D
Dibenz(a,h)anthracene	2000 J	3900	10000	22000 U	25000 J	5800	8700
Fluoranthene	51000	27000	190000 D	22000 U	1600000	270000 D	180000 D
Fluorene	6600	1400 J	2200 J	22000 U	520000	21000	5600
Indeno(1,2,3-cd)pyrene	5300	11000	23000	22000 U	59000 J	12000	22000 J
Naphthalene	4500	5400	4100	22000 U	100000 J	6700	2200
Phenanthrene	26000	7400	9000	22000 U	2000000 D	97000 D	26000 D
Pyrene	31000	20000	77000 D	22000 D	1100000	230000 D	170000 D

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 7				
	Soils				
Sample ID:	7-8A	7-9A	7-10A	7-11A	7-12A
Depth:	0-6"	0-6"	0-6"	0-6"	0-6"
Metals (mg/kg)					
Arsenic	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA
Zinc	130 J	276 J	125 J	334 J	286 J
Organics (ug/kg)					
Pentachlorophenol	23000 U	10000 J	27000	26000	31000
2-Chloronaphthalene	4700 U	4300 U	4200 U	2200 U	1900 U
2-Methylnaphthalene	100000 D	1100 J	1500 J	2800	15000
Acenaphthene	26000	910 J	1100 J	2000 J	210000 D
Acenaphthylene	4500 J	1800 J	3500 J	8500	20000 J
Anthracene	8200	4100 J	5200	58000 D	440000 D
Benzo(a)anthracene	24000	18000	9100	83000 D	400000 D
Benzo(a)pyrene	16000	15000	13000	69000 D	230000 D
Benzo(b)fluoranthene	25000 X	38000 X	34000 X	110000 D	450000 X
Benzo(g,h,i)perylene	4900	11000	7600	25000	70000 J
Benzo(k)fluoranthene	25000 X	38000 J	34000 X	97000 D	450000 X
Chrysene	39000	22000	14000	110000 D	500000 D
Dibenz(a,h)anthracene	3200 J	3700 J	2800 J	7200	17000
Fluoranthene	12000	43000	15000	210000 D	1900000 D
Fluorene	16000	760 J	710 J	4000	250000 D
Indeno(1,2,3-cd)pyrene	4400 J	11000	7300	27000	76000 J
Naphthalene	16000	2200 J	2600 J	4600	16000
Phenanthrene	48000	4600	5300	32000	1100000 D
Pyrene	30000	34000	13000	170000 D	1300000 D

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 8							
	Soils							
Sample ID:	**8-1A**	**8-2A**	**8-3A**	**8-4A**	**8-5A**	**8-6A**	**8-7A**	**8-8A**
Depth:	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**	**0-6"**
Metals (mg/kg)								
Arsenic	135 J	122	NA	495 J	4.4 []J	20.7 J	NA	NA
Copper	964	884	NA	1190 J	561 J	9780	NA	NA
Zinc	3570 J	2590	86.8 J	1550	719	20400	3460 J	17000 J
Organics (ug/kg)								
Pentachlorophenol	6200 J	11000	43000	10000 J	1800 U	620 J	2800 J	11000
2-Chloronaphthalene	2300	2200	8900	38000 U	370 U	2100	1600 U	2300
2-Methylnaphthalene	1400 J	2200	13000	7500 J	110 J	280 J	2000	290 J
Acenaphthene	2300	2200	9400	82000	110 J	2100	11000	320 J
Acenaphthylene	4500	2200	2400 J	17000 J	94 J	2100	6300	520 J
Anthracene	33000	2200	170000	190000	260 J	580 J	16000	1200 J
Benzo(a)anthracene	64000	900	72000	790000 D	840	2900	120000	5100
Benzo(a)pyrene	34000	1000	22000	840000 D	830	1400 J	100000 D	4400
Benzo(b)fluoranthene	47000 X	2400	58000 X	1600000 X	1600	3500 X	220000 D	6800
Benzo(g,h,i)perylene	11000	520	17000	300000	510	490 J	58000 D	1800 J
Benzo(k)fluoranthene	58000 X	2400	58000 X	1600000 X	900	3500 X	220000 D	7200
Chrysene	76000	1600	41000	770000 D	1700	3400	120000 D	7300
Dibenz(a,h)anthracene	5400	2200	4100 J	130000	150 J	2100	12000	2300
Fluoranthene	140000	1600	89000	1900000 D	3500	2600	230000 D	9000
Fluorene	4400	2200	19000	62000	100 J	2100	10000	2300
Indeno(1,2,3-cd)pyrene	12000	490	15000	380000	490	550 J	54000 D	2200 J
Naphthalene	3300	2200	12000	13000 J	100 J	380 J	2700	450 J
Phenanthrene	24000	370	120000	910000 D	1800	1100 J	110000 D	3000
Pyrene	89000	1800	62000	1100000 D	2000	1500 J	130000 D	7100

NA - Not Analyzed

Table 1
Relevant Surface Soil Data From the RI

	Area 9
	Borings
Sample ID:	9B
Depth:	0-2ft
Metals (mg/kg)	
Arsenic	NA
Copper	NA
Zinc	118 J
Organics (ug/kg)	
Pentachlorophenol	240000
2-Chloronaphthalene	380
2-Methylnaphthalene	3500
Acenaphthene	10000 J
Acenaphthylene	2900
Anthracene	15000 J
Benzo(a)anthracene	13000 J
Benzo(a)pyrene	11000 J
Benzo(b)fluoranthene	14000 J
Benzo(g,h,i)perylene	3600
Benzo(k)fluoranthene	12000 J
Chrysene	380
Dibenz(a,h)anthracene	1500
Fluoranthene	68000
Fluorene	6400 J
Indeno(1,2,3-cd)pyrene	4200
Naphthalene	4300
Phenanthrene	23000
Pyrene	60000

NA - Not Analyzed

Table 2
Relevant Surface Soil Data From the RI - Dioxin/Furan

Sample ID:	B1-S	S9-S	S13-A	T1-4A	T1-4PD	T1-4F	7-2A	7-11	6-2A
Depth (ft):	0-0.5	0-0.5	0-2	0-2	0-2	0-0.5	0-0.5	0-0.5	0-0.5
Total Equivalent 2,3,7,8-TCDD (ug/kg)	0.02	0.22	0.77	0.0000055	0.0000055	0.02	7.1	8.04	2.05

Table 2
Relevant Surface Soil Data From the RI - Dioxin/Furan

Sample ID:	7-6A	7-1A	5-7A	5-3A	7-12A	7-10A	4-5A	9E
Depth (ft):	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-4
Total Equivalent 2,3,7,8-TCDD (ug/kg)	2.54	0.75	1.27	9.31	6.06	11.64	1.03	12.77

Table 3
Relevant Sediment Data From the RI

Sample ID:	SED 1	SED 2	SED 3	SED 4	SED 5	SED 6	SED 7
Metals (mg/kg)							
Arsenic	136	109	135	82.2	150	106	173
Copper	500	173	540	186	432	367	376
Zinc	823	328	1820	433	1520	499	729
Organics (ug/kg)							
Pentachlorophenol	7200	12000	2500 J	1500 J	670 J	2200 J	4800 J
2-Chloronaphthalene	460 U	940 U	690 U	990 U	1800 U	7400 U	15000 U
2-Methylnaphthalene	360 J	130 J	190 J	7800	560 J	980 J	2800 J
Acenaphthene	710 J	420 J	180 J	850 J	330 U	330 U	330 U
Acenaphthylene	590	470	940	2300	1400 J	5200 J	3000 J
Anthracene	3600	1800	1600	560000 D	3900	13000	150000
Benzo(a)anthracene	7400	3800	3900	20000 DJ	9800	49000	78000
Benzo(a)pyrene	6000	3400	4200	16000	7700	43000	53000
Benzo(b)fluoranthene	25000 DX	5200	6900	47000 DX	12000	78000	81000
Benzo(g,h,i)perylene	2600	1800	2900	5300	4400	17000	29000
Benzo(k)fluoranthene	25000 DXJ	6200 J	9100 J	47000 DX	9700	53000	89000
Chrysene	13000 D	4900	6600	39000 DJ	12000	61000	110000
Dibenz(a,h)anthracene	1000	620 J	1100	420 J	1800 J	7100 J	9600 J
Fluoranthene	30000 D	9500	7300	58000 D	13000	73000	230000
Fluorene	810	390 J	180 J	37000 DJ	560 J	2100 J	13000 J
Indeno(1,2,3-cd)pyrene	2800 J	1800 J	2700 J	5600	4700 J	19000	31000
Naphthalene	420 J	170 J	240 J	8500	880 J	1600 J	2600 J
Phenanthrene	11000 D	4400	1300	73000 D	3800	12000	76000
Pyrene	22000 D	7900	8000	45000 D	11000	73000	210000
Total PAHs	151930	52770	57140	964970	96640	507000	1165200

Table 3
Relevant Sediment Data From the RI

Sample ID:	SED 8	SED 028 (Dup)	SED 9	SED 10	SED 11
Metals (mg/kg)					
Arsenic	364	349	171	31.7 J	31.2
Copper	1350	1400	774	95.1	176
Zinc	1890	1790	1190	291	602
Organics (ug/kg)					
Pentachlorophenol	5700 J	NA	32000 U	420 J	2500 J
2-Chloronaphthalene	14000 U	770 U	6600 U	4100 U	1100 U
2-Methylnaphthalene	4900 J	3100	3200 J	550 J	840 J
Acenaphthene	330 U	12000 U	19000	330 U	8000
Acenaphthylene	5300 J	6300	3200 J	740 J	2000
Anthracene	250000 D	83000 D	130000 D	7900	11000
Benzo(a)anthracene	290000 D	120000 D	210000 D	31000	66000 D
Benzo(a)pyrene	210000	100000 D	200000 D	26000	59000 D
Benzo(b)fluoranthene	220000	240000 DX	210000 D	24000	54000 D
Benzo(g,h,i)perylene	77000	41000 D	35000 J	13000	17000
Benzo(k)fluoranthene	310000 D	240000 DX	210000 D	17000	63000 D
Chrysene	320000 D	140000 D	280000 D	31000	70000 D
Dibenz(a,h)anthracene	35000	10000	3300 J	7100	7600 J
Fluoranthene	480000 D	280000 D	540000 D	50000	140000 D
Fluorene	32000	10000 DJ	20000	2800 J	6800
Indeno(1,2,3-cd)pyrene	84000	46000 D	51000	14000	25000 JD
Naphthalene	4800 J	3400	3900 J	1000 J	1100
Phenanthrene	320000 D	120000 D	250000 D	23000	74000 D
Pyrene	480000 D	190000 D	270000 J	35000	84000 D
Total PAHs	3118100	1629700	2435400	283540	688500

Table 4
Summary Statistics - Surface Soil and Sediment Data

Chemical	Frequency of Detection	Mean	Median	Minimum	Maximum
Sediment (mg/kg)					
Arsenic	11 / 11	135	135	31.2	364
Copper	11 / 11	452	376	95.1	1350
Zinc	11 / 11	920	729	291	1890
Pentachlorophenol	10 / 11	5.05	2.5	0.42	12
Total PAHs	11 / 11	870	512	53.37	3123
Soil (mg/kg)					
Arsenic	32 / 32	123	79	3	495
Copper	32 / 32	714	204	9	9780
Zinc	78 / 78	998	281	30	20400
Pentachlorophenol	68 / 78	25.7	4.8	0.11	580
Total PAHs	78 / 78	1675	382	3.52	17641
Dioxin/furan (TEFs)	17 / 17	0.00374	0.00127	0.0000055	0.0128

3.0 Document Summary

This section provides a summary of the relevant information provided in the key documents reviewed. These documents include the 1992 RI, 1992 NOAA ERA, 1995 FS, and 1995 ROD. A chronology of events involved in the derivation of the soil and sediment clean-up levels in the 1995 ROD is provided in Section 4.

3.1 Summary of the RI

The Remedial Investigation (RI) report, prepared by Keystone for AWI, was issued in final form in March 1992. The RI/FS process began in 1988 with the development of the RI/FS work plan, produced in accordance with an Administrative Order of Consent (AOC) between AWI and USEPA Region III dated 23 July 1987. Sampling began on the site in 1988. Sampling associated with the RI process addressed on-site groundwater, on-site surface and subsurface soils, on-site drainage ditch sediments, and sediments in the Southern Branch of the Elizabeth River adjacent to the site. Aquifer testing was also conducted.

A total of 144 soil borings were collected during the RI, 72 surface (0 to 6 inches or 0 to 2 feet) and 72 subsurface (greater than 1 foot). Through 1994, 58 monitoring wells have been installed on the site; 26 were sampled during the RI. Two major groundwater sampling events occurred in 1989 and 1990. Surface sediment samples (0 to 6 inches) were collected in August 1989 from three drainage ditch systems:

- Two samples (SED 1 and SED 2) from the tributary ditch which flows from the CCA and PCP treated wood storage area on the western side of the site into the western boundary ditch (Area 6)
- Two samples (SED 3 and SED 4) from the ditch along the western site boundary (Area 7)
- Seven samples (SED 5 through 11) from the ditch that flows along the southeastern edge of the property into the Elizabeth River (Area 8)

Additional sediment samples were collected in September 1989 as follows:

- Five samples (IN-1 through IN-5) from the northern ditch and inlet (Area 5). The target depths for these samples was from the surface to encountering bed material (or to 3 feet) but cores were actually sampled from the surface to a maximum of about 1 foot because of the conditions encountered
- Nine samples from the Southern Branch of the Elizabeth River (0 to 2 foot cores) in three transects across the river adjacent to the AWI facility

In summary, PCP and creosote constituents (PAHs) were detected in surface and subsurface soils at the site. The highest PAH concentrations were detected in the wood treating process areas (Areas 1 and 2), the historical disposal area (Area 3), and the acetylene sludge area (Area 9). PCP concentrations in soil were highest in Area 3. Arsenic and copper were detected above background levels in soils from the wood storage yard (Area 4). Zinc, not considered a site-related chemical, was detected at its highest soil concentrations in Area 9, an area associated with the disposal of acetylene waste by off-site parties. Dioxins and furans were infrequently detected in 48 on-site soil samples. Additional soil samples collected in June 1990 were tested using the Toxicity Characterization Leaching Procedure (TCLP) and were characterized as non-hazardous based on this test.

PCP, PAHs, and volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene, xylene (BTEX), and styrene, were detected in groundwater collected from shallow wells in the vicinity of the wood treating process areas (Areas 1 and 2), the historical disposal area (Area 3), and the acetylene sludge area (Area 9), as well as in several other areas. PCP, PAHs, and VOCs were not detected in deeper wells. Although wood was never preserved with CCA at the AWI site, CCA-treated wood was stored on-site. Arsenic and copper were detected at elevated levels in groundwater only in the area where untreated wood was stored (Area 4) and generally only in the shallow groundwater. Zinc, copper, and arsenic were detected at elevated levels in groundwater located adjacent to Navy property (Area 9).

PCP, PAHs, chromium, arsenic, copper, and zinc were detected in sediment samples. PAH concentrations were highest in the inlet (Area 5); these sediments have since been excavated. PCP and chromium were principally detected in sediment samples from the ditch flowing out of the wood storage area (Area 6). Arsenic, copper, and zinc were highest in the southeastern ditch (Area 8) which is adjacent to Navy property and flows through the acetylene sludge disposal area (Area 9).

3.1.1 Risk Assessment

The RI also included a public health and environmental assessment (PHEA). The PHEA focused on potential risks to human health given the industrial nature of the site. The environmental (ecological) component of the PHEA was very brief and qualitative.

The PHEA evaluated on-site workers, off-site individuals on adjacent properties, hypothetical construction workers, and hypothetical groundwater users. The assessment focused on soils and groundwater. Potential exposure pathways to sediments were determined to be unlikely for on-site workers and this medium was determined to pose little risk to human health. Thus, sediments were not quantitatively evaluated in the PHEA (nor was surface water). Pathways evaluated included ingestion (direct and incidental), dermal contact, and inhalation (vapors and dust). No residential exposure scenarios were evaluated since residential development is not a potential future use.

Preliminary chemicals of concern (PCOCs) included PAHs, PCP and five other phenolics, VOCs (benzene, toluene, ethylbenzene, styrene), arsenic, copper, zinc, and dioxins/furans. Dermal contact to PCOCs in soils by on-site workers and hypothetical construction (future) workers were identified as the potential exposure pathways for which potential risks exceeded the target carcinogenic risk range of 10^{-4} to 10^{-6}, the latter scenario only for Area 9. Dermal contact to PCOCs in soils by on-site workers (Area 9) and hypothetical construction (future) workers (Areas 1, 2, and 9) were identified as the potential exposure pathways for which the Hazard Index (HI) for non-carcinogenic risks exceeded one. Carcinogenic PAHs, PCP, and arsenic accounted for 99 percent or more of the total human health risk for these exposure scenarios; the other PCOCs were not found to adversely impact human health. Possible human health risks were also identified from hypothetical groundwater exposures. However, since groundwater from under the site and immediately surrounding area is not used for domestic purposes, this exposure scenario was considered unlikely.

3.1.2 Evaluation of the Risk Assessment

The human health risk assessment was conducted in a manner that was technically consistent with USEPA guidance and toxicological information available at the time it was prepared. Since 1992, there have been some minor updates to the approach for evaluating human health risks. However, these updated procedures would not likely change the conclusions of the RI evaluation. The updates include:

- Screening constituent concentrations against risk-based concentrations (RBCs) and not regulatory levels (e.g., Maximum Contaminant Levels [MCLs])
- Toxicological values (reference doses and slope factors) have been revised for a number of constituents (benzo(a)pyrene is not more conservative)
- Adjustment of oral reference doses and slope factors using oral absorption efficiencies from an administered to an absorbed dose

3.1.3 Conclusions of the RI

Based on the PHEA, remedial action objectives were established in the RI as follows:

- Reduce or eliminate direct contact with site soils containing elevated site-related constituents
- Minimize the effect of site soils on groundwater
- Reduce or eliminate the potential for migration of dense non-aqueous phase liquid (DNAPL) off-site or to the lower aquifer
- Reduce or eliminate the potential for migration of PCOCs in groundwater off-site or to the lower aquifer

3.2 Summary of the FS

The Final FS, conducted by Groundwater Technologies, Inc. for AWI, was completed in April 1995. This FS addressed surface and subsurface soils, on-site sediments, and DNAPL (OU-1). Groundwater and river sediments were to be addressed later as separate operable units. The FS for OU-1 was completed using ecological clean-up levels (see Section 4) provided by USEPA, which were not entirely acceptable to AWI. As such, AWI indicated that its completion of the FS using these clean-up levels was not an acceptance of these levels nor an indication of AWI's willingness to implement USEPA's chosen remedial alternative.

The FS addressed five Remedial Response Units (RRU):

- RRU 1 - Areas 1, 2, 3, 4 (soils)
- RRU 2 - Areas 5, 6, 7 (sediments)
- RRU 3 - Subsurface areas with DNAPL

- RRU 4 - Area 8 (sediments)
- RRU 5 - Area 9 (soils)

For this report, only surface soils (generally defined as 0 to 1 foot) and sediments are relevant. DNAPL (RRU-3) is not directly considered.

The east and west wood treatment areas (Areas 1 and 2), historical disposal area (Area 3), wood storage area (Area 4), and acetylene sludge area (Area 9) were identified as the areas requiring remediation based on risks to human health. Separate human health soil clean-up levels were developed for each of these five areas. One set of ecologically-based soil clean-up levels was provided by USEPA and applied to all five areas. The final soil clean-up level used in the FS was the lower of the human health and ecological values. Another set of ecologically-based sediment clean-up levels were applied to sediments in Areas 5 through 8. Since risks to human health based on sediment exposures were unlikely, no human health-based sediment clean-up levels were developed. The derived clean-up levels are summarized in Table 5.

The FS also developed Remedial Action Objectives (RAOs) for each of the nine areas. However, as shown in Table 5, the RAOs were not always consistent with the clean-up levels derived for each area of the site.

3.2.1 Human Health Risk Assessment

Based on the PHEA conducted during the RI, dermal contact to PCOCs in soils by on-site workers (all areas) and hypothetical construction (future) workers (Area 9) were identified as the potential exposure pathways for which potential risks exceeded the target carcinogenic risk range of 10^{-4} to 10^{-6}. Dermal contact to PCOCs in soils by on-site workers (Area 9) and hypothetical construction (future) workers (Areas 1, 2, and 9) were identified as the potential exposure pathways for which the HI for non-carcinogenic risks exceeded one. Clean-up levels were developed in the FS only for those chemicals that accounted for 99 percent or more of the total human health risk. These chemicals were carcinogenic PAHs, PCP, and arsenic. USEPA also provided ecological soil clean-up levels for total PAHs, PCP, arsenic, copper, zinc, and dioxin/furans. However, since copper, zinc, and dioxin/furans were not found to adversely impact human health, no human health-based soil clean-up levels were developed for these chemicals.

The human health-based clean-up levels developed in the FS were based on geometric mean chemical concentrations following remediation. These clean-up levels were calculated by first deriving an action level, defined as a concentration above which soils must be remediated. The action levels and clean-up levels were both derived using a probabilistic approach (Monte Carlo simulation). The action level represents the 95th percentile of the risk distribution. If the 95th upper confidence limit of the mean of the existing site data for a chemical exceeds the action level, then remediation for that chemical would be required. Clean-up levels were calculated by replacing soil data that exceed the action level with a target treatment concentration or with zero (if exposures were eliminated) and recalculating the geometric mean. This "revised" data set was then entered into the risk algorithm to estimate risk (based on the 95th percentile). The iterative process terminates when the target risk levels are achieved.

Clean-up levels were developed for 10^{-4}, 10^{-5}, and 10^{-6} target risk levels. The 10^{-5} clean-up levels were derived on the basis that soils with concentrations exceeding an action level would be treated to a reduced concentration or exposure pathways to these soils would be removed. The 10^{-6} clean-up levels were derived on the basis of eliminating exposures to all soils exceeding the action levels. Since pre-remediation risks calculated using the Monte Carlo simulation were all less than the 10^{-4} risk level, no clean-up would be required and no clean-up levels were derived for this target risk level. Clean-up levels based on a Reasonable Maximally Exposed (RME) individual were also derived. The 10^{-5} target risk level values were used in the FS to estimate remediation areas, volumes, and costs.

The FS concluded that the 10^{-5} clean-up levels for PAHs and arsenic were sufficient to meet the ecological clean-up levels. The ecological clean-up level of 3 mg/kg for PCP (9 mg/kg action level) was lower than the 10^{-5} level. The ecological clean-up level for PCP, provided by USEPA, was based on sediment toxicity. The stated rationale for using this value for surface soils was that these soils are in the 100-year floodplain of the river. The geometric mean concentrations for copper and zinc were less than the ecological clean-up levels except in the acetylene sludge area (Area 9). The geometric mean TCDD concentration was below 0.001 mg/kg (the clean-up level).

3.3 Summary of the ROD

The 1995 Record of Decision (ROD) for the AWI site was issued by USEPA in September 1995. This ROD addressed soils, sediments, and DNAPL on the site, which defined the scope of OU-1. OU-2 (groundwater) and OU-3 (river/off-site areas) would be addressed by one or more other RODs.

The remedy is based on the same 5 RRUs defined in the FS and includes a description of the excavation and treatment methodologies associated with the preferred remedy; a monitoring program following remediation; and institutional controls. The latter includes changes to the title of the property restricting residential development, agricultural development, and the use of groundwater for drinking or domestic purposes.

The ROD also summarized the initial clean-up actions taken at the site:

- Cleaning and installation of a new liner within all affected manholes, catch basins, and sewer pipelines within the Elm Avenue storm sewer (completed in March 1995)
- Excavation of approximately 660 cubic yards of contaminated sediments from the intertidal drainage ditch and inlet (Area 5). This action was completed in May 1995

The soil and sediment clean-up levels in the ROD are shown in Table 5. The clean-up levels used were the lowest of the 10^{-5} human health values (from the FS) and the ecological values provided by USEPA in the FS. One important difference from the FS is that the ROD clean-up levels are based on the arithmetic mean (not the geometric mean as in FS) of post-remedial samples.

The ROD states that the ecological clean-up levels provided "generally originate from ER-M values provided by Long and Morgan (1990)......During the RI/FS, these values were adjusted to accommodate site-specific characteristics". These adjustments are not described (see Section 4). Sediment values were also applied to surface soils with the stated rationale being that most of the site is within the 100-year floodplain of the river. The ER-M values actually listed in the ROD, however, are the updated values from Long et al. (1995):

- Total PAHs - 44.79 mg/kg (1990 ER-M of 35 mg/mg). Neither value was directly used as a clean-up level
- PCP - no ER-M values
- Arsenic - 70 mg/kg (1990 ER-M of 85 mg/kg). The 85 mg/kg value was directly applied to sediments
- Copper - 270 mg/kg (1990 ER-M of 390 mg/kg). The 390 mg/kg value was directly applied to both surface soils and sediments
- Zinc - 410 mg/kg (1990 ER-M of 270 mg/kg). The 270 value was directly applied to sediments and the 410 value was apparently directly applied to soils

In general, the ROD does correctly summarize the results of the human health risk assessment conducted for the site. However, it is uncertain how some of the performance standards in the ROD (Table 2-15) were derived. The values are:

- RRU1 Area 1 and Area 2 - performance standard of 11 mg/kg for benzo(a)pyrene (BaP). Page 7 for Area 1 and page 8 for Area 2 of Appendix B of the FS states a clean-up level of 9 mg/kg for BaP
- RRU1 Area 4 - performance standard of 3 mg/kg for PCP. Page 9 and Table 8 of Appendix B of the FS state a cleanup level of 2 mg/kg for PCP

The ROD acknowledges that there are inconsistencies in the clean-up levels from the RI and the RAOs in the FS. It states that the clean-up levels in the ROD will govern clean-up. It also allows the option of refining the ecological clean-up levels based on a site-specific quantitative ERA.

The ROD does not provide specific methods to determine compliance with the clean-up levels. It states that pre-excavation sampling of soils and sediments will be completed to delineate the areal extent of remedial actions, sampling following excavation will be completed to determine compliance with action levels, and sampling following the back-filling of treated soils will be completed to determine compliance with clean-up levels. The vertical limit of excavation is generally defined as the top of the water table at its seasonally low elevation.

3.4 Summary of the NOAA ERA

The 1992 RI did not contain a quantitative ERA. It references an ERA completed in April 1992 by NOAA under an interagency agreement with USEPA. As acknowledged in the ROD, this April 1992 document was not a quantitative site-specific ERA.

The final ERA (April 1992) did not contain a derivation of ecologically-based clean-up levels for soils or sediments. This information was removed from the draft final version of the document and placed to two technical memorandums (only the sediment memorandum was available for this review; see Section 4).

The stated scope of the ERA was the AWI property (site), the shoreline of the Southern Branch of the Elizabeth River from the Jordan Bridge to the southern site boundary, and the small inlet by the bridge (Area 5). Since site-specific receptor information was not generally available for these areas, the ERA relied on generic information from the general vicinity.

The ERA was partitioned into aquatic and terrestrial components. The aquatic portion of the ERA addressed the estuarine communities in the river along the facility shoreline and in the small inlet, as well as the five small disturbed wetland areas identified on the site in the RI. The Chemicals of Potential Concern (COPCs) for the aquatic ERA (sediments) were qualitatively identified based on prevalence, mobility, persistence, and toxicity. These COPCs were PAHs, PCP, dioxin/furan, arsenic, copper, and zinc. Receptors included fish, shellfish, and aquatic invertebrates. Potential exposure routes to sediments were identified as direct contact, direct ingestion, and ingestion via the food chain. Exposure point concentrations were maximum and median sediment concentrations from samples collected in the inlet (Area 5), wetland ditches (Area 8), and/or the river, except for PCP, for which soils data from areas near the ditches were used. No exposure point concentrations were reported in the aquatic portion of the ERA for dioxin/furans. The primary toxicological endpoint used in the effects assessment was mortality, although histopathological and reproductive endpoints were also considered for PAHs. The only available standards listed were marine ambient water quality criteria (AWQC).

The aquatic risk characterization was completed in two parts. The first part consisted of a comparison of maximum undiluted groundwater concentrations (actually from a DNAPL sample) with AWQC values (where available). The second part compared maximum and median sediment concentrations with available sediment screening values from the literature, including NOAA ER-L, ER-M, and OAET values (Long and Morgan 1990), and AET values from PTI (1988). PAH sediment data were also compared with invertebrate and fish effects data from the literature. The risk characterization concluded that risks in aquatic habitats (especially the river) from site-related chemicals existed.

The terrestrial portion of the ERA addressed the non-wetland portions of the site. The site description indicated that the terrestrial portions of the site were generally devoid of natural vegetation, that the available habitat for ecological receptors was marginal to poor, and that habitats for larger mammals were unavailable. No site-specific data on receptors was available so generic data from the general site area were used. Various species of reptiles, amphibians, mammals, and birds were listed as potential receptors (including wetland dependent species). The COPCs evaluated in terrestrial areas (soils) were the same as those evaluated in the aquatic portion of the ERA. Exposure routes considered included dermal contact, inhalation, direct ingestion, and ingestion via the food chain. However, only ingestion routes were actually evaluated.

Exposures were based on maximum soil concentrations and were qualitatively modeled for four receptor species: cotton rat (omnivore), belted kingfisher (piscivore), eastern bluebird (omnivore), and woodhouse toad (insectivore). These receptors were apparently chosen based on available data from a U.S. Forest Service Environmental Impact Statement and were used as surrogates for species that might actually occur on the site. Note that aquatic receptors (e.g., belted kingfisher) were used in the terrestrial assessment. No bioaccumulation modeling was conducted; it was essentially assumed that the receptors ate soil. A "high" exposure scenario assumed that 100% of the diet contained COPCs at the maximum observed soil concentration. A "low" exposure scenario adjusted this percentage based on body weight using a formula that was not justified, technically, in the document. Effects data were obtained from the literature. The risk characterization consisted of a table comparison of the estimated exposures with the effects data (no hazard quotients were calculated). This risk characterization concluded that risks in terrestrial habitats from site-related chemicals existed.

3.4.1 Evaluation of the ERA

The NOAA ERA did not generally follow accepted ERA guidance at the time it was written and is inconsistent with current ERA guidance (e.g., USEPA 1997) and methodologies. Its major weaknesses were its qualitative nature, lack of site specificity, lack of a conceptual model (and assessment endpoints) to structure and focus the assessment, and the methods used to select receptors and estimate exposures.

The COPCs evaluated in the ERA were selected in a very qualitative manner. No attempt was made to quantitatively or semi-quantitatively apply a set of screening criteria to justify their selection. No conceptual model was developed for the site (a key component of an ERA) and no assessment endpoints were selected either. The selection of receptor species was not well justified given the habitats present (reflecting the lack of a conceptual model and assessment endpoints). For example, the belted kingfisher was used to evaluate terrestrial habitats even though it is a wetland-dependent species (piscivore). The other receptors species, even given that they were used as surrogates, were not well matched with the available habitats and likely exposure pathways.

Food chain modeling was not conducted for aquatic and wetland habitats. The food chain modeling that was conducted for terrestrial habitats used inappropriate methodologies. For example, no bioaccumulation modeling was attempted; it was assumed that the receptors ate soil. There was apparently no attempt to standardize exposures to either dry or wet weight (e.g., exposure concentrations appear to be in dry weight while food ingestion rates appear to be in wet weight). The scaling of exposure based on body weight was not justified. A simpler method would have been to use mean or median soil concentrations.

Table 5
Summary of Soil and Sediment Clean-up Values for the AWI Site

Chemical and Area	Feasibility Study					ROD	
	Monte Carlo		RME				
	10-6	10-5	10-6	10-5	RAOs	Overall	Eco
Basis:	Geometric mean (post-remedial)					Arithmetic Mean	
Arsenic (mg/kg)							
Area 1 (soil)	--	--	--	--	--	150	150
Area 2 (soil)	6	74	1	4	74	76	150
Area 3 (soil)	--	--	--	--	--	150	150
Area 4 (soil)	3 - 7	93	1	8	93	131	150
Area 5 (sediment)	--	--	--	--	85	85	85
Area 6 (sediment)	--	--	--	--	93	85	85
Area 7 (sediment)	--	--	--	--	93	85	85
Area 8 (sediment)	--	--	--	--	85	85	85
Area 9 (soil)	1 - 3	59	1	8	6	150	150
Copper (mg/kg)							
Area 1 (soil)	--	--	--	--	--	390	390
Area 2 (soil)	--	--	--	--	--	390	390
Area 3 (soil)	--	--	--	--	--	390	390
Area 4 (soil)	--	--	--	--	--	390	390
Area 5 (sediment)	--	--	--	--	390	390	390
Area 6 (sediment)	--	--	--	--	--	390	390
Area 7 (sediment)	--	--	--	--	--	390	390
Area 8 (sediment)	--	--	--	--	390	390	390
Area 9 (soil)	--	--	--	--	40	390	390
Zinc (mg/kg)							
Area 1 (soil)	--	--	--	--	--	410	410
Area 2 (soil)	--	--	--	--	--	410	410
Area 3 (soil)	--	--	--	--	--	410	410
Area 4 (soil)	--	--	--	--	--	410	410
Area 5 (sediment)	--	--	--	--	270	270	270
Area 6 (sediment)	--	--	--	--	--	270	270
Area 7 (sediment)	--	--	--	--	--	270	270
Area 8 (sediment)	--	--	--	--	270	270	270
Area 9 (soil)	--	--	--	--	80	410	410
Pentachlorophenol (mg/kg)							
Area 1 (soil)	--	--	--	--	--	3	3
Area 2 (soil)	1	1	2	6	1	2	3
Area 3 (soil)	1	4	4	20	4	3	3
Area 4 (soil)	1	2	2	6	2	3	3
Area 5 (sediment)	--	--	--	--	0.4	0.4	0.4
Area 6 (sediment)	--	--	--	--	2	0.4	0.4
Area 7 (sediment)	--	--	--	--	2	0.4	0.4
Area 8 (sediment)	--	--	--	--	0.4	0.4	0.4
Area 9 (soil)	1	2	2	6	2	3	3

Table 5
Summary of Soil and Sediment Clean-up Values for the AWI Site

Chemical and Area	Feasibility Study					ROD	
	Monte Carlo		RME				
	10-6	10-5	10-6	10-5	RAOs	Overall	Eco
Basis:	**Geometric mean (post-remedial)**					**Arithmetic Mean**	
PAHs (carcinogenic[1]) (mg/kg)							
Area 1 (soil)	1	9	6	8	9	11	--
Area 2 (soil)	0.3 - 1	9	6	8	9	10	--
Area 3 (soil)	0.4	8	6	8	8	8	--
Area 4 (soil)	0.3 - 1	4	6	7	4	6	--
Area 5 (sediment)	--	--	--	--	--	--	--
Area 6 (sediment)	--	--	--	--	4	--	--
Area 7 (sediment)	--	--	--	--	4	--	--
Area 8 (sediment)	--	--	--	--	--	--	--
Area 9 (soil)	0.2 - 0.3	6	6	7	8	8	--
PAHs (total) (mg/kg)							
Area 1 (soil)	--	--	--	--	--	100	100
Area 2 (soil)	--	--	--	--	--	100	100
Area 3 (soil)	--	--	--	--	--	100	100
Area 4 (soil)	--	--	--	--	--	100	100
Area 5 (sediment)	--	--	--	--	25	25	25
Area 6 (sediment)	--	--	--	--	--	25	25
Area 7 (sediment)	--	--	--	--	--	25	25
Area 8 (sediment)	--	--	--	--	25	25	25
Area 9 (soil)	--	--	--	--	--	100	100
Dioxin/furan[2] (mg/kg)							
Area 1 (soil)	--	--	--	--	--	0.001	0.001
Area 2 (soil)	--	--	--	--	--	0.001	0.001
Area 3 (soil)	--	--	--	--	--	0.001	0.001
Area 4 (soil)	--	--	--	--	--	0.001	0.001
Area 5 (sediment)	--	--	--	--	--	0.001	0.001
Area 6 (sediment)	--	--	--	--	--	0.001	0.001
Area 7 (sediment)	--	--	--	--	--	0.001	0.001
Area 8 (sediment)	--	--	--	--	--	0.001	0.001
Area 9 (soil)	--	--	--	--	--	0.001	0.001

1 Based on benzo(a)pyrene equivalents

2 Based on 2,3,7,8-TCDD equivalents

4.0 Preliminary Clean-up Level Evaluation

This section summarizes how the clean-up levels in the ROD were derived, evaluates their technical validity, and provides a preliminary identification of other available screening values for the six COPCs in soils and sediments.

4.1 Evaluation of Existing Site-Specific Clean-up Levels

The following describes the chronology of events that resulted in the ecological clean-up levels for soils and sediments in the ROD. Except for arsenic in some terrestrial areas, the ecological clean-up levels drive remediation. In addition, the derivation of the human health-based clean-up numbers has been accomplished with minimal controversy. This discussion is based on available documentation.

1. USEPA, in a technical memorandum dated 21 June 1991, informed AWI that due to a lack of off-site groundwater information, the remediation efforts at the site would be performed under two separate Records of Decision (RODs). The first ROD (OU-1) would address "highly contaminated" soils and sediments, and dense non-aqueous phase liquid (DNAPL). The second ROD (OU-2) would focus on groundwater and any other impacted media. The ERA for the site would be performed by NOAA under an interagency agreement with USEPA.

2. In a 13 April 1992 letter, USEPA (Region III BTAG) transmitted a technical memorandum which outlined the derivation of target ecological sediment clean-up levels for the site. This document identified possible values from the literature and selected specific values based on a "preponderance of evidence". Approaches considered included Apparent Effects Threshold (AET) values; NOAA ER-L, ER-M, and Overall AET values from Long and Morgan (1990); equilibrium partitioning-based values (at 5% total organic carbon); toxicity values from the literature; and background data from the literature for marine systems. Not all of these numbers are consistent with those reported in the April 1992 ERA (specifically AET values for PAHs and PCP). ER-L values were not considered as they were too low relative to background. For total PAHs, the memo selected the NOAA OAET value of 22 mg/kg as the sediment clean-up level. Specific values for the other COPCs were not selected.

   A similar technical memorandum for soil clean-up levels was apparently produced by the U.S. Fish and Wildlife Service but a copy was not available for this review. A draft version of this technical memorandum, dated 8 April 1992, is referenced in a 14 April 1992 USEPA memo from Drew Lausch transmitting comments to the BTAG on these draft soil clean-up numbers.

3. The draft final ERA (dated 11 September 1991) developed target clean-up levels for on-site sediments (but not soils); the 13 April 1992 technical memorandum referenced above was apparently derived in large part from the draft final ERA for PAHs. The discussion for the other COPCs in the draft final ERA was apparently deleted from the technical

memorandum. The target clean-up levels for on-site sediments reported in the draft final ERA (on pages 53 and 57) are as follows: (1) PAHs (22 mg/kg - NOAA OAET); (2) PCP (0.16 to 0.40 mg/kg - equilibrium partitioning at total organic carbon levels of 2 and 5 percent, respectively); (3) arsenic (50 mg/kg - NOAA OAET); (4) copper (300 mg/kg - NOAA OAET); (5) zinc (260 mg/kg - NOAA OAET); and (6) dioxin/furan - none specified.

A 9 July 1992 letter from NOAA to BTAG reports the following sediment clean-up levels as having been derived in the draft final ERA: PAHs (25 to 35 mg/kg); PCP (0.16 to 0.40 mg/kg); arsenic (85 mg/kg); copper (390 mg/kg), and zinc (270 mg/kg). These values do not match (except for PCP) those that this review extracted from the draft final ERA (see above). However, the values reported in the 9 July 1992 letter are more consistent with what would eventually become the ROD clean-up targets for on-site sediments.

4. A draft Focused Feasibility Study (FFS) was prepared and submitted in May 1992 for OU-1. In a 2 November 1993 letter commenting on this document, USEPA specified the following sediment clean-up levels for the inlet (Area 5) to protect aquatic and marine organisms: PAHs (25 mg/kg); PCP (0.40 mg/kg); arsenic (85 mg/kg); copper (390 mg/kg); and zinc (270 mg/kg).

5. In a 12 October 1994 letter from the USEPA Region III BTAG, they recommended applying sediment clean-up numbers to soils since 90 percent of the site is within the 100-year floodplain of the river. They also recommended a clean-up value of 1.6 mg/kg for PCP in soils (based upon aquatic data).

6. Based on USEPA comments on the FFS, a draft FS was prepared for OU-1 and submitted in February 1994. USEPA commented on this document in a 13 May 1994 letter. In this letter, USEPA indicated that, if bioassays will not be run on post-remedial samples, than the sediment clean-up levels specified in the draft FS (which were the same values as specified by USEPA in their 2 November 1993 letter; see item 4 above) should all be below ER-M values. The ER-M values specified are the 1995 values (not the 1990 values) as follows: total PAHs (44.79 mg/kg); PCP (0.36 mg/kg - lowest AET); arsenic (70 mg/kg); copper (270 mg/kg); and zinc (410 mg/kg). Soil clean-up levels are also proposed as follows: total PAHs (100 mg/kg); PCP (1.6 mg/kg); arsenic (150 mg/kg); copper (390 mg/kg); and zinc (410 mg/kg). No basis is given for these soil values, which were intended to be applied to both surface and subsurface soils.

7. During a 26 July 1994 conference call among USEPA, AWI, and Chester Environmental, Bob Davis (BTAG) indicated that the soil clean-up levels proposed by USEPA were derived from aquatic sediment numbers "multiplied up" (e.g., the PCP soil value of 1.6 mg/kg is the sediment value of 0.40 mg/kg multiplied by four). The receptor of concern was specified as terrestrial invertebrates (earthworms).

8. AWI responded to the 13 May 1994 USEPA letter on 3 June 1994 and stated that the sediment clean-up levels in the document were the same as those specified in agency comments on the May 1992 FFS and would not be changed. This letter also stated that the proposed soil clean-up levels in the USEPA letter were based on aquatic values and are thus not appropriate for soils. In addition, ecologically-based soil clean-up levels should not be needed at the site due to its industrial nature and lack of habitat.

9. In an 8 July 1994 letter, USEPA responded that it believed that there are terrestrial pathways to ecological receptors on the site but agreed to limit ecological soil clean-up levels to surface soils only. The letter also reiterated the soil clean-up levels from the previous letter but added "dioxin/furan (to be determined)". The letter referred to Bob Davis at BTAG as the source of these soil values.

10. On 25 August 1994, Chester Environmental, on behalf of AWI, responded to the 8 July 1994 letter. Chester reiterated AWI's position that ecological soil clean-up levels are not applicable, relevant, nor appropriate for this site. However, since the proposed ecological soil values for PAHs and metals could be met by cleaning up to human health based targets (at 10^{-5} risk levels), these values were accepted. However, the soil value for PCP (1.6 mg/kg), which was extrapolated from aquatic data, was problematic. The letter proposes a 6 mg/kg soil clean-up level which would be met by cleaning up to human health target values in all areas except the historical disposal area. A 12-inch soil cover was proposed in this area.

11. AWI received a letter dated 3 February 1995 from USEPA commenting on Chester Environmental's 24 August 1994 letter regarding ecological issues and the revised draft FS. This letter provided data on other sites where PCP soil clean-up have met lower levels than 1.6 mg/kg. USEPA proposed a PCP soil clean-up level of 3 mg/kg (post-remedial mean) with a maximum allowable value (action level) of 9 mg/kg. However, this value was contingent upon the implementation of a 5-year biological monitoring program. A soil clean-up value for dioxin/furans (0.001 mg/kg) was also introduced; the derivation of this value was not explained.

12. On 17 February 1995, AWI and Chester Environmental met with USEPA to discuss unresolved issues related to the 3 February 1995 letter. AWI also initiated dispute resolution on this date related to these issues to allow sufficient time to revise the FS.

13. USEPA, in a 3 March 1995 letter, outlined their resolution to the unresolved issues. The main issue was the proposed PCP soil clean-up value of 3 mg/kg. USEPA rejected the 6 mg/kg value proposed by AWI. USEPA also reiterated its position that the sediment clean-up value for PCP (0.4 mg/kg) could be applied to site soils since most of the site was in the river floodplain. The letter specified that the PCP soil clean-up level would remain 3 mg/kg (with a maximum allowable concentration of 9 mg/kg). This letter also specified that chemical and biological monitoring (drainage ditches) would be triggered if mean soil concentrations exceed 0.4 mg/kg (the sediment clean-up level for PCP) in post-remedial confirmation soil samples. While allowing a 12-inch soil cover in areas where PCP soil concentrations are between 3 and 9 mg/kg, monitoring would still be required. The letter directed AWI to complete the FS using the USEPA-specific clean-up levels.

14. In response, AWI submitted a letter on 9 March 1995 stating that it strongly disagreed with USEPA's decision regarding the ecological soil clean-up level for PCP contained in the USEPA letter. AWI also stated that the source of this PCP soil level (draft Canadian soil quality criterion document for contaminated sites) supports a PCP soil clean-up level of 25 mg/kg for industrial sites. The use of the USEPA PCP soil value of 3 mg/kg to complete the FS was not an indication of AWI's concurrence with the appropriateness of this value or of its willingness to implement USEPA's chosen remedial alternative.

In summary, the ecological sediment clean-up levels in the ROD are based as follows:

- Total PAHs (25 mg/kg) - NOAA OAET value (Long and Morgan 1990) of 22 mg/kg rounded up to 25 mg/kg. The 1990 (35 mg/kg) and 1995 (44.79 mg/kg) ER-M values are not used
- PCP (0.4 mg/kg) - lowest marine AET value from NOAA (0.36) rounded to 0.4 mg/kg
- Arsenic (85 mg/kg) - 1990 ER-M value
- Copper (390 mg/kg) - 1990 ER-M value
- Zinc (270 mg/kg) - 1990 ER-M value
- Dioxin/furans (0.001 mg/kg) - basis unknown; same as soil value

In summary, the ecological soil clean-up levels in the ROD are based as follows:

- Total PAHs (100 mg/kg) - basis unknown (sediment value multiplied by four?)
- PCP (3 mg/kg) - basis unknown (appears to be a "compromise" value)
- Arsenic (150 mg/kg) - basis unknown
- Copper (390 mg/kg) - basis unknown but the same as the 1990 ER-M value and the low range AET value
- Zinc (410 mg/kg) - basis unknown but the same as the 1995 ER-M value and the low range AET value
- Dioxin/furans (0.001 mg/kg) - basis unknown

4.2 Preliminary Screening Values

This section provides a preliminary evaluation of available soil and sediment screening values for the six COPCs identified in the ROD. These values are summarized in Tables 6 (soils) and 7 (sediments). These values fall into two general categories:

- **Published Screening Values**. These values are generally intended for use in screening ERAs and are not intended as clean-up criteria. They typically focus on lower trophic level organisms and are generally considered conservative.
- **Values Back-Calculated From Food Web Models.** These values are provided for a list of potentially appropriate receptors and pathways for the site. They are back-calculated from a hazard quotient of 1.0 using standard food web and bioaccumulation models and are based on both No Observed Adverse Effect Levels (NOAELs) and Lowest Observed Adverse Effect Levels (LOAEL) from the literature. They assume that the receptor spends all of its time on site (area use factor of 1). Water ingestion, dermal contact, and

inhalation exposures are not considered based on the fate properties of the COPCs and the media of concern (soils and sediments). These numbers are preliminary.

A site-specific ERA is needed to justify alternative clean-up levels. The first step of the ERA would be problem formulation and conceptual model development. It should be noted that setting ecologically-based clean-up levels may not be justified in some areas based on future use (lack of exposure pathways). The implications of any alternative ecological clean-up levels that are developed on risks to human health and on groundwater concentrations (transport to the river) would need to be considered. Thus, updating the human health risk assessment might be warranted in this case.

Based upon this preliminary analysis, it appears that increases in several of the ecologically-based clean-up numbers in the ROD can be technically justified. For surface soils:

- **No Increase Likely:** Arsenic and dioxin/furan
- **Slight Increase Possible:** Copper, zinc, and PAHs
- **Increase Likely:** PCP (2 to 10 times existing value)

For sediments:

- **No Increase Likely:** Arsenic and copper
- **Slight Increase Possible:** Zinc, PCP, and dioxin/furan
- **Increase Likely:** PAHs (2 to 10 times existing value)

It should be noted that increases in these clean-up levels would need to be evaluated in terms of their potential effects on groundwater and human health. These factors could potentially limit any increases made possible by altering the ecological clean-up levels.

Site-specific data could help refine alternative clean-up values, especially for soils. The most potentially useful type of data would be tissue analysis of on-site organisms to determine site-specific chemical body burdens in prey items. This would help refine the food web model calculations by providing site-specific measured values to replace estimated values based on bioaccumulation modeling with literature-based input values. However, it is not known if these data would increase or decrease the preliminary food web values in Table 6. Sediment and soil toxicity testing do not appear warranted at this time but might be considered later in the ERA process.

Table 6
Potential Ecological Screening Values for Surface Soil

Value (mg/kg)	Type	Source	Pathway/Receptor
Arsenic			
3.12	Food web (NOAEL)	Calculated	Ingestion (food web)/Raccoon
4.71	Food web (NOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
10	Soil Flora	Efroymson et al. 1997a	Contact/Plants
29.5	Food web (NOAEL)	Calculated	Ingestion (food web)/Red Fox
31.2	Food web (LOAEL)	Calculated	Ingestion (food web)/Raccoon
31.3	Food web (NOAEL)	Calculated	Ingestion (food web)/Deer Mouse
39.6	Food web (NOAEL)	Calculated	Ingestion (food web)/Meadow Vole
42	Soil Criteria (B)	MHSPE 1994	Contact/Human and Ecological
47.1	Food web (LOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
55	Soil Intervention Value	MHSPE 1994	Contact/Human and Ecological
60	Soil Fauna (Earthworm)	Efroymson et al. 1997b	Contact and Ingestion/Earthworms
76	Human Health (lowest)	ROD	
100	Soil Fauna (Microorganisms)	Efroymson et al. 1997b	Contact/Soil Microorganisms
112	Food web (NOAEL)	Calculated	Ingestion (food web)/American Robin
150	Eco	ROD	
244	Food web (NOAEL)	Calculated	Ingestion (food web)/Mourning Dove
295	Food web (LOAEL)	Calculated	Ingestion (food web)/Red Fox
303	Food web (NOAEL)	Calculated	Ingestion (food web)/American Kestrel
313	Food web (LOAEL)	Calculated	Ingestion (food web)/Deer Mouse
328	Soil Flora	USEPA Region III 1995	Contact/Plants
339	Food web (LOAEL)	Calculated	Ingestion (food web)/American Robin
396	Food web (LOAEL)	Calculated	Ingestion (food web)/Meadow Vole
733	Food web (LOAEL)	Calculated	Ingestion (food web)/Mourning Dove
909	Food web (LOAEL)	Calculated	Ingestion (food web)/American Kestrel
Copper			
15	Soil Flora	USEPA Region III 1995	Contact/Plants
50	Soil Fauna (Earthworm)	Efroymson et al. 1997b	Contact and Ingestion/Earthworms
100	Soil Fauna (Microorganisms)	Efroymson et al. 1997b	Contact/Soil Microorganisms
100	Soil Flora	Efroymson et al. 1997a	Contact/Plants
113	Soil Criteria (B)	MHSPE 1994	Contact/Human and Ecological
190	Soil Intervention Value	MHSPE 1994	Contact/Human and Ecological
390	Eco	ROD	
435	Food web (NOAEL)	Calculated	Ingestion (food web)/Raccoon
563	Food web (LOAEL)	Calculated	Ingestion (food web)/Raccoon
694	Food web (NOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
898	Food web (LOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
1045	Food web (NOAEL)	Calculated	Ingestion (food web)/Red Fox
1350	Food web (LOAEL)	Calculated	Ingestion (food web)/Red Fox
1380	Food web (NOAEL)	Calculated	Ingestion (food web)/American Robin
1810	Food web (LOAEL)	Calculated	Ingestion (food web)/American Robin
1845	Food web (NOAEL)	Calculated	Ingestion (food web)/American Kestrel
2385	Food web (NOAEL)	Calculated	Ingestion (food web)/Mourning Dove
2420	Food web (LOAEL)	Calculated	Ingestion (food web)/American Kestrel
3130	Food web (LOAEL)	Calculated	Ingestion (food web)/Mourning Dove
3660	Food web (NOAEL)	Calculated	Ingestion (food web)/Deer Mouse
3780	Food web (NOAEL)	Calculated	Ingestion (food web)/Meadow Vole
4740	Food web (LOAEL)	Calculated	Ingestion (food web)/Deer Mouse
4890	Food web (LOAEL)	Calculated	Ingestion (food web)/Meadow Vole

Table 6
Potential Ecological Screening Values for Surface Soil

Value (mg/kg)	Type	Source	Pathway/Receptor
Zinc			
10	Soil Flora	USEPA Region III 1995	Contact/Plants
50	Soil Flora	Efroymson et al. 1997a	Contact/Plants
100	Soil Fauna (Microorganisms)	Efroymson et al. 1997b	Contact/Soil Microorganisms
108	Food web (NOAEL)	Calculated	Ingestion (food web)/American Robin
142	Food web (NOAEL)	Calculated	Ingestion (food web)/American Kestrel
200	Soil Fauna (Earthworm)	Efroymson et al. 1997b	Contact and Ingestion/Earthworms
208	Food web (NOAEL)	Calculated	Ingestion (food web)/Raccoon
315	Food web (NOAEL)	Calculated	Ingestion (food web)/Mourning Dove
410	Eco	ROD	
430	Soil Criteria (B)	MHSPE 1994	Contact/Human and Ecological
720	Soil Intervention Value	MHSPE 1994	Contact/Human and Ecological
795	Food web (NOAEL)	Calculated	Ingestion (food web)/Red Fox
970	Food web (LOAEL)	Calculated	Ingestion (food web)/American Robin
1285	Food web (LOAEL)	Calculated	Ingestion (food web)/American Kestrel
1735	Food web (NOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
2075	Food web (LOAEL)	Calculated	Ingestion (food web)/Raccoon
2840	Food web (LOAEL)	Calculated	Ingestion (food web)/Mourning Dove
3470	Food web (LOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
7970	Food web (LOAEL)	Calculated	Ingestion (food web)/Red Fox
8625	Food web (NOAEL)	Calculated	Ingestion (food web)/Deer Mouse
14430	Food web (NOAEL)	Calculated	Ingestion (food web)/Meadow Vole
17250	Food web (LOAEL)	Calculated	Ingestion (food web)/Deer Mouse
28875	Food web (LOAEL)	Calculated	Ingestion (food web)/Meadow Vole
Pentachlorophenol			
0.1	Soil Flora	USEPA Region III 1995	Canadian background
2	Human Health (lowest)	ROD	
2.5	Soil Criteria (B)	MHSPE 1994	Contact/Human and Ecological
3	Soil Flora	Efroymson et al. 1997a	Contact/Plants
3	Eco	ROD	
5	Soil Intervention Value	MHSPE 1994	Contact/Human and Ecological
6	Soil Fauna (Earthworm)	Efroymson et al. 1997b	Contact and Ingestion/Earthworms
13.4	Food web (NOAEL)	Calculated	Ingestion (food web)/Raccoon
16.2	Food web (NOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
90.0	Food web (NOAEL)	Calculated	Ingestion (food web)/Red Fox
90.9	Food web (NOAEL)	Calculated	Ingestion (food web)/Deer Mouse
133	Food web (LOAEL)	Calculated	Ingestion (food web)/Raccoon
162	Food web (LOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
396	Food web (NOAEL)	Calculated	Ingestion (food web)/American Robin
400	Soil Fauna (Microorganisms)	Efroymson et al. 1997b	Contact/Soil Microorganisms
551	Food web (NOAEL)	Calculated	Ingestion (food web)/American Kestrel
662	Food web (NOAEL)	Calculated	Ingestion (food web)/Meadow Vole
793	Food web (LOAEL)	Calculated	Ingestion (food web)/American Robin
900	Food web (LOAEL)	Calculated	Ingestion (food web)/Red Fox
909	Food web (LOAEL)	Calculated	Ingestion (food web)/Deer Mouse
1100	Food web (LOAEL)	Calculated	Ingestion (food web)/American Kestrel
6620	Food web (LOAEL)	Calculated	Ingestion (food web)/Meadow Vole
9190	Food web (NOAEL)	Calculated	Ingestion (food web)/Mourning Dove
18380	Food web (LOAEL)	Calculated	Ingestion (food web)/Mourning Dove

Table 6
Potential Ecological Screening Values for Surface Soil

Value (mg/kg)	Type	Source	Pathway/Receptor
Total PAHs			
20.5	Soil Criteria (B)	MHSPE 1994	Contact/Human and Ecological
22.5	Food web (NOAEL)	Calculated	Ingestion (food web)/Raccoon
>26	Soil Fauna	Cureton et al. 1994	Contact/Soil Fauna (BaP)
31.3	Food web (NOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
40	Soil Intervention Value	MHSPE 1994	Contact/Human and Ecological
100	Eco	ROD	
125	Food web (NOAEL)	Calculated	Ingestion (food web)/Red Fox
217	Food web (NOAEL)	Calculated	Ingestion (food web)/Deer Mouse
225	Food web (LOAEL)	Calculated	Ingestion (food web)/Raccoon
313	Food web (LOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
487	Food web (NOAEL)	Calculated	Ingestion (food web)/Meadow Vole
1245	Food web (LOAEL)	Calculated	Ingestion (food web)/Red Fox
1585	Food web (NOAEL)	Calculated	Ingestion (food web)/American Robin
2165	Food web (LOAEL)	Calculated	Ingestion (food web)/Deer Mouse
3150	Food web (NOAEL)	Calculated	Ingestion (food web)/American Kestrel
3500	Soil Flora	Cureton et al. 1994	Contact/Plants (BaP)
4870	Food web (LOAEL)	Calculated	Ingestion (food web)/Meadow Vole
5500	Food web (NOAEL)	Calculated	Ingestion (food web)/Mourning Dove
15850	Food web (LOAEL)	Calculated	Ingestion (food web)/American Robin
31500	Food web (LOAEL)	Calculated	Ingestion (food web)/American Kestrel
54975	Food web (LOAEL)	Calculated	Ingestion (food web)/Mourning Dove
Dioxin/furan			
0.0000028	Food web (NOAEL)	Calculated	Ingestion (food web)/Raccoon
0.0000034	Food web (NOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
0.000015	Food web (NOAEL)	Calculated	Ingestion (food web)/Red Fox
0.000019	Food web (NOAEL)	Calculated	Ingestion (food web)/Deer Mouse
0.000028	Food web (LOAEL)	Calculated	Ingestion (food web)/Raccoon
0.000034	Food web (LOAEL)	Calculated	Ingestion (food web)/Short-tailed Shrew
0.000035	Food web (NOAEL)	Calculated	Ingestion (food web)/American Robin
0.000046	Food web (NOAEL)	Calculated	Ingestion (food web)/American Kestrel
0.00015	Food web (LOAEL)	Calculated	Ingestion (food web)/Red Fox
0.00019	Food web (LOAEL)	Calculated	Ingestion (food web)/Deer Mouse
0.0002	Food web (NOAEL)	Calculated	Ingestion (food web)/Meadow Vole
0.00035	Food web (LOAEL)	Calculated	Ingestion (food web)/American Robin
0.00046	Food web (LOAEL)	Calculated	Ingestion (food web)/American Kestrel
0.001	Eco	ROD	
0.002	Food web (LOAEL)	Calculated	Ingestion (food web)/Meadow Vole
0.0023	Food web (NOAEL)	Calculated	Ingestion (food web)/Mourning Dove
0.01	Fauna	USEPA Region III 1995	LD50 (oral) - rabbit
0.023	Food web (LOAEL)	Calculated	Ingestion (food web)/Mourning Dove
5	Soil Fauna (Earthworm)	Reinecke and Nash 1984	Contact/Soil Fauna

Table 7
Potential Ecological Screening Values for Sediment

Value (mg/kg)	Type	Source	Pathway/Receptor
Arsenic			
7.2	Marine TEL	Buchman 1999	Contact/Benthic Invertebrates
8.2	Marine ER-L	Long et al. 1995	Contact/Benthic Invertebrates
35	Marine AET (lowest)	Buchman 1999	Contact/Bivalves
37.6	Food web (NOAEL)	Calculated	Ingestion (food web)/Marsh Wren
70	Marine ER-M	Long et al. 1995	Contact/Benthic Invertebrates
85	Old Marine ER-M	Long and Morgan 1990	Contact/Benthic Invertebrates
113	Food web (LOAEL)	Calculated	Ingestion (food web)/Marsh Wren
244	Food web (NOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
610	Food web (LOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
855	Food web (NOAEL)	Calculated	Ingestion (food web)/Mallard
900	Food web (NOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
2135	Food web (LOAEL)	Calculated	Ingestion (food web)/Mallard
2265	Food web (LOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
Copper			
18.7	Marine TEL	Buchman 1999	Contact/Benthic Invertebrates
34	Marine ER-L	Long et al. 1995	Contact/Benthic Invertebrates
270	Marine ER-M	Long et al. 1995	Contact/Benthic Invertebrates
360	Food web (NOAEL)	Calculated	Ingestion (food web)/Marsh Wren
390	Marine AET (lowest)	Buchman 1999	Contact/Microtox; Oyster Larvae
390	Old Marine ER-M	Long and Morgan 1990	Contact/Benthic Invertebrates
475	Food web (LOAEL)	Calculated	Ingestion (food web)/Marsh Wren
1730	Food web (NOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
2270	Food web (LOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
3675	Food web (NOAEL)	Calculated	Ingestion (food web)/Mallard
4825	Food web (LOAEL)	Calculated	Ingestion (food web)/Mallard
10500	Food web (NOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
13700	Food web (LOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
Zinc			
108	Food web (NOAEL)	Calculated	Ingestion (food web)/Marsh Wren
124	Marine TEL	Buchman 1999	Contact/Benthic Invertebrates
150	Marine ER-L	Long et al. 1995	Contact/Benthic Invertebrates
270	Old Marine ER-M	Long and Morgan 1990	Contact/Benthic Invertebrates
410	Marine AET (lowest)	Buchman 1999	Contact/Benthic Invertebrates
410	Marine ER-M	Long et al. 1995	Contact/Benthic Invertebrates
440	Food web (NOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
600	Food web (NOAEL)	Calculated	Ingestion (food web)/Mallard
975	Food web (LOAEL)	Calculated	Ingestion (food web)/Marsh Wren
2190	Food web (NOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
4000	Food web (LOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
5400	Food web (LOAEL)	Calculated	Ingestion (food web)/Mallard
19800	Food web (LOAEL)	Calculated	Ingestion (food web)/Great Blue Heron

Table 7
Potential Ecological Screening Values for Sediment

Value (mg/kg)	Type	Source	Pathway/Receptor
Pentachlorophenol			
0.017	Marine AET (lowest)	Buchman 1999	Contact/Bivalves
0.36	Marine AET (lowest)	USEPA Region III 1995	Contact/Amphipods
0.40	Marine AET (lowest)	--	Contact/Amphipods - rounded
829	Food web (NOAEL)	Calculated	Ingestion (food web)/Marsh Wren
1650	Food web (LOAEL)	Calculated	Ingestion (food web)/Marsh Wren
1720	Food web (NOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
3440	Food web (LOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
5420	Food web (NOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
10840	Food web (LOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
11575	Food web (NOAEL)	Calculated	Ingestion (food web)/Mallard
23150	Food web (LOAEL)	Calculated	Ingestion (food web)/Mallard
Total PAHs			
1.684	Marine TEL	Buchman 1999	Contact/Benthic Invertebrates
4.022	Marine ER-L	Long et al. 1995	Contact/Benthic Invertebrates
25	Overall Marine AET	Long and Morgan 1990	Contact/Benthic Invertebrates (rounded from 22)
35	Old Marine ER-M	Long and Morgan 1990	Contact/Benthic Invertebrates
44.792	Marine ER-M	Long et al. 1995	Contact/Benthic Invertebrates
1645	Food web (NOAEL)	Calculated	Ingestion (food web)/Marsh Wren
1710	Food web (NOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
4380	Food web (NOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
12860	Food web (NOAEL)	Calculated	Ingestion (food web)/Mallard
16450	Food web (LOAEL)	Calculated	Ingestion (food web)/Marsh Wren
17125	Food web (LOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
43880	Food web (LOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
128600	Food web (LOAEL)	Calculated	Ingestion (food web)/Mallard
Dioxin/furan			
0.0000036	Marine AET (lowest)	Buchman 1999	Contact/Benthic Invertebrates
0.00093	Food web (NOAEL)	Calculated	Ingestion (food web)/Marsh Wren
0.001	?	?	Same as ROD soil value
0.0019	Food web (NOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
0.0052	Food web (NOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
0.0062	Food web (NOAEL)	Calculated	Ingestion (food web)/Mallard
0.0093	Food web (LOAEL)	Calculated	Ingestion (food web)/Marsh Wren
0.019	Food web (LOAEL)	Calculated	Ingestion (food web)/Belted Kingfisher
0.052	Food web (LOAEL)	Calculated	Ingestion (food web)/Great Blue Heron
0.062	Food web (LOAEL)	Calculated	Ingestion (food web)/Mallard

5.0 References

Buchman, M.F. 1999. *NOAA screening quick reference tables.* NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.

Cureton, P.M., G. Balch, D. Linott, K. Poirrier, C. Gaudet, and S. Goudey. 1994. Toxicity testing of NCSRP priority substances for the development of soil quality criteria. Poster presented at the 15th annual meeting of the Society of Environmental Toxicology and Chemistry. 30 October - 3 November 1994. Denver, Colorado.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological benchmarks for screening contaminants of potential concern for effects on soil and litter invertebrates and heterotrophic process: 1997 revision.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-126/R2.

Long, E.R. and L.G. Morgan. 1990. *The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program.* NOAA Technical Memorandum NOS OMA 52.

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.* 19:81-97.

Ministry of Housing, Spatial Planning and Environment (MHSPE). 1994. *Intervention values.* Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. 9 May. DBO/07494013.

PTI. 1988. *The briefing report to the Environmental Protection Agency Science Advisory Board: the apparent effects threshold approach.* Washington DC: Environmental Protection Agency.

Reinecke, A.J. and R.G. Nash. 1984. Toxicity of 2,3,7,8-TCDD and short-term bioaccumulation by earthworms (Oligochaeta). *Soil Biology and Biochemistry.* 16:45-49.

U.S. Environmental Protection Agency (USEPA). 1997. *Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments.* Interim Final. EPA/540/R-97/006.

U.S. Environmental Protection Agency (USEPA) Region III. 1995. *Revised Region III BTAG screening levels.* Memorandum from R.S. Davis to Users. 9 August.

Appendix A: Response to Comments

Comment Response Summary
LANTNAVFACENGCOM Comments to Draft Final Existing Conditions Report
Atlantic Wood Industries, Inc., Portsmouth, Virginia Site

General Comments

1. *The report does not include information from the Data Evaluation Report/Sites 3 and 9 issued for the Navy by Baker Environmental in May of 1998. This information should be considered for inclusion in the data set utilized for performing the Ecological Risk Assessment (ERA).*

These data will be considered during later stages of the ERA process. A statement indicating this was added to the end of Section 2.3.

2. *There are a significant number of contaminants that have been identified at the site that are not addressed in the ROD. It will not be effective to move forward with performance of an ERA for just the COPCs in the ROD without the evaluation of the data from the current investigatory work being performed by the EPA. This field work currently underway will likely yield additional COPCs and will therefore require performance of additional ecological risk assessment.*

The data from the EPA soil sampling program will be considered during later stages of the ERA process. A statement indicating this was added to the end of Section 2.3. As indicated in the comment, the new data may result in additional COPCs that will need to be evaluated in the ERA. However, the scope of the existing conditions report is limited to the ROD COPCs.

Specific Comments

3. *2.1 Environmental Setting. AWII is bounded on the south by the "Southgate Annex" of NNSY.*

The text was changed as indicated in the comment.

4. *Figure 1 indicates the "Acetylene Sludge Area" is further west than it actually is.*

The boundaries of the acetylene sludge area shown on Figure 1 were obtained from the FS and ROD. This was added to the text of Section 2.0. Figure 1 was not changed.

5. *Table 1. Why are chromium levels not included in this table when they were analyzed? Show where it was found and where non-detected.*

Chromium was not included since it was not a ROD COPC. See response to Comment 2.

6. *3.1 Summary of RI, page 8, last paragraph. States that highest PAH concentrations were detected in Areas 1, 2, and 3. Highest level detected was actually in Area 9 (Figure 4-7 indicated level of 10,684 ppm at SB 8-4 and 1,420 at SB 8-7). There were also high PAH levels detected in groundwater at MW-119 (Figure 4-12).*

The text was modified by including Area 9 in the list of areas with high PAH concentrations in surface soils.

7. *3.1 Summary of RI, page 9, second paragraph. Indicate that PAHs were also discovered in samples collected from shallow wells in Acetylene Sludge Area (Area 9). Refer to levels in MW-119 on Figure 4-12 of the RI.*

The text was modified by including Area 9 in the list of areas with high PAH concentrations in groundwater.