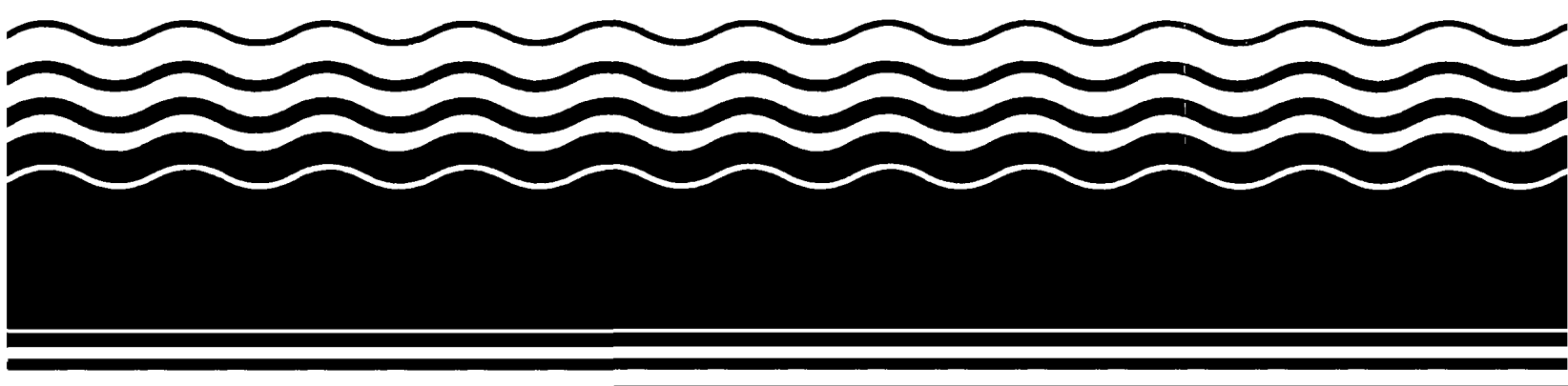


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July 1995

**EPA Superfund
Record of Decision:**

**H & H, Inc., Burn Pit
Hanover County, VA
6/30/95**



HH BURN PIT SUPERFUND SITE
HANOVER COUNTY, VIRGINIA

RECORD OF DECISION

PREPARED BY
THE U.S. ENVIRONMENTAL PROTECTION AGENCY

JUNE 1995

RECORD OF DECISION
HH BURN PIT SUPERFUND SITE

PART I - DECLARATION

I. SITE NAME AND LOCATION

HH Burn Pit Superfund Site¹
Hanover County, Virginia

II. STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the final remedial action selected for the HH Burn Pit Superfund Site, located in Hanover County, Virginia (Site). This remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. §§ 9601 et seq., and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the remedial action and is based on the Administrative Record for this Site. An index of documents included in the Administrative Record may be found at Appendix A of the ROD.

The Virginia Department of Environmental Quality (VDEQ) has commented on the selected remedy and the State's comments have been incorporated to the extent possible.

III. ASSESSMENT OF THE SITE

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. § 9606, that actual or threatened releases of hazardous substances from this Site, as discussed in Section VI (Summary of Site Risks) of this ROD, if not addressed by implementing the remedial action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

IV. DESCRIPTION OF THE SELECTED REMEDY

The Environmental Protection Agency (EPA), in consultation with VDEQ, has selected the following remedial action for the HH Burn Pit Superfund Site. This remedy addresses contaminated soil, sediment, surface water, and ground water at the Site. The selected remedy is comprised of the following major components:

¹ The Site has been identified using different names in many of the documents in the Administrative Record and on the National Priorities List. This Record of Decision will refer to the Site as the "HH Burn Pit Superfund Site."

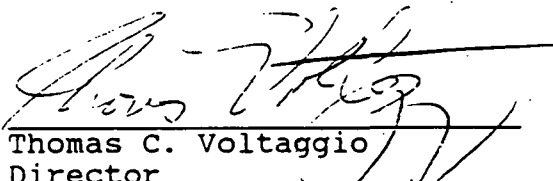
- Excavation of contaminated soil in the unsaturated zone above the water table (i.e., above the depth of four to six feet) where soil cleanup levels in Table 12 of the ROD are exceeded;
- Excavation of contaminated sediments from the drainage ways downgradient of the bermed disposal area where contaminant concentrations exceed the sediment cleanup levels listed in Table 12 of the ROD;
- Disposal of contaminated soils and sediments that do not exhibit hazardous characteristics in a landfill permitted in accordance with the Resource Conservation and Recovery Act (RCRA) Subtitle D requirements;
- Treatment and disposal of contaminated soils and sediments that exhibit hazardous characteristics at a RCRA-permitted Subtitle C facility;
- Disposal of soils found to contain polychlorinated biphenyls (PCBs) above 50 mg/kg at a Toxic Substances Control Act (TSCA) landfill;
- Extraction of contaminated ground water containing Site-related contaminants above the ground water cleanup levels listed in Table 12 of the ROD;
- Treatment of contaminated ground water by precipitation and sedimentation to remove metals and by Ultra Violet (UV) oxidation to destroy organics;
- At the option of responsible parties who may implement this remedial action, and only if treatability studies performed during remedial design demonstrate to EPA that the technologies are effective, air sparging and soil vapor extraction may be implemented to accelerate the removal of contamination from saturated soils and ground water.
- Implementation of a monitoring program to verify performance of the ground water treatment system and detect any impacts to the tributary, surrounding wetlands, and the nearest residences downgradient of the Site.

V. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the

maximum extent practicable, and, in the case of ground water, satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.


Thomas C. Voltaggio
Director
Hazardous Waste Management Division
Region III
Environmental Protection Agency

6/30/75
Date

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RECORD OF DECISION
HH BURN PIT SUPERFUND SITE

PART I - DECLARATION

I. SITE NAME AND LOCATION

HH Burn Pit Superfund Site¹
Hanover County, Virginia

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The Environmental Protection Agency (EPA), in consultation with VDEQ, has selected the following remedial action for the HH Burn Pit Superfund Site. This remedy addresses contaminated soil, sediment, surface water, and ground water at the Site. The selected remedy is comprised of the following major components:

¹ The Site has been identified using different names in many of the documents in the Administrative Record and on the National Priorities List. This Record of Decision will refer to the Site as the "HH Burn Pit Superfund Site."

- Excavation of contaminated soil in the unsaturated zone above the water table (i.e., above the depth of four to six feet) where soil cleanup levels in Table 12 of the ROD are exceeded;
- Excavation of contaminated sediments from the drainage ways downgradient of the bermed disposal area where contaminant concentrations exceed the sediment cleanup levels listed in Table 12 of the ROD;
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- Implementation of a monitoring program to verify performance of the ground water treatment system and detect any impacts to the tributary, surrounding wetlands, and the nearest residences downgradient of the Site.

V. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the

maximum extent practicable, and, in the case of ground water, satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Thomas C. Voltaggio
Director
Hazardous Waste Management Division
Region III
Environmental Protection Agency

Date

RECORD OF DECISION
HH BURN PIT SUPERFUND SITE

PART II - DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

The HH Burn Pit Site is located in Hanover County, Virginia, approximately 12 miles northwest of the City of Richmond on Staples Mill Road (Route 33) and 0.5 mile south of the small community of Farrington, Virginia (See Figure 1).

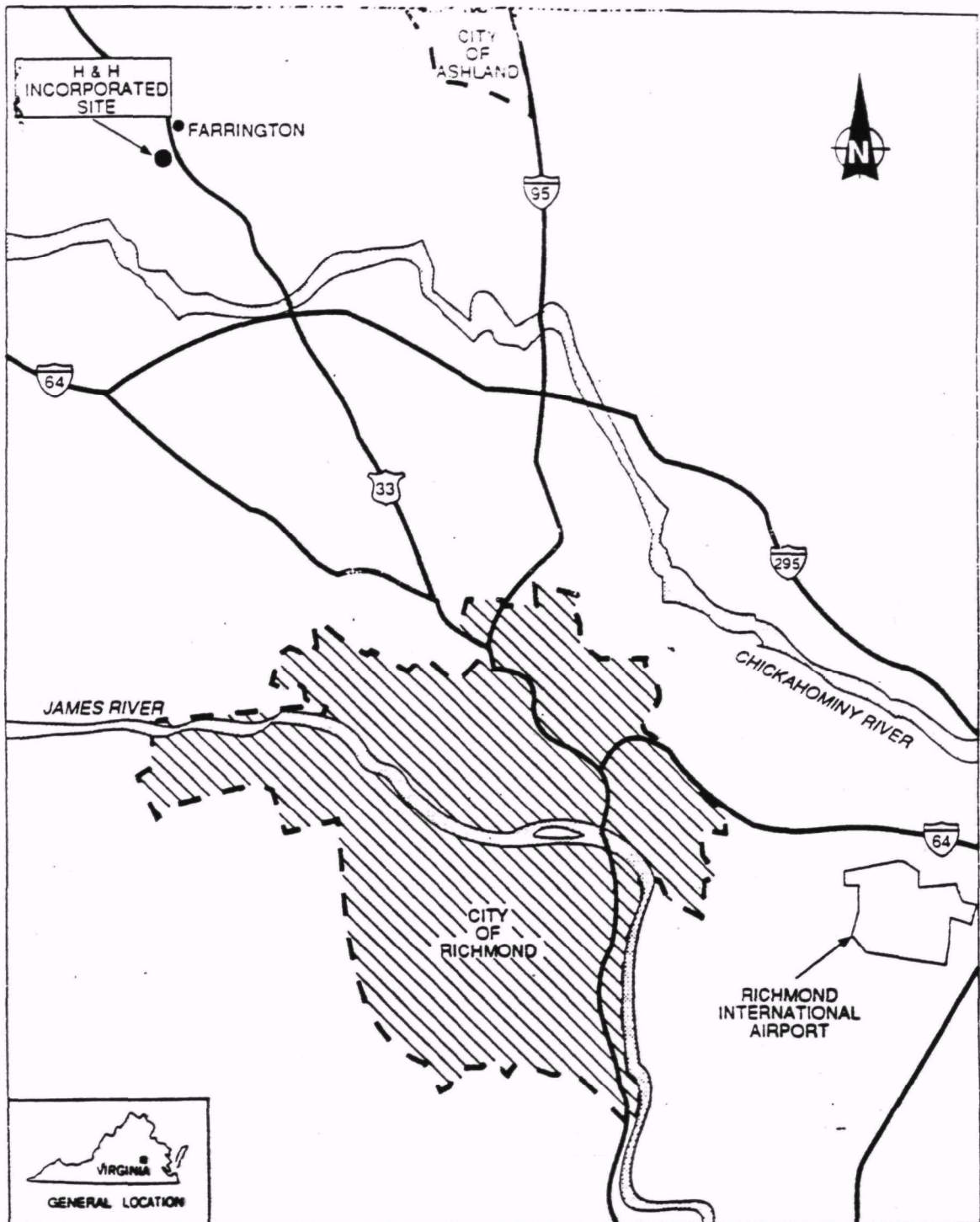
The Site is defined as all areas found presently, or in the future, that are impacted by contamination that resulted from hazardous waste disposal operations previously conducted at this location. The Site currently includes: 1) contaminated soil in a circular clearing approximately one acre in size, hereafter referred to as "the disposal area"; 2) areas of contaminated soil beyond the disposal area; 3) contaminated portions of an unnamed intermittent stream that originates in the disposal area and flows westward approximately 2,800 feet to the Black Haw Branch; and 3) the area of the contaminated ground water plume.

The Site is located on a 73.5-acre parcel of land currently owned by T. Frank Flipppo and Sons, a Virginia limited partnership formed on July 15, 1985.

Solvents from printing press cleaning operations, printing ink residues, and other materials were burned in two pits, designated as the "West" and "Northeast" Burn Pits, located in the disposal area. The disposal area is approximately 260 feet in diameter and is surrounded by a raised berm of native soil approximately two to four feet high. The berm was created when the disposal area was cleared. Presently, a band of trees extend 20 to 50 feet beyond the disposal area and along the path of the intermittent stream (See Figure 2).

The rest of the 73.5-acre property was clearcut in 1990 as part of Mr. Flipppo's lumber business, and only low brush and young trees remain. No structures exist on the property.

Access to the Site is limited to a dirt road, which is approximately 1,200 feet long and perpendicular to the west side of Route 33. A locked cable located at the approximate half-way point of the road restricts vehicular access. No barriers exist that would restrict pedestrian access.



SOURCE: Ecology and Environment, Inc. 1992

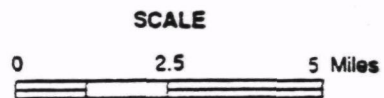


Figure 1
H&H INCORPORATED
SITE LOCATION MAP

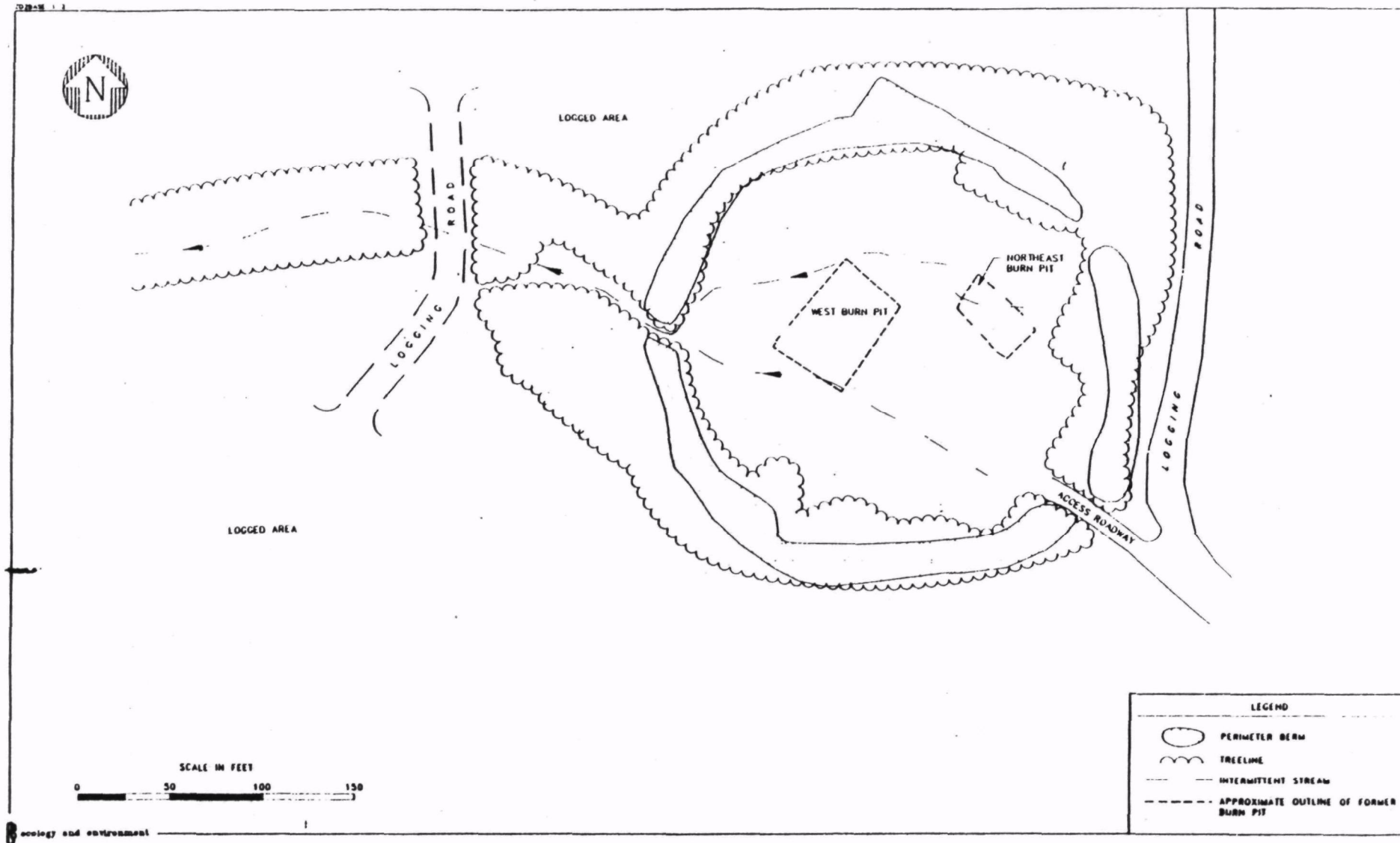


Figure 2 H & H SITE MAP

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Site property was purchased in 1950 by Mr. Howze Haskell. From approximately 1960 to 1976, the Site was owned and operated by the Haskell Chemical Company, Inc., which manufactured chemicals at an off-site plant for distribution to several companies in the Richmond area.

From 1960 to 1976, the Site was used to burn solvents from printing press cleaning operations, printing ink residues, and other materials collected by the Haskell Chemical Company and otherwise brought to the Site for disposal. Much of the waste was brought in 55-gallon drums and stored on-site in one of two major collection areas. For disposal, wastes were emptied into one of two pits and burned. The burn pits are no longer visible since the disposal area has been graded.

Although operations ceased in 1976, the Site became part of Mr. Haskell's newly formed holding company, HH Incorporated (HH), in 1977. In June 1981, HH submitted the Notification of Hazardous Waste Site (Form 8900-1) to the EPA, as required by CERCLA. The property was conveyed to the present owners, T. Frank Flippo and Sons, a Virginia limited partnership, in July 1985.

The Virginia Department of Health, Division of Solid and Hazardous Waste (VA DSHW), the agency responsible for hazardous waste regulation prior to the establishment of the Virginia Department of Waste Management (VDWM), initially managed investigation activities at the Site. Six residential wells were sampled in November and December 1981 to determine if there was evidence of migrating contamination. The VA DSHW determined that the level of organic and inorganic contaminants in the residential wells did not exceed background levels. In December 1981, VA DSHW approved a cleanup plan for the Site prepared by HH, which, if implemented, would remove the sources of contamination.

In May 1982, approximately 1,000 empty drums stored in the two collection areas were reportedly crushed on Site and transported to a hazardous waste disposal facility under the supervision of the VA DSHW. Stained soil, including the soil that lined the burn pit, was also reportedly removed from the Site at the same time. A soil erosion and sediment control program was initiated. The plan included grading and stabilizing soils, interception and containment of run-off, and reseeding and planting. On August 2, 1982, two monitoring wells, one upgradient and the other downgradient, were installed at the Site under the direction of the Virginia State Water Control Board. Based on the analytical results of water samples taken from these wells in October 1982, no conclusive evidence of groundwater contamination was found.

In response to community concerns, a general health survey was conducted by the Virginia Department of Health in May 1983. Thirty-five households were surveyed, representing 143 individuals. Based on the survey, no conclusive evidence linking health problems to Site contamination was found.

EPA conducted a non-sampling preliminary assessment of the Site on March 16, 1983. On March 27, 1984, EPA performed a Site Inspection (SI) that included sampling of groundwater, sediments, leachate, and runoff water. Analytical results of these samples revealed the presence of polychlorinated biphenyls (PCBs), organics (such as benzene, xylene, toluene, and naphthalene), and inorganics (beryllium and cobalt) in a downgradient monitoring well. These results, combined with the knowledge that waste burning had occurred at the Site, raised concerns that dioxin might be present at the Site (the burning of PCBs is known to create dioxin compounds). The SI report was published in October 1985.

On December 3, 1985, EPA performed a dioxin screening at the Site that involved sampling soil and sediment for dioxin within the bermed disposal area and on the outer perimeter of the disposal area to the north, southwest, and west. Results of the analyses showed the presence of dioxin and dibenzofuran isomers. On October 9, 1986, EPA performed a more extensive sampling study that involved the collection of 19 field samples for dioxin. Results of the dioxin analysis showed trace levels of dioxin in three of the 19 samples. EPA determined that these levels were sufficiently low so as not to warrant any further dioxin sampling at the Site.

The presence of other contaminants including volatile organic compounds (VOCs), metals, and PCBs did, however, provide reason for immediate concern at that time.

The analytical data collected were used to evaluate the relative hazards posed by the Site using EPA's Hazard Ranking System (HRS). EPA uses the HRS to calculate a score for hazardous waste sites based upon the presence of potential and observed hazards. If the final HRS score exceeds 28.5, the Site may be placed on the National Priorities List (NPL), making it eligible to receive Superfund monies for remedial cleanup. The Site scored 33.71 using the HRS, was proposed for inclusion on NPL in January 1987, and finalized in March 1989.

In 1988, EPA commenced a Remedial Investigation and Feasibility Study (RI/FS) to ascertain the nature and extent of contamination at the Site and to evaluate remedial action alternatives. Initial sampling was performed from November 1988 through March 1989. The Phase I analytical results showed a higher level of contamination at the Site than expected, and a potential for further migration. Contamination beyond the burn

pits and the areas where drummed waste was handled (i.e., the disposal area) consisted of VOCs, PCBs, pesticides, and inorganics (lead, zinc, cadmium, copper, and mercury). Ten residential drinking water wells were tested; however, no contamination of drinking water believed to be attributable to the Site was found. Phase II of the RI/FS began in the spring of 1992 and was completed in June 1992.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The documents which EPA used to develop, evaluate, and select a remedial alternative for the Site have been maintained at the Pamunkey Public Library, Ashland Branch (Reference Section), 102 South Railroad Avenue, Ashland, VA 23005 and at the EPA Region 3, Philadelphia Office.

The RI/FS and Proposed Plan for the HH Burn Pit Site were released to the public on December 21, 1993. The notice of availability for these two documents was published in the Ashland Herald Progress on December 16, 1993 and in the Richmond Times Dispatch on December 20, 1993. A reminder notice appeared in the Ashland Herald Progress on December 30, 1993. A public comment period was held from December 21, 1993 to January 19, 1994. By request, the public comment period was extended until February 18, 1994.

In addition, a public meeting was held during the public comment period on January 11, 1994. At this meeting, representatives from EPA and VDEQ answered questions about the Site and the remedial alternatives under consideration. Approximately 65 people, including residents from the impacted area, local government officials, and news media persons, attended the meeting.

The initial Proposed Plan contemplated disposal of contaminated soils and sediments from the Site at a landfill regulated under Subtitle D of RCRA. In response to concerns raised during the comment period, EPA revisited the issue and proposed that Site wastes be considered "listed hazardous wastes" under RCRA and that, accordingly, such wastes be disposed of at a landfill regulated under Subtitle C of RCRA after such wastes were treated to the extent necessary to meet RCRA Land Ban Restrictions.

These treatment requirements and disposal restrictions associated with management of RCRA listed hazardous wastes significantly increased EPA's cost estimates for several of the remedial alternatives detailed in the initial Proposed Plan. EPA accordingly issued a Revised Proposed Remedial Action Plan on December 22, 1994, and held a public meeting to explain changes made to the initial Proposed Plan. Notices of the availability of the Revised Proposed Remedial Action Plan and of the scheduled

public meeting were published in the Ashland Herald Progress on December 22, 1994 and December 29, 1994, respectively. A public comment period on the Revised Proposed Remedial Action Plan was scheduled to run from December 23, 1994 through January 23, 1995. Upon request, this second comment period was extended through February 22, 1995. A notice announcing this extension appeared in the Ashland Herald Progress on January 26, 1995.

A response to the comments received during the public comment periods is included in the Responsiveness Summary found at Part III of this Record of Decision.

IV. SCOPE AND ROLE OF THE RESPONSE ACTION

The remedial action selected in this Record of Decision is intended to remediate contamination in soils, ground water, sediments, and surface water impacted from the release of hazardous substances from the Site. EPA does not contemplate further remedial action for the Site if the cleanup requirements announced herein are achieved.

V. SUMMARY OF SITE CHARACTERISTICS

A. General

The HH Burn Pit Site is located in a rural area of Hanover County. The population of Hanover County, based on the 1990 census, is 63,306 persons. With an area of 473 square miles, the population density is 134 people per square mile. Approximately 46% of the population is urban, and 54% is rural. In 1981, 89% of Hanover County was agricultural, forested, or undeveloped. According to recent traffic zone maps provided to EPA by the senior county planner, the population density of the area bordered by U.S. Route 33, State Route 623, and the Chickahominy River is 55.7 persons per square mile. Using this figure, EPA estimates the number of people currently living within a one-mile radius of the Site to be 175. Since the 1950s, Hanover County's growth has been largely attributed to urban migration from Richmond, Virginia. In 1991, Hanover County estimated that two-thirds of its employed residents commuted to the Richmond, Virginia area for work.

The land surrounding the Site is primarily woodlands and farm fields, but an increasing number of residential homes are being built. Public roads exist within one mile of the Site in every direction. As of the early 1980s, developed land in Hanover County included residential (8% of the developed land within the county), commercial (0.4%), industrial (0.6%), and public (2%). Most of the urban development has occurred along the major highways, which include Interstate 95, Interstate 295, and U.S. Route 1.

B. Surface Hydrology

The Site and surrounding areas are characterized by a gently sloping, relatively flat terrain drained by intermittent streams. The bermed disposal area drains into an intermittent stream that flows westerly to the Black Haw Branch and eventually to the Chickahominy River (See Figure 3). Precipitation slowly infiltrates into the saprolite and saprolite-derived soils at the Site to the depth of the shallow water table. North and east of the Site, where elevations are the highest, the water table is four to six feet below the ground surface. West of the Site along the intermittent stream down to its confluence with the Black Haw Branch, the water table is less than one foot below the ground surface. Site contaminants have been transported along the intermittent stream during rain events. Four logging roads cross the intermittent stream. The logging road nearest the bermed area has served to slow the flow of surface water from the disposal area and has deflected the flow in a north/south direction along the logging road.

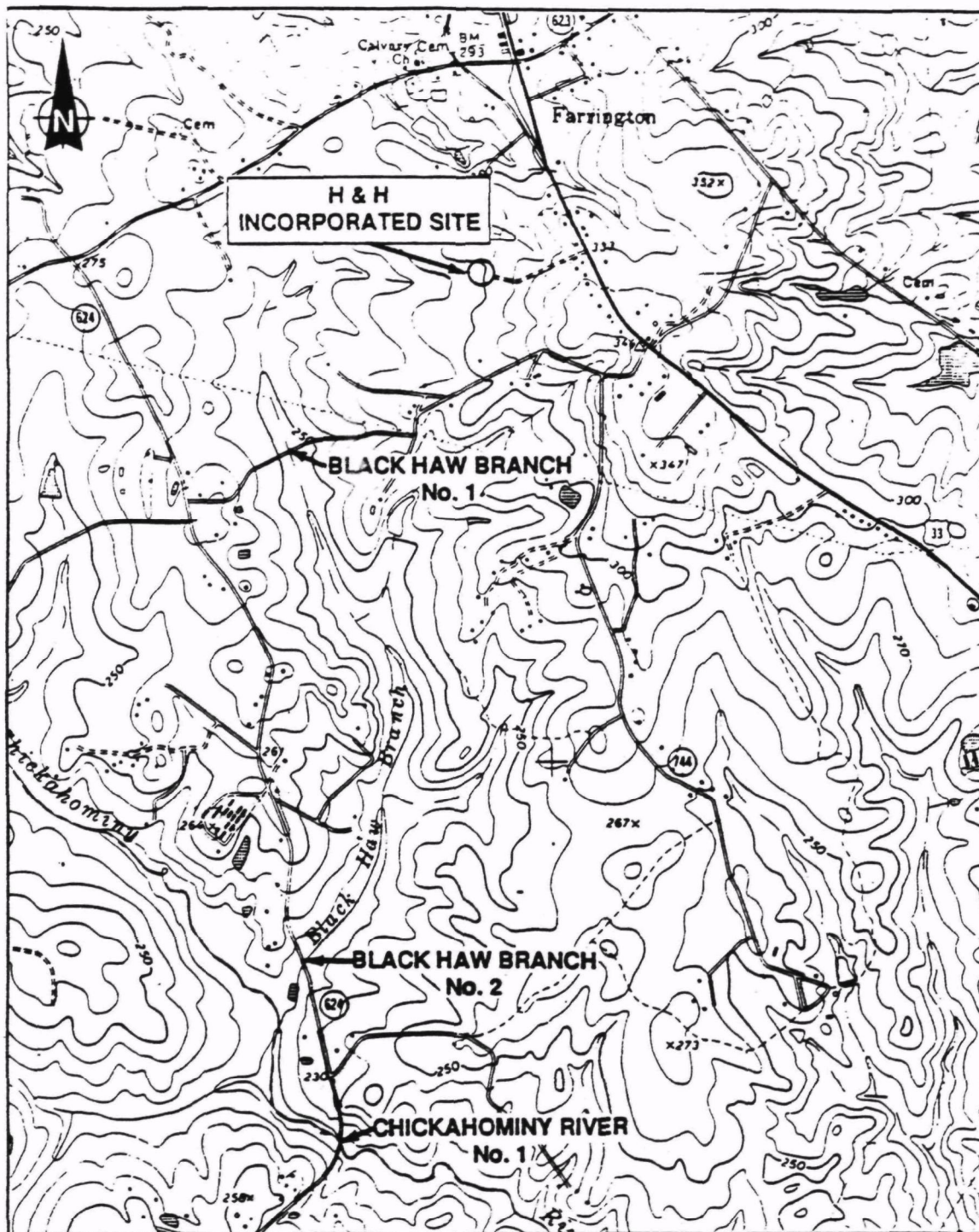
C. Geology

The HH Burn Pit Site lies within the Piedmont Plateau Physiographic Province approximately five miles west of the fall line, which distinguishes the Piedmont Plateau from the Atlantic Coastal Plain. The Piedmont Plateau Province has mature rolling topography that consists of gently sloping ridges with very steep slopes along drainage ways. This province's geology is characterized by a thick mantle of saprolite, which is a clay-rich unconsolidated material overlying fractured crystalline and metamorphic bedrock. The surface elevation at the Site ranges from 290 to 300 feet above mean sea level with the land surface relatively flat to gently sloping to the west.

The Site is directly underlain by saprolite which is derived from in-situ weathering of the underlying crystalline bedrock, which at this Site is the Petersburg granite. The overburden, which is unconsolidated material that overlies bedrock, consists of soils derived from the saprolite and ranges in thickness from 63 to about 71 feet at the Site. Absent at the Site, but mapped as occurring in close proximity to it, a 20 foot or less thick Tertiary age gravel composes the uppermost portion of the overburden. The grain size of the saprolite ranges from fine to coarse with a general upward fining sequence. The Upper Paleozoic age Petersburg granite is the bedrock underlying the Site.

D. Hydrogeology

The overburden (i.e., saprolite) aquifer is about 60 feet in saturated thickness at the Site and immediately overlies the Petersburg bedrock aquifer. While saturated soils were



SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Glen Allen, VA. 1963, Photorevised 1987.

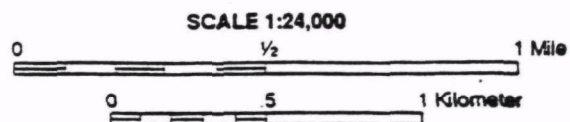


Figure 3
DOWNSTREAM AQUATIC HABITAT SURVEY STATIONS

encountered at two to five feet below the ground surface, ground water flow into a borehole was encountered at roughly 12 feet below ground surface. This appears to be a result of the clay-rich soils which are present to this approximate depth within the bermed disposal area. The average hydraulic conductivity of the overburden aquifer was estimated from slug testing results at 0.00068 feet/minute and the estimated gradient of the water table is approximately 1.4 percent (i.e., 1.4 feet per 100 feet) toward the west. An average linear velocity was estimated at 20 feet/year using the preceding information and assuming an average effective porosity of 25 percent. The general ground water flow direction in the overburden aquifer is toward the west and appears to mimic surface topography. The overburden aquifer is recharged through percolation of rain. There are residential wells that obtain water from the overburden aquifer in the Site vicinity at reported total depths ranging from 20 to 50 feet.

The bedrock aquifer underlying the Site is the Petersburg granite aquifer. Ground water occurs within secondary porosity features, such as fractures, in the Petersburg granite. Four bedrock monitoring wells were installed during the RI/FS to evaluate the extent of ground water contamination. Three of the bedrock monitoring wells were constructed in the shallow portion of the Petersburg aquifer and one monitoring well was constructed in the deeper portion. Ground water movement will depend on the orientation and interconnection of fractures. While the ground water flow direction is most likely controlled by fractures, the general direction for ground water flow in the bedrock aquifer is to the west-northwest with an estimated gradient of 2.4 percent. At the Site, the bedrock aquifer is most likely recharged by the overburden aquifer. The estimated average hydraulic conductivity for the Petersburg aquifer is about 0.00065 feet/minute. Residential wells which produce water from the Petersburg aquifer in the Site vicinity generally have a total depth of 300 feet or more.

E. Wetlands

Wetlands in the vicinity of the Site are primarily palustrine systems that have: 1) a dominance of vegetation that requires high moisture, 2) high moisture soils, and 3) a water table that inundates the ground surface for some portion of the growing season. One of the three characteristics may be absent in a disturbed system.

Three types of palustrine systems in the vicinity of the Site are forested, scrub-shrub, and emergent (See Figure 4). Within the Piedmont province, these wetlands will generally occur along water courses. The forested wetlands in the area consist of vegetation similar to the adjacent upland forests. The shrub-scrub and emergent wetlands in the vicinity of the Site result primarily from disturbance to forested wetlands. Characteristic

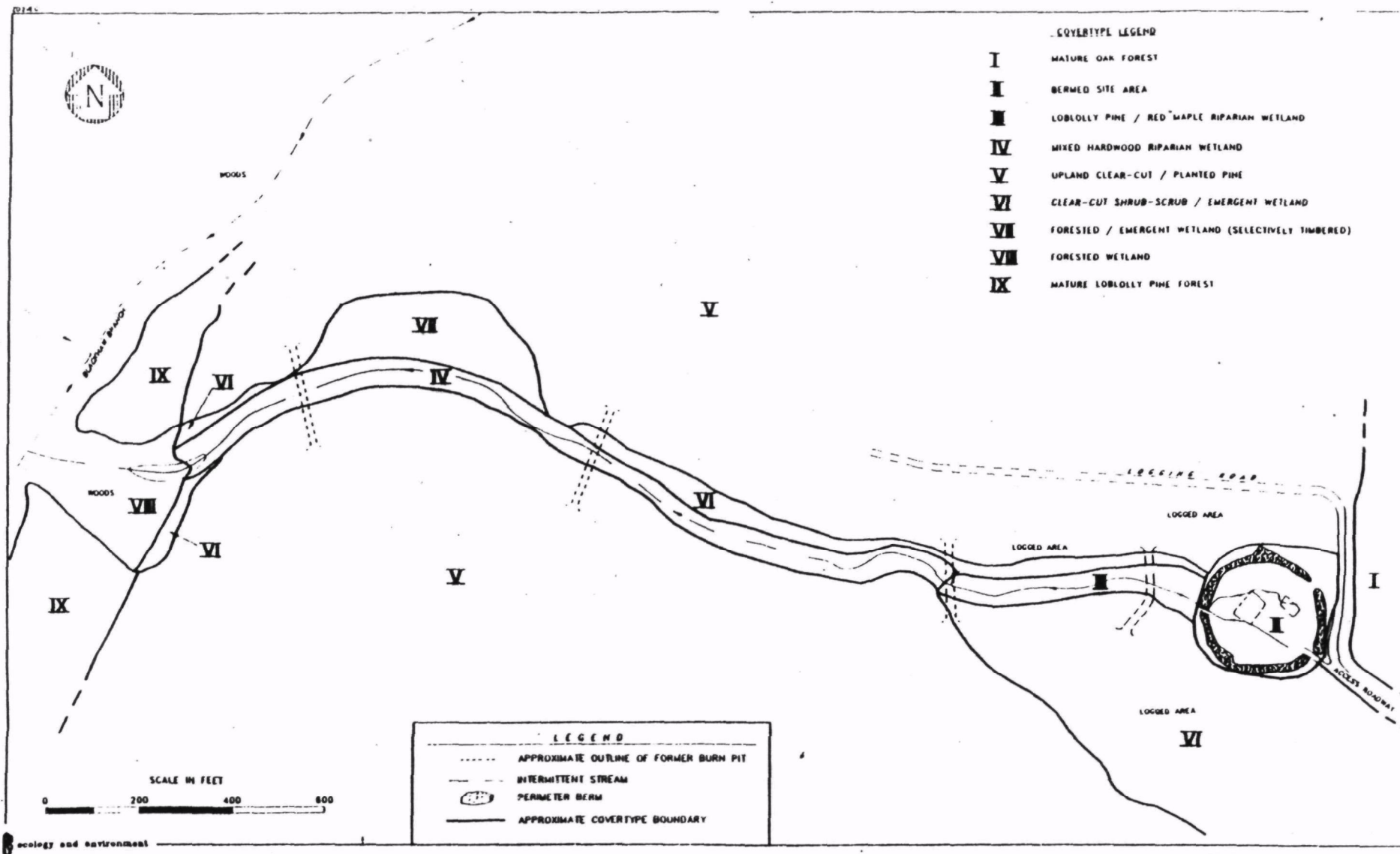


Figure 4 PHASE II VEGETATION
COVER TYPE MAP
H & H SITE

species in the scrub-shrub wetlands include viburnums and arrowwoods, greenbriers, and blackberries, in addition to the shrub species typical of the forested wetlands. The emergent wetlands are dominated by grasses and sedges intermixed with flowering herbaceous plants.

The wetland habitats are intermixed with upland habitats. Wildlife usage of this area will tend to be similar to that in adjacent upland areas. Wetland areas tend to be less disturbed and may provide additional security for breeding animals. Amphibian populations will be more represented in the wetlands also.

F. Extent of Contamination

The primary objective of the RI was to characterize the nature and extent of hazardous substances present at the HH Burn Pit Site. As part of this effort, the RI identified and evaluated potential migration routes for contaminants and exposure pathways for human and ecological receptors.

1. Surface Soil

All surface soil samples collected in the bermed disposal area contained relatively high concentrations of PCBs (Aroclor 1248 and Aroclor 1260) and phthalates (See Figure 5). Various VOCs such as trichloroethene, toluene, and methylene chloride, were also detected at low levels in surface soil samples collected in the bermed disposal area. Surface soil samples collected north (SS-10) and west (SS-9) of the disposal area had elevated levels of PCBs as well as several other organic contaminants. Surface soil samples collected south of the disposal area (SS-8, SS-11, and SS-12) were generally free of organic contamination (low levels of pesticides were detected in SS-12).

Surface soil samples contained elevated levels of six metals (See Figure 6). Most widespread were lead (Pb) and zinc (Zn), which were detected at maximum concentrations of 835 mg/kg and 3,190 mg/kg, respectively. Antimony (Sb), chromium (Cr), copper (Cu), and selenium (Se) were detected at levels above the upper 90th percentile of the common ranges found in eastern U.S. soils and, therefore, were considered to be of concern.

2. Subsurface Soil

The locations of the soil borings for Phase I and II of the investigation are shown on Figure 7. Elevated levels of volatile and semi-volatile organic compounds were detected with the highest concentrations in or near the former burn pit areas.

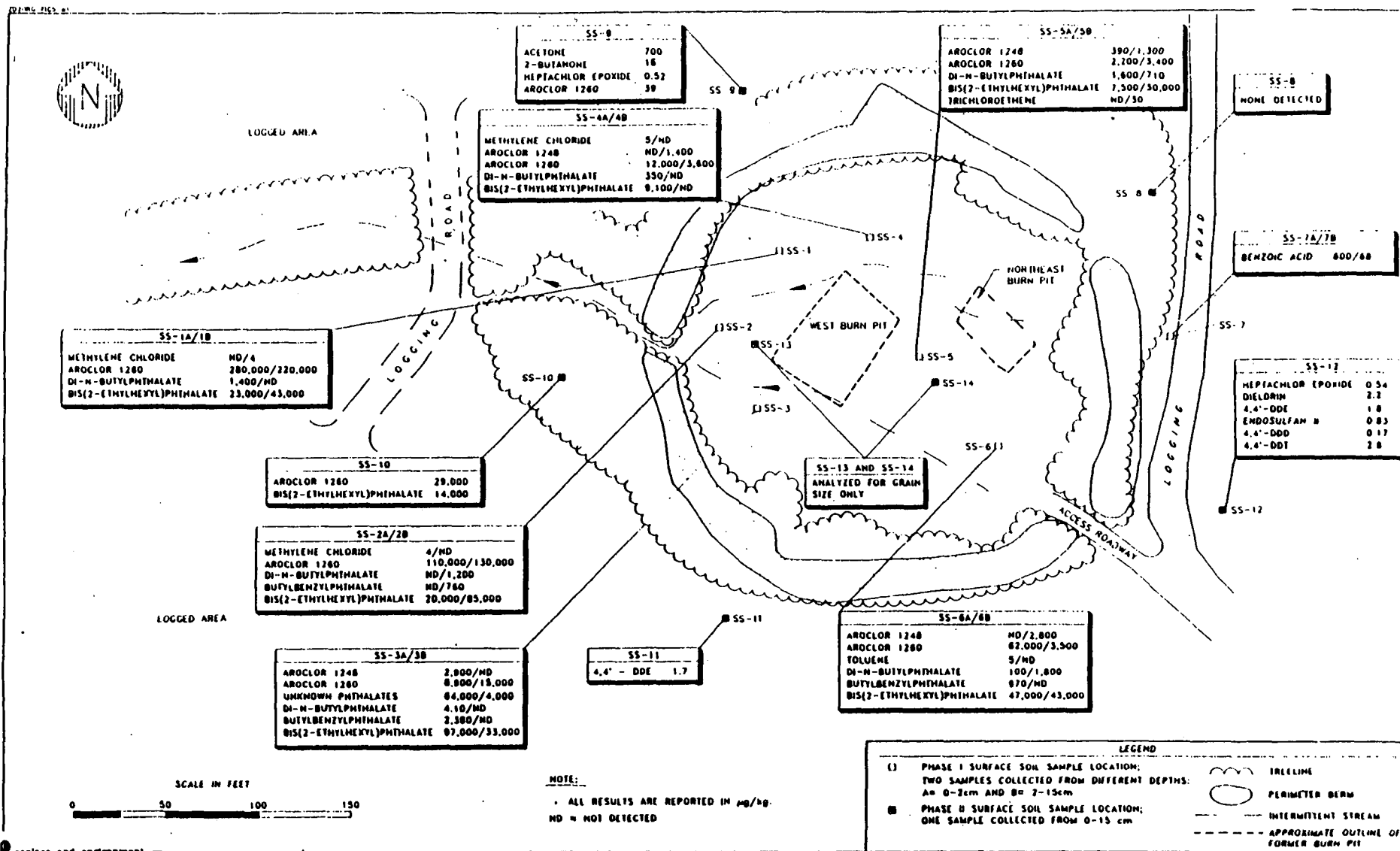
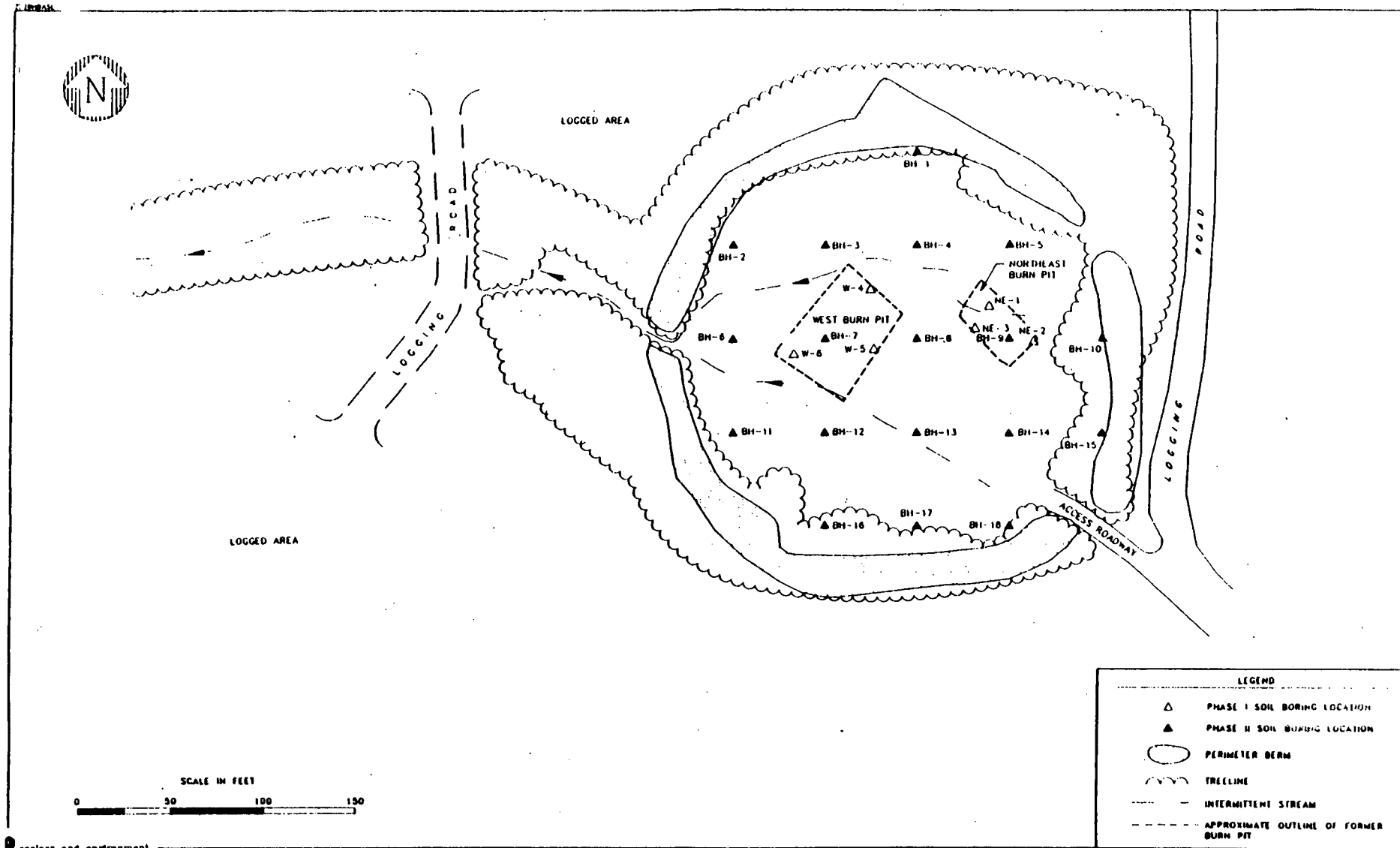


Figure 5 ORGANICS DETECTED IN SURFACE SOIL SAMPLES H & H SITE



Maximum concentrations detected, and the locations where these concentrations were found, are presented in Table 1 for VOCs and Table 2 for semi-volatiles. Total concentrations of VOC, semi-volatile, PCB, and pesticide contaminants found in each boring at various depths are presented in Table 3.

PCBs were detected in subsurface soils at levels ranging up to 72,000 ug/kg. The highest concentrations were found primarily in the vicinity of the former burn pits. Significant PCB concentrations were found primarily in subsurface soil above the depth of six feet.

A variety of pesticides were found at low levels in all borings at various depths. Most pesticides detected were found at depths of less than six feet.

Table 1 - Maximum Detected VOCs in Subsurface Soil			
Contaminant	Maximum Concentration (ug/kg)	Boring Number	Depth (feet)
Acetone	9,300J	BH-13	2-4
1,1-Dichloroethane	32	BH-13	2-4
Chloroform	87	BH-13	2-4
1,2-Dichloroethane	1,600J	BH-12	10-12
2-Butanone	760,000L	W-5	4-6
Trichloroethene	48	BH-13	2-4
1,1,2-Trichloroethane	26,000	W-6	2-4
Benzene	22	BH-13	2-4
4-Methyl-2-pentanone	34,000J	W-5	4-6
Tetrachloroethene	6,600J	BH-8	2-4
Toluene	1,600,000	BH-8	2-4
Ethylbenzene	64,000J	BH-8	2-4
Total Xylenes	540,000	BH-8	2-4

Key: J - Data qualifier indicating that analyte is present, but actual value may be higher or lower
 L - Data qualifier indicating that analyte is present, but actual value may be higher

<p align="center">Table 2 Maximum Detected Semi-Volatiles in Subsurface Soil</p>			
Contaminant	Maximum Concentration (ug/kg)	Boring Number	Depth (feet)
Phenol	1,600	BH-8	8-10
1,2-Dichlorobenzene	8,900J	W-5	4-6
1,3-Dichlorobenzene	57J	BH-8	4-6
1,4-Dichlorobenzene	120J	BH-8	4-6
2-Methylphenol	2,400J	W-6	0-2
4-Methylphenol	3,400J	W-5	4-6
Isophorone	1,200	BH-9	6-8
2,4-Dimethylphenol	4,000J	W-5	4-6
Benzoic Acid	380J	NE-1	4-6
Naphthalene	23,000	NE-3	0-2
4-Nitrophenol	100J	BH-11	2-4
Phenanthrene	4,200J	W-5	4-6
Anthracene	40J	BH-10	6-8
Di-n-butylphthalate	50,000J	NE-1	0-2
Butylbenzylphthalate	21,000	W-6	0-2
bis(2-ethylbenzyl)phthalate	2,200,000J	BH-7	0-2
Di-n-octylphthalate	5,200J	BH-7	0-2

Key: J - Data qualifier indicating that analyte is present, but actual value may be higher or lower
L - Data qualifier indicating that analyte is present, but actual value may be higher

Table 3 Total Organic Concentrations Detected in Subsurface Soil (ug/kg)										
Boring #	Type	Depth (feet)								
		0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18
BH-1	VOC	*	*	*	*	*	*	*		
	SV	*	*	*	*	*	*	*		
	PCB	ND	ND	ND	ND	*	ND	*		
	Pest	1	ND	ND	ND	*	ND	*		
BH-2	VOC	ND	ND	ND	ND	*	ND	*		
	SV	490	48	73	72	*	*	*		
	PCB	30,000	1,600	12	26	*	120	*		
	Pest	7	0	0	0	*	<1	*		
BH-3	VOC	*	*	*	*	*	*			
	SV	*	*	*	*	*	*			
	PCB	4,400	7	ND	ND	ND	*			
	Pest	5	<1	ND	ND	ND	*			
BH-4	VOC	*	*	*	*	*	*	*	*	
	SV	*	*	*	*	*	*	*	*	
	PCB	12	140	ND	ND	ND	*	ND	*	
	Pest	<1	<1	ND	ND	ND	ND	ND	*	
BH-5	VOC	*	*	*	*	*	*	*		
	SV	*	*	*	*	*	*	*		
	PCB	4,800	15	ND	ND	*	ND	*		
	Pest	3	<1	<1	<1	*	ND	*		
BH-6	VOC	1	ND	ND	ND	*	*	ND	*	*
	SV	90	85	100	68	*	*	59	*	*
	PCB	9	52	34	17	*	*	ND	*	*
	Pest	ND	<1	ND	ND	*	*	ND	*	*
BH-7	VOC	71,000	ND	ND	ND	*	ND	*		
	SV	2,300,000	100	110	1,800	*	62	*		
	PCB	34,000	70	9	270	*	ND	*		
	Pest	25	ND	<1	ND	*	ND	*		
BH-8	VOC	15,000	250,000	94,000	130,00	300,00				
	SV	35,000	122,000	43,000	ND	ND				
	PCB	5,600	5,900	7,500	1,000	3,000				
	Pest	69	80	74	86	ND				
BH-9	VOC	19	350,000	21,000	9,700					
	SV	72,000	104,000	60,000	9,300					
	PCB	4,800	220	47	40					
	Pest	2	7	<1	<1					

Table 3
Total Organic Concentrations Detected in Subsurface Soil (ug/kg)

Boring #	Type	Depth (feet)								
		0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18
BH-10	VOC	210	ND	ND	ND	*	ND	*		
	SV	ND	ND	ND	40	*	ND	*		
	PCB	ND	ND	ND	25	*	150	*		
	Pest	<1	ND	ND	<1	*	ND	*		
BH-11	VOC	2	2	ND	ND	*	*	*	ND	*
	SV	5,700	200	81	79	*	*	*	76	*
	PCB	ND	ND	0	ND	*	*	*	ND	*
	Pest	<1	ND	<1	ND	*	*	*	ND	*
BH-12	VOC	*	ND	ND	ND	1	3,100	*		
	SV	*	240	60	91	110	ND	*		
	PCB	*	ND	240	ND	ND	ND	*		
	Pest	*	ND	<1	ND	ND	ND	*		
BH-13	VOC	*	28,000	470,000	ND	*	1,400	53	*	
	SV	*	20,000	73,400	120	*	55	140	*	
	PCB	*	2,100	13,000	ND	*	ND	29	*	
	Pest	*	4	ND	ND	*	<1	ND	*	
BH-14	VOC	*	*	*	*	*	*	*	*	
	SV	*	*	*	*	*	*	*	*	
	PCB	600	11	ND	7	*	*	ND	*	
	Pest	2	1	<1	ND	*	*	<1	*	
BH-15	VOC	*	*	*	*	*	*	*	*	
	SV	*	*	*	*	*	*	*	*	
	PCB	ND	ND	ND	ND	*	340	*	*	
	Pest	<1	<1	>1	ND	*	<1	*	*	
BH-16	VOC	*	*	*	*	*	*	*	*	*
	SV	*	*	*	*	*	*	*	*	*
	PCB	ND	ND	ND	ND	*	*	*	ND	*
	Pest	2	<1	<1	1	*	*	*	<1	*
BH-17	VOC	*	*	*	*					
	SV	*	*	*	*					
	PCB	62	0	*	*					
	Pest	1	<1	*	*					
BH-18	VOC	*	*	*	*	*	*	*	*	*
	SV	*	*	*	*	*	*	*	*	*
	PCB	80	ND	11	ND	*	*	*	ND	*
	Pest	10	<1	<1	ND	*	*	*	<1	*

Table 3 Total Organic Concentrations Detected in Subsurface Soil (ug/kg)										
Boring #	Type	Depth (feet)								
		0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18
NE-1	VOC	1,000	25,000	48,000	70,000					
	SV	863,900	39,000	2,300	39,000					
	PCB	680	ND	ND	ND					
	Pest	47	ND	ND	ND					
NE-2	VOC	11	8	26						
	SV	11,100	59	44						
	PCB	ND	ND	ND						
	Pest	ND	ND	ND						
NE-3	VOC	656,000	130,000	6,300						
	SV	221,700	18,000	50						
	PCB	1,100	710	ND						
	Pest	20	420	ND						
W-4	VOC	6	ND	ND						
	SV	ND	ND	ND						
	PCB	6,900	430	520						
	Pest	ND	ND	ND						
W-5	VOC	1,800	1,100	1,292,000						
	SV	358,900	302,200	317,300						
	PCB	47,000	72,000	27,000						
	Pest	ND	ND	ND						
W-6	VOC	75,500	669,600	53,100						
	SV	1,168,800	69,000	11,600						
	PCB	88,000	42,200	3,900						
	Pest	ND	ND	ND						
MW-2	VOC	16	1,500	2,900	42	173	ND			
	SV	60	ND	63	ND	ND	ND			
	PCB	530	ND	ND	ND	ND	ND			
	Pest	ND	ND	ND	ND	ND	ND			

Key: VOC - Total Volatile Concentrations
 SV - Total Semi-Volatile Concentrations
 PCB - Total Polychlorinated Biphenyl Concentrations
 Pest - Total Pesticide Concentrations
 * - No analysis performed
 ND - Not detected

Subsurface soils were also analyzed for inorganic contaminants. Since many inorganic elements occur naturally, the levels found were not considered to be of concern unless they exceeded the upper limit of the 90th percentile of the common ranges found in the eastern United States. Table 4 presents the inorganic data for various depths at each boring where the 90th percentile values were exceeded. The most prevalent metals found at elevated levels were copper, lead, and zinc. The highest concentrations were found generally at depths of less than two feet and occasionally to the depth of four feet. Beryllium, selenium, chromium, nickel, and antimony were detected at elevated levels at random depths and lateral distribution.

3. Groundwater

Organic contaminants detected at elevated levels in groundwater monitoring wells within the bermed disposal area include benzene, toluene, vinyl chloride, 1,2-dichloroethane, tetrachloroethane, 1,1,2-trichloroethane, ethylbenzene, 1,2-dichloropropane, bis(2-ethylhexyl)phthalate, aldrin, dieldrin, and heptachlor epoxide (See Figure 8). The approximate location of the plume of groundwater contamination based on the total concentrations of VOCs is shown in Figure 9. All overburden wells (both shallow and deep) within the disposal area contained organic contamination at levels exceeding the Safe Drinking Water Act Maximum Contaminant Levels (MCLs). Bis(2-ethylhexyl)phthalate was the only organic contaminant found at elevated levels in the bedrock well located in the disposal area.

Monitoring wells located outside the bermed disposal area were generally free of organic contamination. Monitoring well MW-4, located immediately downgradient of the disposal area, had elevated levels of benzene, 1,2-dichloroethane, dieldrin, and vinyl chloride. Upgradient monitoring well MW-1 showed an elevated level of toluene during the Phase I sampling; however, toluene was not detected during the Phase II sampling. Monitoring wells MW-7 and MW-8 had elevated levels of heptachlor epoxide and heptachlor, respectively.

Several metals were detected at levels above MCLs in monitoring wells within or near the disposal area. The metals appearing most frequently are aluminum, iron, and manganese. These metals were also found in upgradient monitoring wells and residential wells at concentrations similar to those detected in disposal area wells. Figure 10 shows the inorganic contaminants present at levels of concern in the Site monitoring wells.

Twelve residential wells surrounding the Site were sampled during the RI. One residential well sample had beryllium at a concentration slightly above the MCL. Another residential well sample had a trace concentration of heptachlor epoxide slightly above the Virginia Groundwater Protection Level, but below the

Table 4 Total Inorganic Concentrations Detected in Subsurface Soil (mg/kg)										
Boring #	Type	Depth (feet)								
		0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18
BH-1		**	**	**	**	*	**	*		
BH-2	Cu Be	110	11	**	**	*	3	*		
BH-3	Cu Pb	50 36	**	**	**	*				
BH-4		**	**	**	**	*	**	*	*	
BH-5	Cu Pb Zn Se	425 398 124	**	**	1	*	**	*		
BH-6	Pb Be	74	**	**	**	*	*	2	*	*
BH-7	Cu Pb Zn Sb Be	2,620 1,100 489 61	162 137	**		**	** 90 21 3			
BH-8	Cu Pb Zn M	276 361 170	**	118	**					
BH-9	Cu Pb Zn	82 122	196	**	**					
BH-10	Be	**	**	**	**	*	2	**		
BH-11	Be	**	**	**	**	*	*	*	4	*
BH-12	Se	*	1	**	**	**	*			
BH-13	Be	*	**	**	**	*	**	2	*	
BH-14	Cu Pb Zn Be	713 528 258	**	**	**	*	*	2	*	
BH-15		**	**	**	**	*	*	**	*	

Table 4 Total Inorganic Concentrations Detected in Subsurface Soil (mg/kg)										
Boring #	Type	Depth (feet)								
		0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18
BH-16		**	**	**	**	*	*	*	**	*
BH-17	Cu	664	**	*	*					
	Zn	173								
BH-18	Cu	531	**	**	**	*	*	*		*
	Pb	37							38	
	Zn	213								
NE-1	Cu	1,190	395	**	**					
	Pb	2,600	265							
	Zn	285	166							
	Se	9								
NE-2		**	**	**						
NE-3	Cu	2,300	515	**						
	Pb	2,020	463							
	Zn	290	136							
	Cr	300								
	Se	<1								
W-4	Pb	112	**	**						
W-5	Cu	193	85							
	Pb	81								
	Zn			130						
W-6	Cu	9,100	11,800	71						
	Pb	1,390	1,570	52						
	Zn	2,120	2,270							
	Cr	364	1,010							
	Sb	38	199							
MW-2		**	**	**	**	**	**			

Key:

90th Percentile Value:

Cu Copper 49 mg/kg
 Pb Lead 33 mg/kg
 Zn Zinc 104 mg/kg
 Be Beryllium 2 mg/kg
 Se Selenium 0.3 mg/kg
 Cr Chromium 112 mg/kg
 Sb Antimony 2 mg/kg
 M Nickel 38 mg/kg

* No analysis performed
 ** Not detected

MCL. This residential well is upgradient from the Site. Sample results from a residential well located over a mile south-southwest from the Site had a concentration of tetrachloroethene below the MCL.

4. Surface Water

Organic and inorganic contaminants were detected in surface water collected from the intermittent stream draining the disposal area (See Figure 11). PCBs, the primary organic contaminant, were detected at elevated levels downstream to sampling location SW-8 approximately 400 feet from the disposal area.

Inorganics were detected at levels above EPA and/or Virginia water quality criteria for the protection of aquatic life at all surface water sampling locations, including those in the Black Haw Branch (See Figure 12). Inorganics of concern that may be attributable to the Site are copper, lead, and zinc. Concentrations of these metals rapidly decrease with distance from the Site, but exceed background levels for the entire length of the Site stream. The inorganic contaminants found in sample locations located along the first logging road downstream from the disposal area (SW-4, SW-5, and SW-6) indicate that runoff from the disposal area is diverted along this road.

5. Sediments

Organic contaminants found in sediment samples collected from the intermittent stream draining the disposal area include PCBs, pesticides, and phthalates (See Figure 13). In general, no pesticides or phthalates were detected downstream of the first logging road crossing, which is approximately 120 feet west of the disposal area. PCBs, however, were detected at low levels along the entire length of the Site stream and in the Black Haw Branch downstream.

Inorganics, including beryllium, copper, chromium, lead, and zinc, were detected in sediment samples collected from the intermittent stream (See Figure 14). Copper and lead were found at elevated levels most frequently. Elevated levels of inorganic contaminants were detected downstream to the second logging road crossing approximately 550 feet west of the disposal area. Sediment sampling results also indicate that transport of contaminants by runoff from the disposal area has been diverted to some extent by the first logging road.

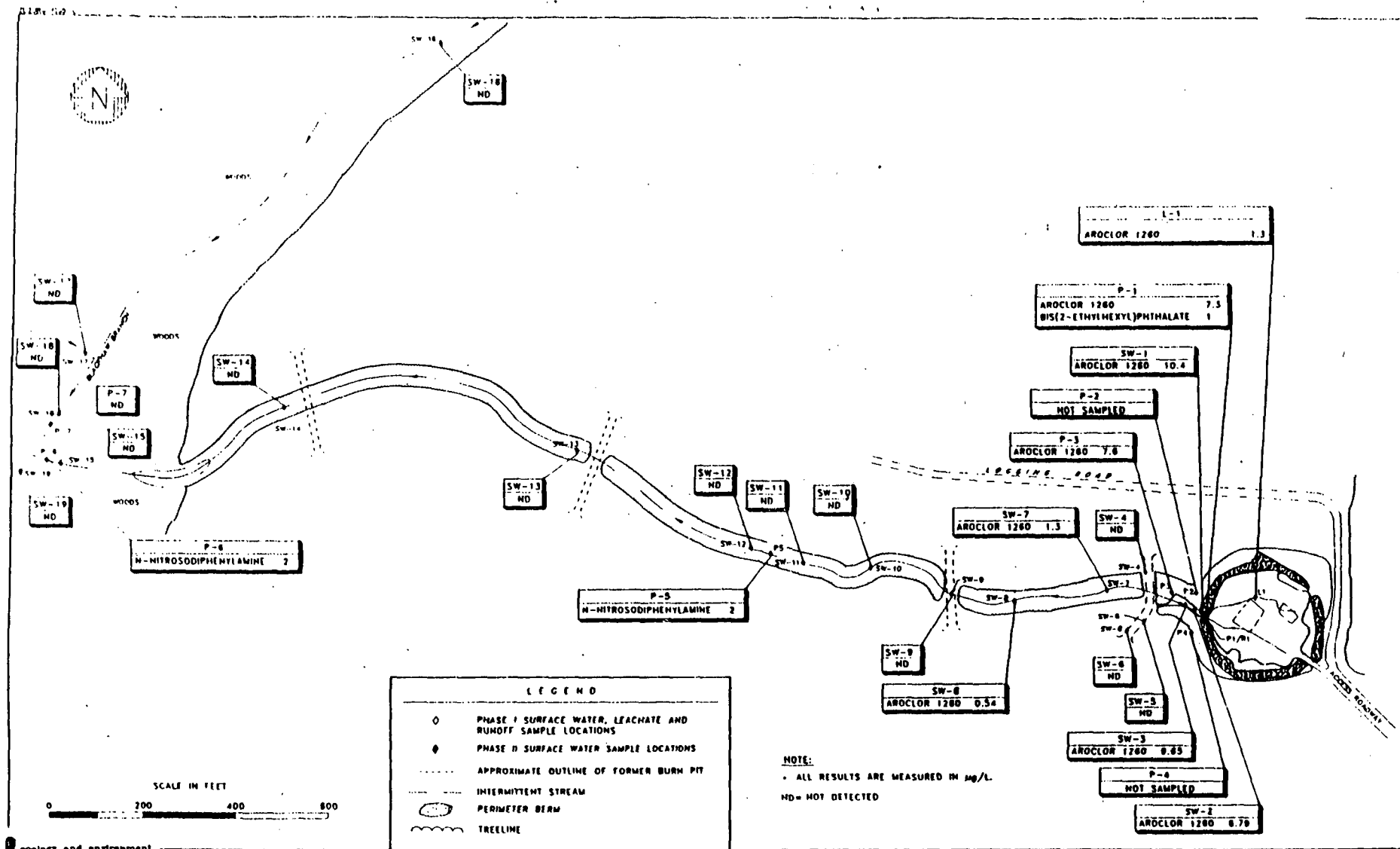


Figure 11 ORGANICS DETECTED IN SURFACE WATER SAMPLES H & H SITE

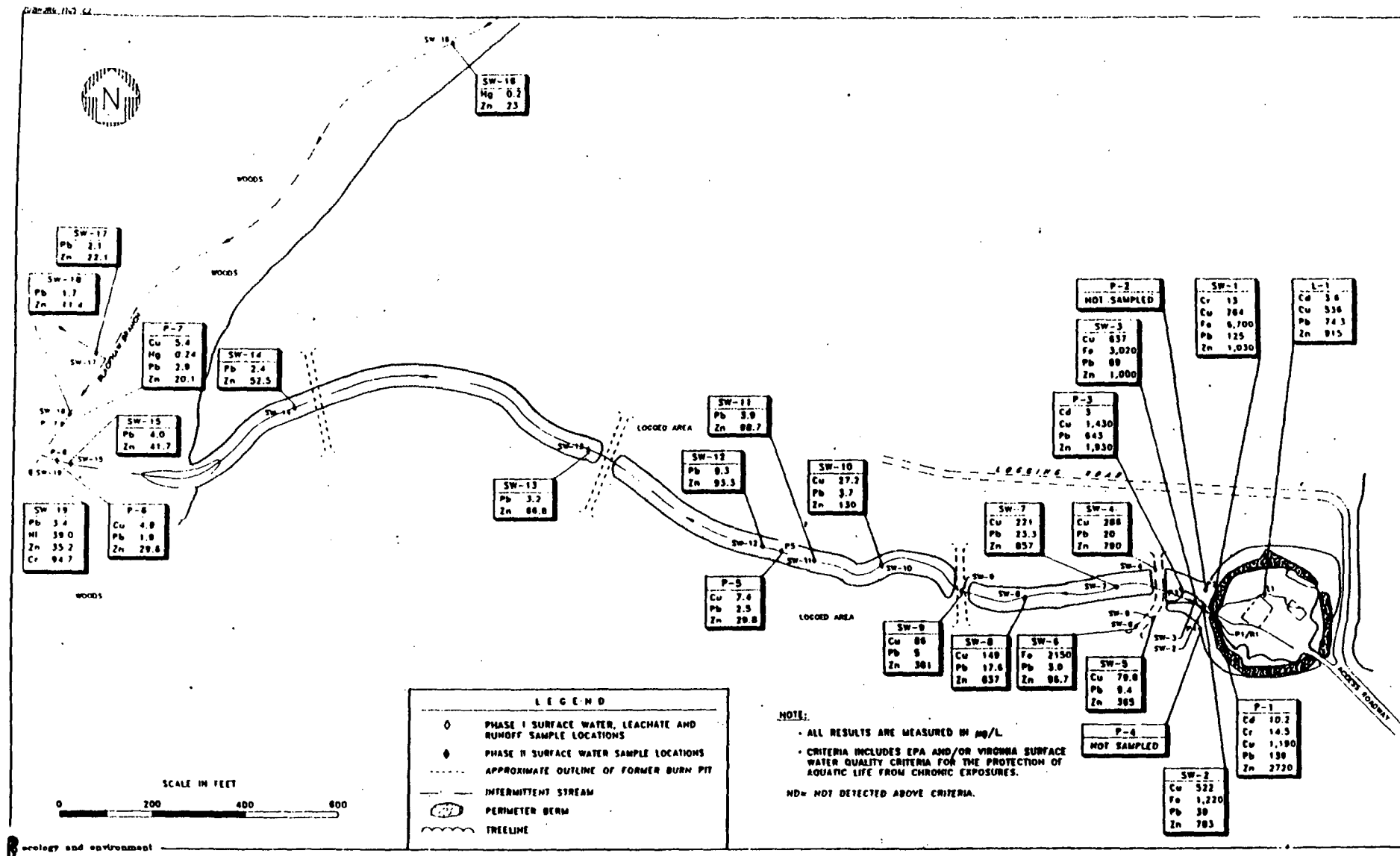


Figure 12 INORGANICS DETECTED ABOVE STANDARDS IN UNFILTERED SURFACE WATER SAMPLES

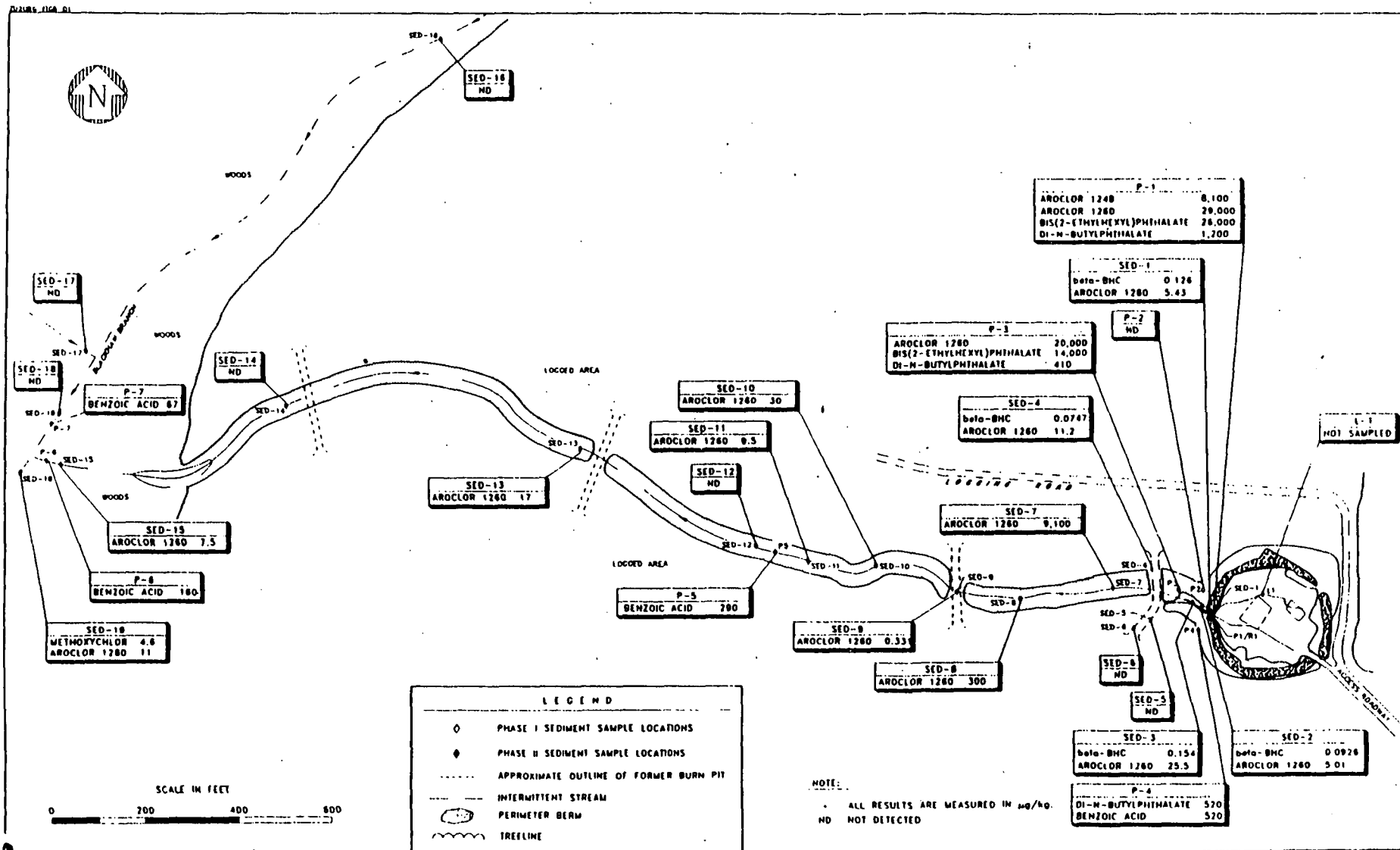
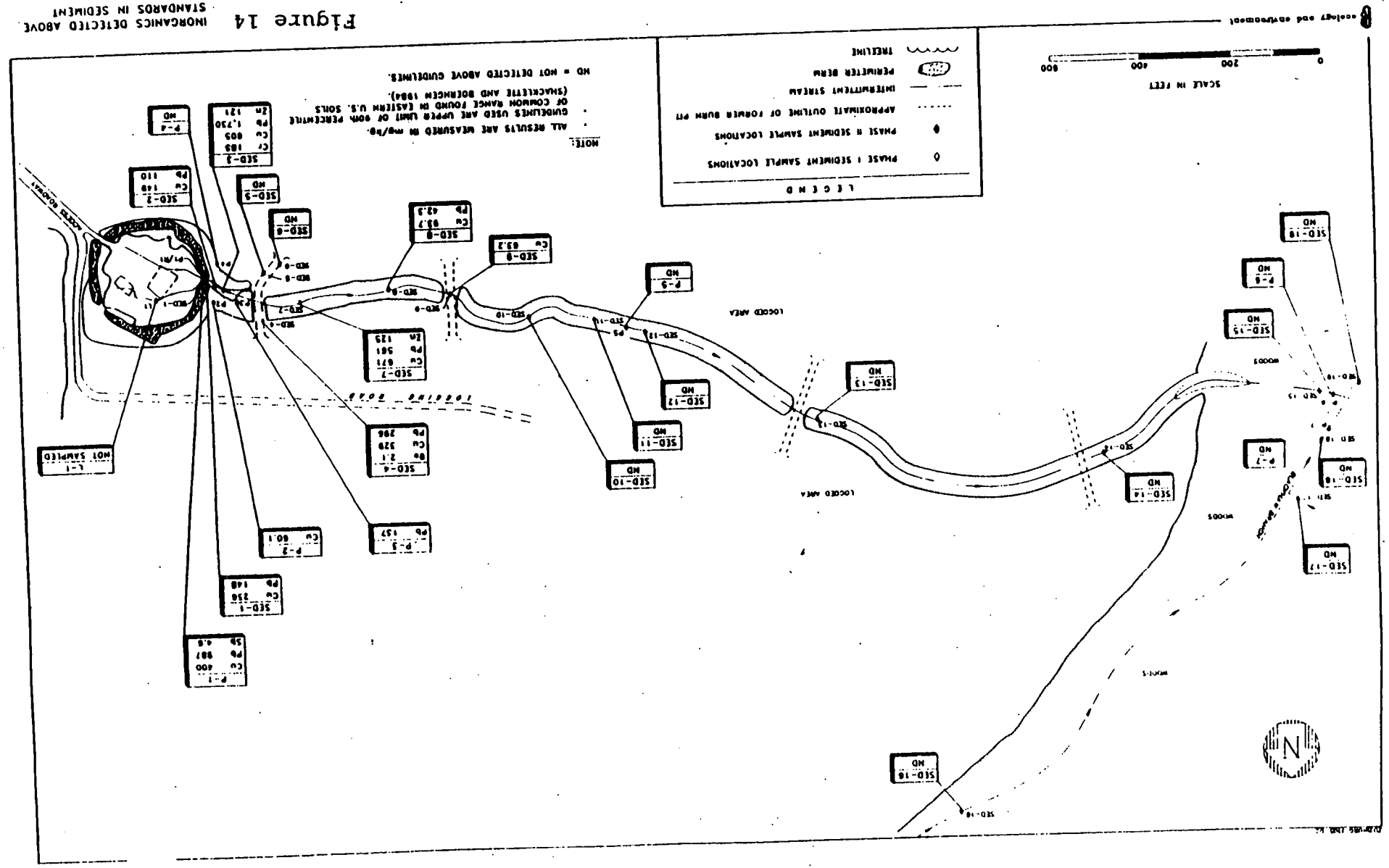


Figure 13 ORGANICS DETECTED IN SEDIMENT SAMPLES

Figure 14
INORGANICS DETECTED ABOVE
STANDARDS IN SEDIMENT
SAMPLES



6. Air

Although no samples of air were collected for analysis and soil gas sampling was not conducted, some general assumptions can be made regarding the air transport route based on Site conditions and results of ambient air monitoring and sample screening.

When field activities were occurring, the ambient air at the Site was never observed to be above background levels using an Organic Vapor Analyzer (OVA) and/or a Photovac Micro-tip photo-ionization detector (PID). When near-surface soils were disturbed for sampling purposes, no readings in the breathing zone were encountered above background levels. When collecting subsurface soils from split spoon samplers, and during installation of on-Site borings and monitoring wells, organic contaminants were often detected in the immediate vicinity of the disturbed samples and cuttings. Organic contaminants in the air, as measured by the OVA and PID, tended to behave as if heavier than the ambient air and would dissipate quickly into the atmosphere.

Particulate transport in air was not observed to be a problem as dust monitoring equipment (Mini-Ram) never indicated any increase of dust concentrations above background levels even during field tasks which disturbed the soil. At no time during the field investigations did high winds reach the surface through the trees which surround the disposal area, nor was dust a problem.

IV. SUMMARY OF SITE HUMAN HEALTH RISKS

As part of the RI/FS process, EPA conducted an analysis to identify human health and environmental risks that could exist if no action were taken at the Site. This analysis, completed in accordance with the NCP, is referred to as a baseline risk assessment. This assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action.

In general, a baseline risk assessment is performed in four steps: (1) data collection and evaluation, (2) the exposure assessment, (3) the toxicity assessment, and (4) risk characterization. This section of the ROD will summarize the result of each of these steps.

A. Data Collection and Evaluation

The data collected and described in the previous section were evaluated for use in the baseline risk assessment. This evaluation involves reviewing the quality of the data and determining which data are appropriate to use to quantitatively

estimate the risks associated with Site soil, sediment, surface water, and ground water.

Based on the soil sampling data, the area of highest soil contamination is the bermed disposal area from the surface to a depth of two feet. The analytical results from samples collected in this area were used to estimate the soil exposure point concentrations for use in the baseline risk assessment. The exposure point concentrations are upper 95th percentile confidence limits of the arithmetic average concentrations of this data set. These values are presented in Table 5.

For surface water and sediment, all data from samples collected in the intermittent stream were used to calculate the exposure point concentrations. As with the Site soil, the area of groundwater contamination is best represented by samples collected from monitoring wells within the bermed disposal area. These data were used to calculate the groundwater exposure point concentrations. For both soil and groundwater, exposure to contaminants, particularly VOCs, could occur through inhalation of air or vapors. As part of the baseline risk assessment, exposure point concentrations were also calculated for these pathways.

B. Exposure Assessment

There are three basic steps involved in an exposure assessment: 1) identifying the potentially exposed populations, both current and future, 2) determining the pathways by which these populations could be exposed, and 3) quantifying the exposure. Under current Site conditions, the populations that could potentially be exposed to contaminants in soil, sediment, and surface water are primarily visitors/trespassers. The bermed disposal area can be accessed by a dirt road approximately 1,200 feet in length from Route 33. A locked cable located at the half-way point restricts vehicular access; however, there are no barriers to pedestrian access. There is evidence that the area is used for target shooting and other recreational activities such as hiking and hunting. The potential pathways for current exposure include: 1) ingestion of soils, sediment, and/or surface water, 2) dermal contact with the soils, sediment, and/or surface water, and 3) inhalation of airborne soil vapors.

EPA believes that residential development is a potential future use of the Site. The proximity of the Site to Richmond, the continued growth occurring in the Richmond area, and the continued construction of new homes in the vicinity of the Site make the potential for future residential use a reasonable assumption. The land use currently in the vicinity of the Site is rural residential. The Hanover County Comprehensive Plan does not propose any changes in the vicinity of the Site that would attract more intense residential development (i.e., public sewer

Table 5 - Reasonable Maximum Exposure Point Concentrations						
Contaminants	Soil		Sediment	Surface Water	Groundwater	
	Ingestion/ Dermal Contact (mg/kg)	Inhalation of Vapors (mg/m ³)	Ingestion/ Dermal Contact (mg/kg)	Ingestion/ Dermal Contact (mg/L)	Ingestion/ Dermal Contact (mg/L)	Inhalation of Vapors (mg/m ³)
Acetone	6.56E-01 ²	4.77E-06	3.36E+03			
Aldrin	4.63E-04	5.35E-14			1.31E-05	6.80E-06
Aluminum	1.04E+04			1.80E+00	7.01E-02	
Antimony	1.54E+01		1.47E+00	4.63E-03		
Aroclor 1248	1.06E+01	4.28E-07	1.00E+00			
Aroclor 1254	1.26E-01	2.61E-09				
Aroclor 1260	3.30E+01	2.98E-11	5.03E+00	3.45E-03	7.29E-04	2.73E-03
Benzene		5.48E-08			3.70E-02	5.72E-01
Benzoic Acid	2.40E-01	3.54E-11	5.11E-02			
Beryllium	6.71E-01		5.39E-01	3.84E-04	2.44E-03	
Bis(2-chloroethyl) ether					1.31E-02	9.12E-02
Bis(2-ethyl hexyl)phthalate	4.66E+02	3.00E-09	8.58E+00	4.46E-04	1.61E-02	5.68E-03
2-Butanone	3.93E-01	2.17E-03			5.14E+00	9.76E+00
Cadmium	1.02E-00		3.57E-01	1.69E-03	4.57E-04	
Chromium (total)	9.80E+01		3.40E+01	1.56E-02	3.70E-03	
Copper	1.42E+03		1.94E+02	4.41E-01	6.82E-03	
Dibutyl Phthalate	1.23E+01	9.34E-11	8.92E-01			
1,4-Dichlorobenzene	3.90E-02	1.65E-07			8.21E-04	9.32E-03
1,1-Dichloroethane		1.91E-07			5.97E-03	8.28E-02
1,2-Dichloroethane		2.34E-08			1.54E-02	1.84E-01
1,1-Dichloroethene					1.91E-03	2.80E-02
1,2-Dichloroethene					5.58E-02	7.96E-01

² Concentrations are presented using scientific notation. A value expressed as 1.0E-01 is equivalent to 0.01, otherwise expressed as 1.0 x 10⁻¹.

Table 5 - Reasonable Maximum Exposure Point Concentrations

Contaminants	Soil		Sediment	Surface Water	Groundwater	
	Ingestion/ Dermal Contact (mg/kg)	Inhalation of Vapors (mg/m ³)	Ingestion/ Dermal Contact (mg/kg)	Ingestion/ Dermal Contact (mg/L)	Ingestion/ Dermal Contact (mg/L)	Inhalation of Vapors (mg/m ³)
1,2-Dichloropropane					3.89E-03	4.96E-02
Dieldrin	2.09E-04	6.72E-14			9.73E-06	1.51E-07
Endrin Aldehyde	6.93E-03				1.36E-05	
Ethylbenzene	2.31E+00	9.38E-06			1.90E-02	2.6E-01
Heptachlor Epoxide	3.10E-04	2.77E-10			2.77E-05	1.0E-04
Alpha-BHC	6.18E-03	4.18E-11			2.29E-05	5.12E-06
Gamma-BHC	2.17E-03	2.71E-11			8.31E-04	2.44E-04
Delta-BHC	3.67E-03	5.36E-13				
Iron	1.01E+04		4.40E+03	1.53+00	4.80E+00	
Isophorone	1.65E-01	1.20E-07			2.35E-03	5.88E-04
Lead	5.72E+02		3.40E+02	1.11E-01	1.85E-02	
Manganese	3.03E+01		1.15E+01	9.73E-02	1.22E+00	
Methyl Isobutyl Ketone	2.89E-02	3.21E-06			1.51E-01	6.56E-01
Nickel	4.02E+00		2.32E+00	7.99E-03		
N-Nitrosodiphenylamine				4.17E-04		
Tetrachloroethene	1.46E-01	3.13E-05			3.94E-03	4.48E-02
Toluene	4.95E+01	9.47E-04			3.85E-01	5.60E+00
1,1,2-Trichloroethane	5.31E-01	2.45E-05		6.50E-04	1.84E-02	1.98E-01
Trichloroethene	1.28E-03	1.29E-07			1.31E-03	1.65E-02
Vinyl Chloride					1.21E-02	2.15E-01
Xylenes (total)	1.50E+01	5.61E-04			2.33E-01	3.18E+00
Zinc	4.13E+02		4.29E+01	8.38E-01	3.33E-02	

and water); nor does the plan advocate changes that would discourage continued construction of rural single-family homes (i.e., targeted future commercial or industrial use). Any homes constructed in the vicinity of the Site would rely on private drinking wells since public water is not available. The potential pathways for exposure to Site contaminants under a future residential use scenario would include those listed previously under current use as well as pathways associated with use of contaminated groundwater (i.e., ingestion of drinking water, dermal contact during showering, and inhalation during showering).

In order to quantify the potential exposure associated with each pathway, assumptions must be made with respect to the various factors used in the calculations. Table 6 summarizes the values used in the baseline risk assessment.

C. Toxicity Assessment

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals. Where possible, the assessment provides a quantitative estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects.

A toxicity assessment for contaminants found at a Superfund site is generally accomplished in two steps: 1) hazard identification, and 2) dose-response assessment. Hazard identification is the process of determining whether exposure to an agent can cause an increase in the incidence of a particular adverse health effect (e.g., cancer or birth defects) and whether the adverse health effect is likely to occur in humans. It involves characterizing the nature and strength of the evidence of causation.

Dose-response evaluation is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the administered population. From this quantitative dose-response relationship, toxicity values (e.g., reference doses and slope factors) are derived that can be used to estimate the incidence or potential for adverse effects as a function of human exposure to the agent. These toxicity values are used in the risk characterization step to estimate the likelihood of adverse effects occurring in humans at different exposure levels. For the purpose of the risk assessment, contaminants were classified into two groups: potential carcinogens and noncarcinogens. The risks posed by these two types of compounds are assessed differently because noncarcinogens generally exhibit a threshold dose below which no adverse effects occur, while no such threshold can be proven to exist for carcinogens. As used here, the term carcinogen means any chemical for which there is sufficient evidence that exposure may result in continuing

Table 6 - Reasonable Maximum Exposure Assessment Factors

Exposure Factors	Current Site Visitor			Future Site Resident	
	Adult (age >16)	Adolescent (age 6-16)	Child (age <6)	Adult/Adolescent (age >6)	Child (age <6)
INGESTION EXPOSURE PATHWAY					
Ingestion Rate:					
Soil/Sediment	100 mg/day	100 mg/day	200 mg/day	100 mg/day	200 mg/day
Surface Water	0.01 liters/day	0.01 liters/day	0.01 liters/day	0.01 liters/day	0.01 liters/day
Drinking Water				2.0 liters/day	1.0 liters/day
Exposure Frequency:					
Soil	15 days/year	50 days/year	15 days/year	350 days/year	350 days/year
Sediment	15 days/year	50 days/year	15 days/year	15 days/year	50 days/year
Surface Water	15 days/year	50 days/year	15 days/year	15 days/year	50 days/year
Drinking Water				350 days/year	350 days/year
DERMAL CONTACT EXPOSURE PATHWAY					
Skin Surface Area Available for Contact:					
Soil/Sediment/					
Surface Water	5,300 cm ²	3,800 cm ²	2,000 cm ²	5,300 cm ²	2,000 cm ²
Shower Water				20,000 cm ²	7,000 cm ²
Soil/Sediment to Skin Adherence Factor	1.0 mg/cm ²	1.0 mg/cm ²	1.0 mg/cm ²	1.0 mg/cm ²	1.0 mg/cm ²
Exposure Time:					
Surface Water	1 hour/day	1 hour/day	1 hour/day	1 hour/day	1 hour/day
Shower Water				0.2 hours/day	0.2 hours/day
Exposure Frequency:					
Soil	15 days/year	50 days/year	15 days/year	350 days/year	350 days/year
Sediment	15 days/year	50 days/year	15 days/year	15 days/year	50 days/year
Surface Water	15 days/year	50 days/year	15 days/year	15 days/year	50 days/year
Shower Water				350 days/year	350 days/year
INHALATION EXPOSURE PATHWAY					
Inhalation Rate:					
Soil Vapor	1.4 m ³ /hour	1.7 m ³ /hour	1.3 m ³ /hour	0.83 m ³ /hour	0.63 m ³ /hour
Water Vapor				0.83 m ³ /hour	0.63 m ³ /hour
Exposure Time:					
Soil Vapor	1 hour/day	1 hour/day	1 hour/day	24 hours/day	24 hours/day
Water Vapor				0.2 hours/day	0.2 hours/day
Exposure Frequency:					
Soil Vapor	15 days/year	15 days/year	15 days/year	350 days/year	350 days/year
Water Vapor				350 days/year	350 days/year

Table 6 - Reasonable Maximum Exposure Assessment Factors					
Exposure Factors	Current Site Visitor			Future Site Resident	
	Adult (age >16)	Adolescent (age 6-16)	Child (age <6)	Adult/Adolescent (age >6)	Child (age <6)
EXPOSURE ASSESSMENT CONSTANTS					
Exposure Duration	30 years	10 years	6 years	30 years	6 years
Body Weight	70 kg	42 kg	15 kg	70 kg	15 kg
Averaging Time:					
Carcinogens	70 years	70 years	70 years	70 years	70 years
Noncarcinogens	30 years	10 years	6 years	30 years	6 years

uncontrolled cell division (cancer) in humans and/or animals. Conversely, the term noncarcinogen means any chemical for which the carcinogenic evidence is negative or insufficient.

Slope factors have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. Slope factors, which are expressed in units of $(\text{mg/kg/day})^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg/day , to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper-bound" reflects the conservative estimate of the risks calculated from the slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). Slope factors used in the baseline risk assessment are presented in Table 7.

Reference doses have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day , are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of contaminants of concern from human epidemiological studies or animal studies to which uncertainty factors have been applied account for the use of animal data to predict effects on humans. Reference doses used in the baseline risk assessment are presented in Table 7.

Table 7 - Slope Factors and Reference Doses

Chemical	Slope Factors (mg/kg-day) ¹			Reference Dose (mg/kg-day)			
	Oral	Inhalation	Class	Oral		Inhalation	
				Chronic	Subchronic	Chronic	Subchronic
Acetone				0.10	1.0	0.10	1.0
Aldrin	17	17	B2	0.00003	0.00003	0.00003	0.00003
Antimony				0.0004	0.0004	0.0004	0.0004
Aroclor 1248	7.7	7.7	B2				
Aroclor 1254	7.7	7.7	B2				
Aroclor 1260	7.7	7.7	B2				
Benzene	0.029	0.029	A				
Benzoic acid				4.0	4.0	4.0	4.0
Beryllium	4.3	8.4	B2	0.005	0.005	0.005	0.005
Alpha-BHC	6.3	6.3	B2				
Gamma-BHC	1.3	1.3	B2	0.0003	0.003	0.0003	0.003
Bis(2-chloroethyl) ether	1.1	1.1	B2				
Bis(2-ethylhexyl) phthalate	0.014	0.014	B2	0.02	0.02	0.02	0.02
2-Butanone				0.60	0.60	0.29	0.29
Cadmium	ND	6.3	B1	0.0005	0.0005	0.0005	0.0005
Chromium(VI)				0.005	0.02	ND	ND
Copper				0.0371	0.0371		
Dibutyl phthalate				0.10	1.0	0.10	1.0
1,4-Dichlorobenzene	0.024	0.024	C	0.2	0.2	0.2	0.2
1,1-Dichloroethane	ND	ND	C	0.1	0.1	0.14	1.4
1,2-Dichloroethane	0.091	0.091	B2				
1,1-Dichloroethene	0.6	0.175	C	0.009	0.009	0.009	0.009
1,2-Dichloroethene				0.02	0.20	0.02	0.20
1,2-Dichloropropane	0.068	0.068	B2			0.0011	0.0037
Dieldrin	16	16	B2	0.00005	0.00005	0.00005	0.000005
Endrin				0.0003	0.0003	0.0003	0.0003

Table 7 - Slope Factors and Reference Doses							
Chemical	Slope Factors (mg/kg-day) ¹			Reference Dose (mg/kg-day)			
	Oral	Inhalation	Class	Oral		Inhalation	
				Chronic	Subchronic	Chronic	Subchronic
Ethylbenzene				0.10	1.0	0.29	0.29
Heptachlor epoxide	9.1	9.1	B2	0.000013	0.000013	0.000013	0.000013
Isophorone	0.00095	0.00095	C	0.2	2.0	0.2	2.0
Lead	--	--	B2				
Manganese				0.005	0.005	0.0001	0.0001
Methyl isobutyl ketone				0.05	0.5	0.023	0.23
Nickel	--	ND	D/--	0.02	0.02	0.02	0.02
N-Nitroso diphenylamine	0.0049	--	B2				
Tetrachloro-ethene	0.052	0.002	B2	0.01	0.1	0.01	0.1
Toluene				0.2	2.0	0.12	0.6
1,1,2-Trichloroethane	0.056	0.056	C	0.004	0.04	0.004	0.04
Trichloroethene	0.011	0.006	B2				
Vinyl chloride	1.9	0.30	A				
Xylenes				2.0	4.0	2.0	4.0
Zinc				0.3	0.3	0.3	0.3

Key: ND - Not determined

Class = EPA Weight-Of-Evidence Class for Carcinogenicity

- A Human Carcinogen - sufficient evidence from epidemiological studies to support a causal association between exposure and cancer
- B Probable Human Carcinogen -
 - At least limited evidence of carcinogenicity to humans from epidemiological studies
- B2 ● Usually a combination of sufficient evidence of carcinogenicity in animals and inadequate evidence of carcinogenicity in humans
- C Possible Human Carcinogen - limited evidence of carcinogenicity in animals in the absence of human data
- D Not Classified - inadequate evidence of carcinogenicity in animals

D. Human Health Effects

The health effects of the Site contaminants that are most associated with the unacceptable risk levels are summarized below. In most cases, the information in the summaries is drawn from the Public Health Statement in the Agency for Toxic Substances and Disease Registry's (ATSDR) toxicological profile for the chemical.

Antimony: Antimony can enter the body by absorption from the gastrointestinal tract following ingestion of food or water containing antimony, or by absorption from the lungs after inhalation. Ingestion of high doses of antimony can result in burning stomach pains, colic, nausea, and vomiting. Long-term occupational inhalation exposure has caused heart problems, stomach ulcers, and irritation of the lungs, eyes, and skin. The critical or most sensitive noncarcinogenic effects of exposure to antimony are shortened life span, reduced blood glucose levels, and altered cholesterol levels. Existing data suggest that antimony may be an animal carcinogen but are not sufficient to justify a quantitative cancer potency estimate at this time. In laboratory rats, inhalation of antimony dust can increase the risk of lung cancer. However, there is no evidence of increased risk of cancer to animals from eating food or drinking water containing antimony. It is not known whether antimony can cause cancer in humans.

Benzene: Benzene is readily absorbed by inhalation and ingestion, but is absorbed to a lesser extent through the skin. Most of what is known about the human health effects of benzene exposure is based on studies of workers who were usually exposed for long periods to high concentrations of benzene. Benzene is toxic to blood-forming organs and to the immune system. Excessive exposure (inhalation of concentrations of 10 to 100 ppm) can result in anemia, a weakened immune system, and headaches. Occupational exposure to benzene may be associated with spontaneous abortions and miscarriages (supported by limited animal data), and certain developmental abnormalities such as low birth weight, delayed bone formation, and bone marrow toxicity. Benzene is classified as a Group A human carcinogen based on numerous studies documenting excess leukemia mortality among occupationally exposed workers.

Beryllium: The respiratory tract is the major target of inhalation exposure to beryllium. Short-term exposure can produce lung inflammation and pneumonia-like symptoms. Long-term exposure can cause berylliosis, an immune reaction characterized by noncancerous growths on the lungs. Similar growths can appear on the skin of sensitive individuals exposed by dermal contact. Epidemiological studies have found that an increased risk of lung cancer may result from exposure to beryllium in industrial settings. In addition, laboratory studies have shown that

breathing beryllium causes lung cancer in animals. However, it is not clear what cancer risk, if any, is associated with ingestion of beryllium. EPA has classified beryllium as a Group B2 probable human carcinogen based on the limited human evidence and the animal data.

Bis(2-chloroethyl)ether (BCEE): BCEE enters the body easily after being ingested or inhaled, and crosses the skin easily after dermal contact. People exposed to the vapors of BCEE report that they are highly irritating to the nose and eyes. Animals exposed to high amounts of BCEE by inhalation can sustain lung damage sometimes leading to death. There is no information on the effects on other organ systems or the effects of low doses of BCEE over long periods of time. BCEE causes cancer in mice. Mice exposed to low levels of BCEE orally for long periods of time develop liver tumors. However, there is no excess cancer in rats when they are treated similarly. There are no cases of cancer in humans attributed to BCEE. EPA classifies BCEE as a Group B2 probable human carcinogen based on the studies on mice.

Bis-(2-ethylhexyl)phthalate (DEHP): DEHP can enter the body following exposure by breathing air or eating food or water that contain DEHP. The most likely route of human exposure is through food. DEHP can leach into foods from plastics used in food processing and storage. Most of what is known about the health effects of DEHP comes from studies of laboratory mice and rats. The very low levels to which humans may be routinely exposed have not been shown to cause adverse effects; however, liver disease and reproductive effects have been associated with DEHP exposure to laboratory animals. DEHP has been shown to cause liver cancer in rats and mice. However, because there have been no studies of DEHP carcinogenic effects in humans, DEHP is classified as a Group B2 probable human carcinogen.

2-Butanone (Methyl Ethyl Ketone [MEK]): In general, observable effects occur only in animal studies at high doses. Health effects resulting from inhalation or ingestion of MEK include: respiratory irritation, kidney and liver abnormalities, underdeveloped offspring, and unconsciousness and death at high doses. Toxic effects to offspring (as an indicator) is EPA's critical or most sensitive effect noted. There are reports of behavioral effects in mice and baboons at low doses of MEK. There is very little long-term exposure data for MEK in humans and animals. It is unknown whether MEK causes cancer in animals or humans.

Cadmium: Cadmium can cause a number of adverse health effects. Ingestion of high doses causes severe irritation to the stomach, leading to vomiting and diarrhea, while inhalation can lead to severe irritation of the lungs and may cause death. People have committed suicide by drinking water containing high levels of cadmium. There is very strong evidence that the kidney is the

main target organ of cadmium toxicity following chronic exposure. Long-term ingestion of cadmium has caused kidney damage and fragile bones in humans. Long-term human exposure by the inhalation route may cause kidney damage and lung disease such as emphysema. The most sensitive or critical effect of cadmium exposure is high concentrations of protein in urine, indicative of abnormal kidney function. Long-term inhalation of air containing cadmium by workers is associated with an increased risk of lung cancer. Laboratory rats that breathe cadmium have increased cancer rates. Studies of humans or animals have not demonstrated increased cancer rates from eating or drinking cadmium. EPA classifies cadmium as a Group B1, probable human inhalation carcinogen based on occupational studies.

Chlordane/Heptachlor/Heptachlor Epoxide: Chlordane, heptachlor, and heptachlor epoxide can be absorbed by the body through dermal contact, inhalation of particulates in ambient air, and ingestion of contaminated food or soils. These substances may remain stored for months or years in the blood plasma or the body fat of the liver, spleen, brain, and kidneys. Heptachlor epoxide can also pass directly from a mother's blood to an unborn baby through the placenta. Little data are available on the adverse health effects of chlordane, heptachlor, and heptachlor epoxide exposure in humans. Symptoms associated with human overexposure to those compounds include headache, dizziness, lack of coordination, irritability, weakness, and convulsions. In humans, an acute oral lethal dose of chlordane is estimated to be between 25 and 50 mg/kg. Experimental studies exploring the health effects on animals exposed to various levels of chlordane showed an association between exposure and immunologic dysfunction, reproductive dysfunction, nervous system damage, liver damage, convulsions, liver cancer, and death. The lethal dose of chlordane in rats is estimated to be between 85 and 560 mg/kg. Some occupational epidemiology research suggests an increased cancer risk associated with human exposure to chlordane. Chronic oral treatment with chlordane and heptachlor has resulted in significant increases in hepatocellular carcinomas in mice. EPA has classified chlordane, heptachlor, and heptachlor epoxide as Group B2 probable human carcinogens.

Chromium: There are two major forms of chromium, which differ in their potential adverse health effects, found in the environment. One form, chromium VI (chromium 6⁺), is irritating; short-term, high-level exposure can result in adverse effects at the site of contact, causing ulcers of the skin, irritation and perforation of the nasal mucosa, and irritation of the gastrointestinal tract. Minor to severe damage to the mucous membranes of the respiratory tract and to the skin have resulted from occupational exposure to as little as 0.1 mg/m³ chromium VI compounds. Chromium VI may also cause adverse effects in the kidney and liver. Long-term occupational exposure to low levels of chromium

VI compounds has been associated with lung cancer in humans. Chromium VI is classified by EPA as a Group A known human carcinogen based on evidence from epidemiological studies. The second form, chromium III (chromium 3⁺), does not result in these effects and is the form thought to be an essential nutrient. The only effect observed in toxicological studies of chromium III is a decrease in liver and spleen weights in rats. This effect was used as the basis for the RfD.

Copper: Copper may enter the body by breathing air, drinking water, eating food containing copper, and by skin contact with soil, water, and other copper-containing substances. Copper is an essential element at low-dose levels but may induce toxic effects at high-dose levels. The critical or most sensitive effect is gastrointestinal irritation. The National Academy of Science has recommended 2 to 3 mg/day of copper as a safe and adequate daily intake. Long-term overexposure to copper dust can irritate the nose, mouth, and eyes and cause headaches, dizziness, nausea, and diarrhea. Ingestion of high concentrations of copper can cause vomiting, diarrhea, stomach cramps, and nausea. Very young children are particularly sensitive to ingested copper. Liver and kidney damage and possibly death may result from long-term exposure. In general, the seriousness of health effects of copper increase as the level and duration of exposure increases. Copper is not known to cause cancer or birth defects.

1,2-Dichloroethane (1,2-DCA): The lungs, heart, liver, and kidneys are the organs primarily affected in both humans and animals exposed to 1,2-DCA. Short-term exposure to 1,2-DCA in air may result in an increased susceptibility to infection and liver, kidney, and/or blood disorders. Effects seen in animals after long-term exposure to 1,2-DCA included liver, kidney, heart disease, and/or death. 1,2-DCA has caused increased numbers of tumors in laboratory animals when administered in high doses in the diet or on the skin and is classified as a Group B2 probable human carcinogen.

1,1-Dichloroethene (1,1-DCE): 1,1-DCE usually enters the body via inhalation and/or ingestion. It may also enter the body through the skin. The human health effects resulting from exposure to 1,1-DCE are unknown. In animal studies, brief exposures to high concentrations of 1,1-DCE have caused liver, kidney, heart damage, lung damage, nervous system disturbances, and death. Prolonged exposure to lower concentrations of 1,1-DCE has also produced liver damage. An increased risk for cancer was observed in animals exposed to 1,1-DCE, as were birth defects in the offspring of exposed pregnant animals. Based upon animal studies, 1,1-DCE is classified as a Group C possible human carcinogen.

Polychlorinated Biphenyls (PCBs): PCBs can enter the body when fish, other foods, or water containing PCBs are ingested, when air that contains PCBs is breathed, or when skin comes in contact with PCBs. Skin irritations characterized by acne-like lesions and rashes and liver effects were the only significant adverse health effects reported in PCB-exposed workers. Epidemiological studies of workers occupationally exposed to PCBs thus far have not found any conclusive evidence of an increased incidence of cancer in these groups. Effects of PCBs in experimentally exposed animals include liver damage, skin irritations, death, low birth weights, and other reproductive effects. Some strains of rats and mice that were fed PCB mixtures throughout their lives showed increased incidence of cancer of the liver and other organs. Based on these animal studies, EPA has classified PCBs as Group B2 probable human carcinogen.

1,1,2-Trichloroethane: No case reports or epidemiological studies regarding human occupational or environmental exposure are available. Studies with various animals, however, suggest that 1,1,2-TCA can enter the body following inhalation of contaminated air, ingestion of or dermal contact with contaminated drinking water, or through dermal contact with the solvent itself. 1,1,2-TCA is a central nervous system depressant. It has narcotic properties and can act as a local irritant to the eyes, nose, and lungs. 1,1,2-TCA is also associated with both liver and kidney damage. 1,1,2-TCA may be carcinogenic. It caused liver tumors in mice, but not rats, chronically fed 1,1,2-TCA. No other studies have shown evidence of carcinogenicity, however. Further studies with rats using higher concentrations and other species would improve the knowledge of 1,1,2-TCA carcinogenicity. Based upon the present evidence from animal studies, EPA considers 1,1,2-TCA a Group C - possible human carcinogen.

Vinyl Chloride (VC): VC may cause adverse health effects following exposure by inhalation, ingestion, or by dermal or eye contact. VC inhalation can cause dizziness or sleepiness. Breathing very high levels of VC can cause unconsciousness and in some cases death. On skin, exposure to liquid VC can cause burns. Noncarcinogenic effects associated with long-term occupational VC exposure include hepatitis-like changes in the liver, immune reactions, and nerve damage. VC has been shown to cause liver and lung cancer in rats and liver cancer in workers occupationally exposed to air concentrations in the range of 25 ppm to greater than 200 ppm. Based on this evidence, EPA has classified VC as a Group A human carcinogen. Air standards as low as 1 ppm are specified for occupational exposure to VC in many countries.

Zinc: Zinc appears to be toxic only at levels at least 10 times higher than the recommended daily allowance. Symptoms of overexposure may include severe diarrhea, stomach cramping,

nausea, and vomiting. Serious damage to the digestive system can occur if too much zinc is ingested over a long period of time. Ingesting too much zinc can cause deficiency in other nutrients such as iron (anemia) and copper. Anemia is the critical effect or most sensitive effect caused by zinc overexposure. Inhalation of zinc fumes or dusts has been associated with a condition called "metal fume fever" characterized by flu-like symptoms including throat irritation, body aches, weakness, and fatigue. Zinc is not thought to cause cancer or birth defects. MRLs are not available for zinc because zinc is an essential nutrient.

E. Risk Characterization

The risk characterization process integrates the toxicity and exposure assessments into a quantitative expression of risk. For carcinogens, the exposure point concentrations and exposure factors discussed earlier are mathematically combined to generate a chronic daily intake value that is averaged over a lifetime (i.e., 70 years). This intake value is then multiplied by the toxicity value for the contaminant (i.e., the slope factor) to generate the incremental probability of an individual developing cancer over a life-time as a result of exposure to the contaminant. These probabilities are generally expressed in scientific notation (e.g., 1×10^{-6} , otherwise expressed as $1E^{-6}$). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the site. The generally acceptable excess cancer risk range, as defined by Section 300.430 (e)(2)(i)(A)(2) of the NCP, is between 1.0×10^{-4} to 1.0×10^{-6} .

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (i.e., the chronic daily intake) with the toxicity of the contaminant for a similar time period (i.e., the reference dose). The ratio of exposure to toxicity is called a hazard quotient. A Hazard Index (HI) is generated by adding the appropriate hazard quotients for contaminants to which a given population may reasonably be exposed. Any media with an HI greater than 1.0 has the potential to adversely affect health.

The baseline risk assessment estimates the reasonable maximum total lifetime cancer risks for future Site residents to be 2.0×10^{-3} for adults and 1.2×10^{-3} for children under six years old. These risks exceed the acceptable risk range of 10^{-4} to 10^{-6} established in Section 300.430(e)(2)(i)(A) of the NCP. Table 8 summarizes the baseline risk assessment calculations for carcinogenic risk to individuals who would experience a reasonable maximum exposure to Site contaminants. The baseline risk assessment also calculates the risks to individuals who would experience an average exposure to Site contaminants. Under

average conditions, future Site residents would experience a total lifetime cancer risk of 1.4×10^{-4} for adults and 4.1×10^{-4} for children under six years old.

The baseline risk assessment estimates the hazard index for noncarcinogenic effects for future Site residents to be 8.4 for adults and 19 for children under six years old, under reasonable maximum exposure (RME) conditions. These risks exceed 1.0, which is the acceptable hazard index level. Table 9 summarizes the hazard indices for noncarcinogenic risk to individuals who would experience a reasonable maximum exposure to Site contaminants. Under average exposure conditions, future Site residents would experience a hazard index for noncarcinogenic effects of 2.4 for adults and 7.9 for children under six years old.

VII. SUMMARY OF SITE ECOLOGICAL RISKS

The ecological assessment (EA) focuses on existing and potential risk posed by Site-related contaminants to nearby natural habitats and associated flora and fauna. It provides information pertinent to selection and development of the remedial actions. Potential contamination via surface water runoff from the Site led to the selection of the unnamed ephemeral tributary to Black Haw Branch up to the second logging road for investigation.

Ecological receptors and potential exposure pathways were evaluated for inclusion in the ecological assessment on the basis of the Site contaminants, affected media identified, and the characteristics of receptors. The following exposure pathways were chosen for evaluation in the risk assessment:

- Aquatic biota in the unnamed ephemeral tributary and semi-aquatic species were chosen due to their potential exposure to elevated metal levels and PCB concentrations in the sediment and surface water.
- Plants growing on top of and along the edge of the Site were chosen due to the observation of stressed vegetation in some areas. This exposure pathway was incorporated into the secondary consumer pathway.
- Secondary consumers, especially small mammals using the Site, were chosen due to their potential exposure to elevated levels of metals, PCBs, and phthalates in the soil.
- Migratory birds using the Site were chosen due to their potential exposure to elevated levels of PCBs and metals contaminants in the soil and sediment.

Table 8

**SUMMARY OF ESTIMATED EXCESS CANCER RISKS
ASSOCIATED WITH THE H&H SITE - RME CASE**

Exposure Scenario	Exposure Media	Receptors			Risk Contributions by Exposure Route ^a	Risk Contributions by Chemical ^a
		Adults	Children (1-6 year-old)	Adolescents (6-16 year-old)		
Site visitors	Soil	3.1×10^{-5}	1.8×10^{-5}	4.4×10^{-5}	Soil ingestion - 18% Dermal contact with soil - 82%	PCBs - 99%
	Air (vapors)	1.8×10^{-9}	1.5×10^{-9}	4.0×10^{-9}	--	PCBs - 71% 1,1,2-TCA - 28%
	Stream sediment	4.0×10^{-6}	1.8×10^{-6}	5.4×10^{-6}	Incidental ingestion - 8% Dermal contact - 92%	PCBs - >99%
	Stream surface water	2.5×10^{-5}	8.9×10^{-6}	3.4×10^{-5}	Incidental ingestion - 0.4% Dermal contact - 99%	PCBs - >99%
TOTAL		6.0×10^{-5}	2.9×10^{-5}	8.3×10^{-5}		
Future site residents	Groundwater	1.1×10^{-3}	5.3×10^{-4}	--	Drinking water - 68% Dermal contact with water - 10% Inhalation of vapors in shower - 22%	Vinyl chloride - 32% Bis(2-chloroethyl)ether - 25% PCBs - 17% Beryllium - 12% Benzene - 3% 1,2-DCA - 3% 1,1-DCE - 2%
	Soil	8.3×10^{-4}	6.0×10^{-4}	--	Incidental ingestion - 25% Dermal contact - 75%	PCBs - 99%
	Air (vapors)	5.8×10^{-7}	4.1×10^{-7}	--	--	PCBs - 71% 1,1,2-TCA - 28%

Table 8 (Cont.)

**SUMMARY OF ESTIMATED EXCESS CANCER RISKS
ASSOCIATED WITH THE H&H SITE - RME CASE**

Exposure Scenario	Exposure Media	Receptors			Risk Contributions by Exposure Route ^a	Risk Contributions by Chemical ^a
		Adults	Children (1-6 year-old)	Adolescents (6-16 year-old)		
Future site residents (Cont.)	Stream sediment	4.0×10^{-6}	5.9×10^{-6}	--	Incidental ingestion - 26% Dermal contact - 74%	PCBs - 99%
	Stream surface water	2.5×10^{-5}	3.0×10^{-5}	--	Incidental ingestion - 0.7% Dermal contact - 99%	PCBs - >99%
TOTAL		2.0×10^{-3}	1.2×10^{-3}			

^a These columns are independent of each other. Both refer to the total receptor risks for the receptor with the highest estimated cancer risk.

Source: Ecology and Environment, Inc. 1992.

Table 9
SUMMARY OF ESTIMATED HAZARD INDICES
FOR NONCARCINOGENIC EFFECTS ASSOCIATED
WITH THE H&H SITE - RME CASE

Exposure Scenario	Exposure Media	Receptors			Significant Hazard Index Contributions by Exposure Route ^a	Significant Hazard Index Contributions by Chemical ^a
		Adults	Children (1-6 year-old)	Adolescents (6-16 year-old)		
Site visitors	Soil	3.9×10^{-3}	3.2×10^{-2}	2.1×10^{-2}	--	--
	Air (vapors)	2.1×10^{-5}	3.6×10^{-5}	1.4×10^{-4}	--	--
	Stream sediment	2.5×10^{-4}	1.6×10^{-3}	1.4×10^{-3}	--	--
	Stream surface water	4.8×10^{-4}	1.7×10^{-3}	2.4×10^{-3}	--	--
TOTAL		0.005	0.04	0.02		
Future site residents	Groundwater	8.2	17.3	--	Drinking water - 96% Inhalation of vapors - 4%	Manganese - 94% 2-Butanone - 5%
	Soil	1.8×10^{-1}	1.5	--	Incidental ingestion - 99% Dermal contact - 0.2%	Antimony - 34% Copper - 33% Bis(2-ethylhexyl)phthalate - 20% Manganese - 5% Chromium - 4% Cadmium - 2% Zinc - 1%
	Air (vapors)	7.0×10^{-3}	9.9×10^{-3}	--	--	--
	Stream sediment	2.5×10^{-4}	5.4×10^{-3}	--	--	--
	Stream surface water	4.8×10^{-4}	5.6×10^{-3}	--	--	--
TOTAL		8.4	19			

^a These columns are independent of each other. Both refer to the total receptor risks for the receptor with the highest hazard index.

Source: Ecology and Environment, Inc. 1992.

Receptors and exposure pathways excluded from evaluation in the risk assessment were upland tertiary consumers and top carnivores due to the size of the Site relative to the necessary home range for these species. The potential for significant exposure of these taxa to Site contaminants is considered minimal.

Based on these considerations, and on the potential exposure pathways and receptors identified in the previous section, indicator species and assessment endpoints were selected. Ubiquitous indicator species were chosen based on their habitat requirements and the likelihood they would occur on the Site. The indicator species include:

- Amphipods (*Hyalella azteca*) and midges (*Chironomus tentans*) representing aquatic biota expected to occur in the unnamed ephemeral tributary;
- The green frog (*Rana clamitans melanota*) representing semi-aquatic and terrestrial wildlife that are expected to occur in the area and which may depend on the tributary for a fraction of their food or habitat needs;
- The meadow vole (*Microtus pennsylvanicus*) representing small mammals that are expected to occur on the Site; and
- The American robin (*Turdus migratorius*) representing migratory birds that are expected to occur on the Site.

Assessment endpoints for the indicator species are the estimated effects of Site contaminants on survival, reproduction, growth, or other critical effects. These indicator species were chosen because of their potential exposure and susceptibility to adverse effects of Site contaminants and available toxicological data for these taxa.

A. Selection of Contaminants of Ecological Concern

Copper, lead, and zinc were found at elevated concentrations in surface water samples collected up to the second logging road along the unnamed ephemeral tributary that drains the disposal area. Beyond the second logging road, only lead and zinc are present, though at concentrations substantially lower than the samples collected before the second logging road. Aroclor 1260 was detected in six of the 15 surface water samples collected from the unnamed ephemeral tributary prior to the second logging road. Therefore, the EA focused on copper, lead, zinc, and Aroclor 1260 in surface water.

In sediment, lead and copper were found in elevated concentrations along the unnamed ephemeral tributary immediately below the disposal area and downstream to the second logging

road. Arsenic, aluminum, chromium, and zinc also were present at elevated concentrations along the same portion of the tributary. Of these six contaminants, lead and copper are present in substantially higher concentrations and are more widely distributed (i.e., they are present in elevated concentrations in more of the samples collected from the above-mentioned location). Therefore, even though all six metals are of concern, lead and copper received greater attention in the EA. Aroclor 1260 was detected in 14 of the 22 sediment samples collected in the unnamed ephemeral stream and was also addressed in the EA.

In soil, copper, lead, and zinc were found at concentrations above the upper limit of 90th percentile of common range found in eastern United States soils. Aluminum, arsenic, and chromium were also found at elevated concentrations in all surface soils collected on Site, and one surface soil collected downgradient of the Site. One sample, SS-6A, contained chromium at a concentration above the upper limit of 90th percentile of common range found in eastern United States soils. While these inorganics are important, copper, lead, and zinc were the focus of the EA because of their toxicity and elevated concentrations compared to the other inorganics.

PCBs, especially Aroclor 1260 and 1248, were detected in soil at concentrations greater than the EPA Region 3 risk-based concentrations for residential soil. Bis(2-ethylhexyl) phthalate was found at concentrations above the background sample collected. However, none of the samples exceeded the EPA Region 3 risk-based concentrations for residential soils. In contrast, bis(2-ethylhexyl)phthalate was detected in 12 of the 17 soil samples with a maximum concentration of 63,000 $\mu\text{g}/\text{kg}$. Eleven of the 12 samples had concentrations significantly above background levels. PCBs and bis(2-ethylhexyl)phthalate were the focus of the EA for organics in soil.

B. Exposure Assessment

Three metals (lead, copper, and zinc) and two organics (PCB and bis(2-ethylhexyl) phthalate) have been identified as the contaminants of ecological concern. Three contaminant migration mechanisms are potentially operating to disperse these Site contaminants further into the environment: stormwater runoff, wind, and groundwater. Under the conditions at the Site, and with the apparent absence of an organic carrier solvent for PCBs and bis(2-ethylhexyl)phthalate, both the metal and organic contaminants would be predominantly insoluble in the ground water. Therefore, the contaminants would be more prone to bulk migration via runoff and wind rather than by dissolution followed by migration in groundwater. The absence and low levels of these contaminants in the groundwater samples collected from beneath the Site and from nearby residents corroborate this conclusion.

Contaminants migrating via surface water runoff may be found in the water and sediment of the unnamed ephemeral tributary to Black Haw Branch and its associated wetland area. In this exposure scenario, contaminants could directly migrate from the bermed disposal area to the tributary during storms or snow melt. These contaminants can be carried on suspended soil or sediment particles or in solution. The pH of the surface water is acidic and metals, especially zinc, will go into solution. This was corroborated by elevated zinc concentrations in the filtered surface water samples. Black Haw Branch, which receives the tributary's water and suspended burden approximately one mile downstream from the disposal area, would be the ultimate fate of contaminants being transported by the tributary.

The aquatic sediment and surface water data indicate that exposure of the tributary's aquatic biota and semiaquatic and terrestrial wildlife to elevated contaminant concentrations does currently not extend past the second logging road located near samples SW-13 and SED-13. At this point, a secondary tributary enters the intermittent stream. The sediment and surface water metal concentration in samples immediately below the second logging road are greatly reduced from those adjacent to the disposal area. In sediment, the metal concentrations decrease to background levels. PCBs appear to have migrated in sediments to the confluence of the intermittent stream and the Black Haw Branch. Contaminant migration via wind erosion, while possible, is not likely assuming the dense woody vegetation surrounding the bermed disposal area is maintained.

1. Organic Exposure Point Concentrations

A number of environmental factors affect the bioavailability of organics in the soil, especially the amount of organic carbon available. The sorption of organics by humic substances will be the controlling factor in determining release, migration, and fate of organics. For this assessment, the bioavailable fraction for organics was determined and used as the concentration available for uptake by receptor organisms in the soil.

While plants do readily absorb soluble organic compounds of low molecular weight, the insolubility and size of PCBs and phthalate would argue against substantial uptake via soil pore water. Therefore, it was assumed for this assessment that plants will not uptake the organic contaminants.

The geometric mean organic contaminant concentration detected in surface water and sediments was used as the exposure point concentration.

2. Metals Exposure Point Concentrations

A number of environmental factors affect the bioavailability of metals in soil. If environmental factors such as adsorption and precipitation reactions are considered, the bioavailable concentrations may drop by 10 to 100 fold for lead, 10 to 50 fold for copper, and 5 to 10 fold for zinc. However, for the purposes of this screening-level risk assessment, the bulk metal concentrations measured at the Site will serve as a simple estimate of exposure concentrations. The geometric average metal contaminant concentration in unfiltered surface water and sediments was used as the exposure point concentration.

The principal routes of potential exposure of the meadow vole and American robin to contaminants would be via bioaccumulation through the food chain and incidental ingestion of contaminants in soil. For the green frog, the principal routes of uptake of contaminants are from the water, direct ingestion of soil, and bioaccumulation through the food chain.

C. Summary of Ecological Risks and Uncertainties

The risks of Site contamination were quantified by calculating an HI ratio for each contaminant, pathway, and receptor that could be quantitatively evaluated. The HIs were calculated as follows:

$$HI = ED/TRV$$

where

HI = Hazard index;
ED = Estimated dosage or geometric mean concentrations
(for surface water and sediment) in medium;
TRV = Toxicity reference value.

An HI greater than one (1) would be considered presumptive evidence of the potential for risk of chronic or acute (for aquatic benthos only) toxicological effects to a given ecological receptor.

The surface water acute and chronic HIs are 15.0 and 22.5, respectively, for copper, 1.2 and 173.57 for PCBs, and 4.65 and 5.07 for zinc. This suggests a potential for ecological risk to aquatic biota for both acute and chronic impacts. The lead acute and chronic HIs are 0.69 and 17.94, respectively, suggesting no acute impacts, but potential chronic impacts in surface water. As a result, taxa receiving brief exposures to the tributary waters (e.g., migrating waterfowl) would be a low risk, while resident taxa may be affected).

For amphibians, such as the green frog, exposure to copper and lead in the sediment and surface water via the food chain or direct contact or incidental ingestion may result in adverse effects. The HIs are 3.15 and 7.62 for lead and copper, respectively. As a result, resident biota receiving chronic exposures to the sediment and surface water may be at risk for toxic effects by the current copper and lead levels. HI values for PCBs, zinc, and bis(2-ethylhexyl)phthalate were not calculated. Toxicity reference values were not available for these substances. The high estimated dosage value suggests that a potential exists for adverse effects for these contaminants.

For copper and lead in the Site soil, food chain or direct exposures may result in adverse toxicological effects for the meadow vole and American robin. The copper HIs for meadow vole and American robin are 175 and 1.69, respectively, and HIs for lead are 6.30 and 14.03, respectively. Results for PCBs indicate a potential for adverse effect for the robin (HI of 26.23), but not the meadow vole (HI of 0.07). The HI for zinc in meadow vole was essentially one (1) and may pose some risk while zinc poses no potential risk for the American robin. Bis(2-ethylhexyl)phthalate poses no risk potential to the meadow vole. The HI for this substance was not calculated for the robin because toxicity reference values were not available. The high estimated dosage value suggests that a potential exists for adverse effects for this contaminant.

The sediment HIs for the ephemeral tributary based on the lowest-observed-effect level are 4.84 for copper, 6.03 for lead, 0.29 for zinc, and 497 for Aroclor 1260. These HI values indicate that there is a high risk of some ecological impact associated with the copper, lead, and Aroclor 1260 contamination of the sediments and that this contamination at these levels would be expected to impair use of the sediments by the benthic community. This conclusion was corroborated with the chronic toxicity tests performed on *Hyaella azteca* and *Chironomus tentans*. The sediments were toxic to both these organisms.

Uncertainties in this assessment are associated with both the exposure and toxicity assessments. The principal uncertainty in the exposure assessment involves estimating the bioavailable fraction in soils. Additional uncertainties arise from a lack of information about incidental ingestion and dermal pathways for wildlife. Moreover, each input variable used to derive estimated exposures for the food chain pathway is subject to uncertainty. Generally, the worst case was assumed to provide a conservative estimate. Few reliable toxicity values were available for soils and for effects of Site-related contaminants on wildlife. Therefore, considerable uncertainties exist in the extrapolation of toxicity values derived from surrogate species to the species of concern. As with the exposure assessment, reasonable worst-case assumptions were made to provide a conservative estimate.

In general, the risk assessment is likely to overestimate rather than underestimate the risks of adverse ecological effects at the Site because of the conservative nature of the assumptions used.

Quantitative exposure scenarios were developed for the meadow vole, American robin, and green frog. Based on the habitat and food requirements of the indicator species, each species will exhibit a different exposure scenario. The green frog may use the unnamed tributary and surrounding vegetation and invertebrates for all their food and habitat requirements, while the meadow vole and robin may use the Site and surrounding vegetation for their food and habitat requirements.

VIII. DESCRIPTION OF ALTERNATIVES

In the Feasibility Study (FS), engineering technologies applicable to remediating the contaminated media were screened according to their effectiveness and implementability. Those technologies remaining after the screening process were then developed into remedial alternatives. The medium-specific remedial alternatives were developed utilizing information and data from the FS report.

Because the soil designated for remediation is apparently acting as at least a partial source of ground water contamination, it is appropriate to combine the soil/sediment and ground water alternatives into comprehensive Site-wide alternatives. The retained medium-specific alternatives presented in the FS have been combined into the following Site-wide alternatives:

- Alternative A: No action.
- Alternative B: Capping of contaminated soils and sediments, limited institutional controls.
- Alternative B1: Capping of contaminated soils and sediments, extraction and on-site treatment of contaminated ground water, limited institutional controls.
- Alternative B2: Capping of contaminated soils and sediments, *in situ* biological treatment of ground-water with limited aboveground treatment.
- Alternative C: Excavation of contaminated soils and sediments, on-site thermal desorption treatment of organics-contaminated soils and sediments, on-site solvent extraction treatment of metals-contaminated soils and sediments, on-site disposal.

- Alternative C1: Excavation of contaminated soils and sediments, on-site thermal desorption treatment of organics-contaminated soils and sediments, on-site solvent extraction treatment of metals-contaminated soils and sediments, on-site disposal. Extraction and on-site treatment of contaminated groundwater.
- Alternative C2: Excavation of contaminated soils and sediments, on-site thermal desorption treatment of organics-contaminated soils and sediments, on-site solvent extraction treatment of metals-contaminated soils and sediments, on-site disposal, *in situ* biological treatment of ground water with limited aboveground treatment.
- Alternative D: Excavation and on-site thermal desorption treatment of contaminated soils and sediments, off-site disposal.
- Alternative D1: Excavation and on-site thermal desorption treatment of contaminated soils and sediments, off-site disposal, extraction and on-site treatment of contaminated ground water.
- Alternative D2: Excavation and on-site thermal desorption treatment of contaminated soils and sediments, off-site disposal, *in situ* treatment of contaminated ground water.
- Alternative E: Excavation and off-site treatment and disposal of contaminated soils and sediments.
- Alternative E1: Excavation and off-site treatment and disposal of contaminated soils and sediments, extraction and on-site treatment of contaminated ground water.
- Alternative E2: Excavation and off-site treatment and disposal of contaminated soils and sediments, *in situ* biological treatment of contaminated ground water with limited aboveground treatment.
- Alternative F: *In situ* treatment of contaminated soils with steam stripping and solidification, excavation and off-site disposal of contaminated sediments.
- Alternative F1: *In situ* treatment of contaminated soils with steam stripping and solidification, excavation and off-site disposal of contaminated sediments, extraction and on-site treatment of contaminated ground water.

- Alternative F2: In situ treatment of contaminated soils with steam stripping and solidification, excavation and off-site disposal of contaminated sediments, in situ biological treatment of ground water with limited aboveground treatment.

Alternative A: NO ACTION

Capital Cost: ³	\$ -0-
Annual O&M Cost:	\$ 66,100
Total Present Worth:	\$ 1,016,122
Implementation Time:	30 years

Section 300.430(e)(6) of the NCP requires that a "No Action" alternative be evaluated at every NPL site in order to establish a baseline for comparison. Under this alternative, EPA would take no further remedial action at the Site to prevent exposure to the contaminated media or to otherwise reduce risks at the Site. Ground water and surface water would be monitored under this alternative.

Alternative B: CAPPING OF CONTAMINATED SOIL AND SEDIMENT, LIMITED INSTITUTIONAL CONTROLS

Capital Cost:	\$ 266,000
Annual O&M Cost:	\$ 63,500
Total Present Worth:	\$ 1,049,000
Implementation Time:	30 years

Alternative B would eliminate direct contact with the contaminated soil and sediments through the installation of a RCRA Subtitle C multilayer cap. The cap would also reduce surface water infiltration through the contaminated soil and reduce the continued migration of contaminants to the ground water. The capped area would be fenced to restrict access. Both the cap and the fence would be maintained to ensure long-term protectiveness.

Prior to capping, this alternative would include the excavation of contaminated stream sediments and surface soils beyond the bermed disposal area. Additional sampling would be performed during the Remedial Design to determine the exact limits of excavation. The excavated material would be placed within the bermed area within the area to be capped.

³The costs provided in this document are estimates to be used solely for the purpose of comparative analysis.

Deed restrictions would be placed on the contaminated property to prohibit use of the contaminated ground water and to protect the integrity of the cap. Ground water monitoring would be continued to detect any impact to local residents from the migration of ground water contamination.

A periodic review pursuant to CERCLA § 121(c), 42 U.S.C. § 9621(c), would be required under this alternative.

**Alternative B1: CAPPING OF CONTAMINATED SOILS AND SEDIMENTS,
 EXTRACTION AND ON-SITE TREATMENT OF
 CONTAMINATED GROUND WATER, LIMITED
 INSTITUTIONAL CONTROLS**

Capital Cost:	\$ 886,423
Annual O&M Cost:	\$ 234,508
Total Present Worth:	\$ 4,491,273
Implementation Time:	30 years

All of the actions described under Alternative B would be implemented. In addition, contaminated ground water would be extracted and treated on-site to achieve the cleanup levels (see Table 12). For costing purposes, it was assumed that three extraction wells would be used. Additional field investigations would be performed during the Remedial Design to determine the appropriate configuration of the extraction well network and the need for additional extraction wells. This alternative would include the following elements in addition to those described for Alternative B:

- Ground water extraction via pumping wells;
- Metals removal via precipitation and sedimentation;
- Organics destruction via UV oxidation;
- Carbon polishing; and
- Surface discharge of treated ground water to the intermittent stream.

A monitoring program would be implemented to measure the effectiveness of the ground water treatment system, to evaluate potential impacts of the system on ecological receptors, and to ensure local residents are not impacted by cleanup activities.

**Alternative B2: CAPPING OF CONTAMINATED SOILS AND SEDIMENTS,
 IN SITU TREATMENT OF CONTAMINATED GROUND
 WATER WITH LIMITED ABOVEGROUND TREATMENT,
 LIMITED INSTITUTIONAL CONTROLS**

Capital Cost: \$ 1,419,548
Annual O&M Cost: \$ 376,500
Total Present Worth: \$ 5,327,505
Implementation Time: 15 years

All of the requirements described under Alternative B would be implemented. In addition, ground water treatment would be implemented primarily by in situ biological treatment of phenols, ketones, and aromatic hydrocarbons (and possibly some chlorinated hydrocarbons), and aboveground treatment of metals, pesticides, PCBs, and other non-biodegradable compounds. The treatment system would extract ground water from the center of the plume of contamination, treat it aboveground to remove non-biodegradable compounds, add nutrients and oxygen needed to promote growth of aerobic microorganisms, and reinject the water at the periphery of the plume. This treatment system would be designed to destroy the highest concentration contaminants in situ to reduce the time required to reach the cleanup levels (see Table 12). The ground water in the upper portions of the saprolite aquifer would be treated through a conventual extraction and treatment process.

A monitoring program would be implemented to measure the effectiveness of the ground water treatment system, to evaluate potential impacts of the system on ecological receptors, and to ensure local residents are not impacted by cleanup activities.

**Alternative C: EXCAVATION OF SOILS AND SEDIMENTS, ON-SITE
 THERMAL DESORPTION TREATMENT OF ORGANICS-
 CONTAMINATED SOILS AND SEDIMENTS, ON-SITE
 SOLVENT EXTRACTION TREATMENT OF METALS-
 CONTAMINATED SOILS AND SEDIMENTS, ON-SITE
 DISPOSAL**

Capital Cost: \$ 1,556,024
Annual O&M Cost: \$ 63,500
Total Present Worth: \$ 2,215,132
Implementation Time: 1 year

Alternative C provides for the excavation of contaminated soils and stream sediments followed by on-site treatment and backfilling at the Site. The organics would be treated by thermal desorption, and the metals by solvent extraction. The total estimated volume of contaminated soil to be treated is 5,269 yd³, based on concentrations exceeding the soil cleanup levels to a depth of six feet. Additional sampling would be performed during the Remedial Design to determine the exact extent of soil and sediment excavation.

Excavated soils and sediments would be treated by thermal desorption to remove organic contaminants above health-based cleanup levels (see Table 12). The thermal desorption process consists of heating solids containing organic contaminants, thereby driving off the water and organic contaminants and producing a dry solid containing trace amounts of the organic residue. The treated soils and sediments would be backfilled on-site.

Solvent extraction would then be utilized to remove metals above health-based cleanup levels (see Table 12). Solvent extraction uses a treatment tank in which soil is homogeneously mixed, flooded with a solvent, and again mixed thoroughly to allow the waste to come in contact with the solution. Once mixing is complete, the solvent is drawn off by gravity, vacuum filtration, or some other conventional dewatering process. The solids are then rinsed with a neutralizing agent (if needed) and dried.

Treatability studies would be required to determine the solvent with the best chemical characteristics needed to adequately address the conditions at the Site. The solvent would be treated for reuse on-site through neutralization. The regeneration process would generate a metals sludge which would be disposed of off-site. It is expected that the sludge would be handled as a hazardous waste requiring treatment at a RCRA-permitted facility prior to disposal.

Deed restrictions would be placed on the contaminated property to prohibit use of the contaminated ground water. Ground water monitoring would be continued to detect any impact to local residents from the migration of ground water contamination. A periodic review pursuant to CERCLA § 121(c), 42 U.S.C. § 9621(c), would be required under this alternative.

ALTERNATIVE C1: EXCAVATION OF CONTAMINATED SOILS AND SEDIMENTS, ON-SITE THERMAL DESORPTION TREATMENT OF ORGANICS-CONTAMINATED SOILS AND SEDIMENTS, ON-SITE SOLVENT EXTRACTION TREATMENT OF METALS-CONTAMINATED SOILS AND SEDIMENTS, ON-SITE DISPOSAL, EXTRACTION AND ON-SITE TREATMENT OF CONTAMINATED GROUND WATER

Capital Cost:	\$ 5,155,532
Annual O&M Cost:	\$ 234,500
Total Present Worth:	\$ 8,760,382
Implementation Time:	30 years

All of the actions described under Alternative C would be implemented. In addition, ground water would be treated as described in Alternative B1. Deed restrictions would be required

until the cleanup standards have been achieved.

Alternative C2: EXCAVATION OF CONTAMINATED SOILS AND
SEDIMENTS, ON-SITE THERMAL DESORPTION
TREATMENT OF ORGANICS-CONTAMINATED SOILS AND
SEDIMENTS, ON-SITE SOLVENT EXTRACTION
TREATMENT OF METALS-CONTAMINATED SOILS AND
SEDIMENTS, ON-SITE DISPOSAL, IN SITU
TREATMENT OF GROUND WATER

Capital Cost: \$ 5,708,657
Annual O&M Cost: \$ 376,500
Total Present Worth: \$ 9,616,614
Implementation Time: 15 years

All of the actions described under Alternative C would be implemented. In addition, ground water would be treated as described in Alternative B2. Deed restrictions would be required until the cleanup standards have been achieved.

Alternative D: EXCAVATION OF CONTAMINATED SOILS AND
SEDIMENTS, ON-SITE THERMAL DESORPTION
TREATMENT OF CONTAMINATED SOILS AND
SEDIMENTS, OFF-SITE DISPOSAL

Capital Cost: \$ 3,233,075
Annual O&M Cost: \$ 63,500
Total Present Worth: \$ 3,892,183
Implementation Time: 1 year

Alternative D is similar to Alternative C except that no metals treatment would be provided on-site, and the excavated and treated soils and sediments would be disposed of off-site. The objective of the on-site treatment is to reduce the total mass of PCBs and other organic contaminants sent to the landfill for off-site disposal. Treated soil would be disposed of in an off-site RCRA Subtitle D-permitted landfill, unless found to exhibit hazardous characteristics. Soils found to exhibit hazardous characteristics would require treatment and disposal at a RCRA-permitted Subtitle C facility.

Deed restrictions would be placed on the contaminated property to prohibit future residential development and/or use of the contaminated ground water. Ground water monitoring would be continued to detect any impact to local residents from the migration of ground water contamination.

A periodic review pursuant to CERCLA § 121(c), 42 U.S.C. § 9621(c), would be required under this alternative.

Alternative D1: EXCAVATION OF CONTAMINATED SOILS AND
SEDIMENTS, ON-SITE THERMAL DESORPTION
TREATMENT OF CONTAMINATED SOILS AND
SEDIMENTS, OFF-SITE DISPOSAL, EXTRACTION AND
ON-SITE TREATMENT OF CONTAMINATED GROUND
WATER

Capital Cost: \$ 4,155,775
Annual O&M Cost: \$ 376,500
Total Present Worth: \$ 8,063,732
Implementation Time: 15 years

All of the actions described under Alternative D would be implemented. In addition, ground water would be treated as described in Alternative B1. Deed restrictions would be required until the cleanup standards have been achieved.

Alternative D2: EXCAVATION OF CONTAMINATED SOILS AND
SEDIMENTS, ON-SITE THERMAL DESORPTION
TREATMENT OF CONTAMINATED SOILS AND
SEDIMENTS, OFF-SITE DISPOSAL, IN SITU
TREATMENT OF CONTAMINATED GROUND WATER

Capital Cost: \$ 4,033,000
Annual O&M Cost: \$ 376,500
Total Present Worth: \$ 8,063,732
Implementation Time: 15 years

All of the actions described under Alternative D would be implemented. In addition, ground water would be treated as described in Alternative B2. Deed restrictions would be required until the cleanup standards have been achieved.

Alternative E: EXCAVATION AND OFF-SITE DISPOSAL OF
CONTAMINATED SOILS AND SEDIMENTS

Capital Cost: \$ 524,157
Annual O&M Cost: \$ 63,500
Total Present Worth: \$ 1,183,265
Implementation Time: 1 year

Under Alternative E, contaminated soil and sediments above cleanup levels described in Table 12 would be excavated, treated if necessary, and disposed at an off-site landfill. Additional sampling would be performed during the Remedial Design to determine the exact extent of sediment excavation. Soils and sediments found to be RCRA nonhazardous could be disposed of in an off-site RCRA Subtitle D landfill. Soils and sediments found to be RCRA hazardous would require treatment and disposal at a RCRA-permitted Subtitle C facility. Solely for cost estimation purposes, 15% of the metals-contaminated soil is assumed to require disposal in a RCRA Subtitle C facility.

Soils found to contain PCBs above 50 mg/kg (expected to be a very small quantity) would be disposed of at a Toxic Substances Control Act (TSCA) landfill. Soils found to contain PCBs less than 50 mg/kg would be disposed of in accordance with Virginia Solid Waste Management Regulations (VSWMR) § 672-20-10, if disposed in Virginia. If soils are disposed in another state, they will be disposed in accordance with applicable state requirements.

Deed restrictions would be placed on the contaminated property to prohibit future use of the contaminated ground water. Ground water monitoring would be continued to detect any impact to local residents from the migration of ground water contamination.

A periodic review pursuant to CERCLA § 121(c), 42 U.S.C. § 9621(c), would be required under this alternative.

Alternative E1: EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SOILS AND SEDIMENTS, EXTRACTION AND ON-SITE TREATMENT OF CONTAMINATED GROUND WATER

Capital Cost:	\$ 2,341,432
Annual O&M Cost:	\$ 234,500
Total Present Worth:	\$ 5,946,282
Implementation Time:	30 years

All of the actions described under Alternative E would be implemented. In addition, ground water would be treated and monitored as described in Alternative B1. Deed restrictions would be required until the cleanup standards have been achieved.

Alternative E2: EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SOILS AND SEDIMENTS, IN SITU TREATMENT OF CONTAMINATED GROUND WATER

Capital Cost:	\$ 2,927,557
Annual O&M Cost:	\$ 376,500
Total Present Worth:	\$ 6,835,514
Implementation Time:	15 years

All of the actions described under Alternative E would be implemented. In addition, ground water would be treated as described in Alternative B2. Deed restrictions would be required until the cleanup standards have been achieved.

Alternative F: IN SITU TREATMENT OF CONTAMINATED SOILS WITH
STEAM STRIPPING AND SOLIDIFICATION,
EXCAVATION AND OFF-SITE DISPOSAL OF
CONTAMINATED SEDIMENTS

Capital Cost: \$ 4,011,757
Annual O&M Cost: \$ 63,500
Total Present Worth: \$ 4,670,865
Implementation Time: 1 year

This alternative treats soils via in situ techniques. In situ steam stripping would force steam into areas of organic contamination to volatilize the contaminants. The area being treated would be enclosed to capture the volatilized contaminants. In situ solidification would be used to immobilize metals found in contaminated soil. Large bore augers are used to penetrate and mix the soil. Solidification agents such as portland cement, silicates, or other proprietary additives are introduced through the auger to the soil.

Sediments, because they are located near the surface, are not good candidates for the in situ technologies identified for this Site's contaminants. Therefore, contaminated sediments would be excavated and disposed of off-site. Additional sampling would be performed during the Remedial Design to determine the exact extent of sediment excavation. For costing purposes, it is assumed that the excavated sediments do not exhibit RCRA hazardous wastes characteristics. Under these circumstances, treatment would not be required and the excavated sediments would be disposed of off-site in a RCRA Subtitle D-permitted landfill. Additional sampling of the sediments would be performed during the Remedial Design to determine the need for treatment.

Deed restrictions would be placed on the contaminated property to prohibit future use of the contaminated ground water. Ground water monitoring would be continued to detect any impact to local residents from the migration of ground water contamination.

A periodic review pursuant to CERCLA § 121(c), 42 U.S.C. § 9621(c), would be required under this alternative.

Alternative F1: **IN SITU TREATMENT OF CONTAMINATED SOILS WITH STEAM STRIPPING AND SOLIDIFICATION, EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SEDIMENTS, EXTRACTION AND ON-SITE TREATMENT OF CONTAMINATED GROUND WATER**

Capital Cost: \$ 4,632,007
Annual O&M Cost: \$ 234,500
Total Present Worth: \$ 8,236,857
Implementation Time: 30 years

All of the actions described under Alternative F would be implemented. In addition, ground water would be treated as described in Alternative B1. Deed restrictions would be required until the cleanup standards have been achieved.

Alternative F2: **IN SITU TREATMENT OF CONTAMINATED SOILS WITH STEAM STRIPPING AND SOLIDIFICATION, EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SEDIMENTS, IN SITU BIOLOGICAL TREATMENT OF GROUNDWATER WITH LIMITED ABOVE-GROUND TREATMENT**

Capital Cost: \$ 5,165,132
Annual O&M Cost: \$ 376,500
Total Present Worth: \$ 9,073,089
Implementation Time: 15 years

All of the actions described under Alternative F would be implemented. In addition, ground water would be treated as described in Alternative B2. Deed restrictions would be required until the cleanup standards have been achieved.

IX. COMPARISON OF ALTERNATIVES

The remedial action alternatives described above were evaluated using the following criteria, as required under the NCP, 40 C.F.R. 300.430(e)(9)(iii):

Threshold Criteria: Statutory requirements that each alternative must satisfy in order to be eligible for selection

1) Overall Protection of Human Health and the Environment.

Evaluation of the ability of each alternative to provide adequate protection of human health and the environment in the long and short-term; description of how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- 2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Evaluation of the ability of each alternative to attain applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws or provide grounds for invoking a waiver established under CERCLA.

Primary Balancing Criteria: Technical criteria upon which the detailed analysis is primarily based.

- 3) Long-Term Effectiveness and Permanence

Evaluation of expected residual risk and the ability of each alternative to maintain reliable protection of human health and the environment over time after cleanup requirements have been met.

- 4) Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of the degree to which an alternative employs treatment methods to reduce the toxicity, mobility, or volume of hazardous substances at the Site.

- 5) Short-Term Effectiveness

Evaluation of the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period.

- 6) Implementability

Evaluation of the technical and administrative feasibility of each alternative, including the availability of materials and services.

- 7) Cost

Section 121 of CERCLA, 42 U.S.C. § 9621, requires selection of a cost-effective remedy that protects human health and the environment and meets the other requirements of the statute. Alternatives are compared using present worth cost, which includes all capital costs and the operation and maintenance cost incurred over the life of the project. Capital costs include expenditures necessary to implement a remedial action (e.g., construction costs). All costs presented are estimates computed for comparison purposes only.

Modifying Criteria: Criteria considered throughout the development of the preferred remedial alternative and formally assessed after the public comment period, which may modify the preferred alternative.

8) State Acceptance

Assessment of technical and administrative issues and concerns that the State may have regarding each alternative.

9) Community Acceptance

Assessment of issues and concerns the public may have regarding each alternative based on a review of public comments received on the Administrative Record and the Proposed Plan.

A. Overall Protection of Human Health and the Environment

Alternatives that do not include remediation of the ground water contamination at the Site do not address potential human health risks posed by use of ground water. Alternatives A, B, C, D, E, and F, therefore, do not meet this threshold criteria for overall protection of human health and the environment and will not be considered further in this analysis.

Alternatives B1 and B2 reduce risks posed via Site soils, sediments, surface water, and ground water by capping the contaminated soils and sediments in the disposal area (contaminated sediments will be removed and consolidated into the disposal area prior to capping) and extracting and treating the ground water. Reduced risk will be achieved only if the cap is properly maintained and the extraction system continues to operate.

Alternatives C1, C2, D1, D2, E1, E2, F1, and F2 all effectively reduce risks posed by Site contaminants through treatment and/or disposal of soils and sediments and treatment of contaminated ground water. Alternatives C1 and C2 treat the soils and sediments to health-based cleanup levels (see Table 12). Alternatives D1 and D2 treat organic contaminants on-site, then dispose of the treated soils and sediment in an off-site landfill. Alternatives F1 and F2 treat soils on-site to health-based cleanup levels and dispose of sediments in an off-site landfill. Alternatives E1 and E2 dispose of soils and sediments in an off-site landfill.

B. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Materials (TBCs)

Under Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), and EPA guidance, remedial actions at Superfund sites must attain legally applicable or relevant and appropriate Federal and state environmental standards, requirements, criteria, and limitations (collectively referred to as ARARs). Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address hazardous substances found at the Site, the remedial action to be implemented at the Site, the location of the Site, or other circumstances at the Site. Relevant and appropriate requirements are those which, while not applicable to the Site, nevertheless address problems or situations sufficiently similar to those encountered at the Site that their use is well suited to that Site.

An overview of site-specific ARARs is presented below in Table 10.

1. CHEMICAL-SPECIFIC ARARs

Chemical-specific soil ARARs exist only for PCB contamination (see Table 10). The PCB ARAR would not be met with Alternatives B1 or B2. Alternatives C1, C2, D1, D2, E1, E2, F1, and F2 will meet the soil ARARs through soil excavation and/or treatment.

Chemical-specific ARARs for ground water exist as federal drinking water standards and state ground water quality standards. Alternatives B1, B2, C1, C2, D1, D2, E1, E2, F1, and F2 would meet the ground water ARARs through extraction and treatment or in situ treatment throughout the saprolite aquifer. Long extraction and treatment durations may be required before ARARs are achieved.

2. ACTION-SPECIFIC ARARs

Action-specific ARARs are applicable on an alternative-specific basis. All alternatives discharging treated ground water (Alternatives B1, C1, D1, E1, and F1) would meet the substantive state and federal discharge requirements. Alternatives reinjecting ground water as part of an in situ treatment program (Alternatives B2, C2, D2, E2, and F2) would meet the requirements of the VDEQ for ground water injection.

Alternatives B1 and B2 would meet action-specific ARARs for cap construction. Soil treated by thermal desorption under Alternatives C1, C2, D1, and D2 or by in situ steam stripping under Alternatives F1 and F2 would meet air emission criteria. If total PCB concentrations greater than 50 mg/kg are treated by

TABLE 10 Applicable or Relevant and Appropriate Requirements (ARARs) and Other Standards To Be Considered (TBC)		
Standards, Requirements, Criteria, or Limitations	Citation	Description
CHEMICAL-SPECIFIC ARARs and TBCs		
Safe Drinking Water Act Regulations	40 C.F.R. Part 141, Subpart F 40 C.F.R. Part 141, Subpart B	Establishes Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) that would be allowed to remain in ground water used for drinking water
Toxic Substances Control Act Regulations	40 C.F.R. §761, Subpart G	Establishes level for PCB cleanups and remediation requirements
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities	OSWER Directive No. 9355.4-12, July 1994	Establishes a process and factors to determine Site-specific lead cleanup levels that are protective of human health (TBC)
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive No. 9355.4-01, August 1990	Establishes level of PCB cleanup and remediation requirements (TBC)
The Potential for Biological Effects of Sediment-Desorbed Contaminants Tested in the National Status and Trends Program	NOAA Technical Memorandum NOS OMA52, March 1990	Established chemical-specific goals for sediment remediation (TBC)
ACTION-SPECIFIC ARARs and TBCs		
Resource Conservation and Recovery Act (RCRA) Regulations and Virginia Hazardous Waste Management Regulations (VHWMR)	40 C.F.R. Part 261 VHWMR Part III	Identification and listing of hazardous waste
	40 C.F.R. Part 262 VHWMR Part VI	Standards applicable to generators of hazardous waste
	40 C.F.R. Part 263 VHWMR Part VII	Standards applicable to transporters of hazardous waste
	40 C.F.R. Part 264 VHWMR Part X	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities
	40 C.F.R. Part 268 VHWMR Part XV	Land Disposal Restrictions

Virginia Solid Waste Management Regulations (VSWMR)	VR 672-20-10	Requirements for the identification, treatment, storage and disposal of solid wastes
Clean Water Act (CWA) Regulations	40 C.F.R. § 122.44	Ambient Water Quality Standards for protection of aquatic life in surface waters
Virginia State Water Control Board Regulations	VR 680-21-00	Surface and Ground Water Quality Standards for protection of surface and ground water resources
Virginia Pollution Discharge Elimination System Regulations	VR 680-14-00	Requirements for effluent discharge to surface waters
Virginia Pollution Abatement Permit Program Regulations	VR 680-14-00	Requirements for effluent discharge to land surfaces
Clean Air Act Regulations	40 C.F.R. Part 50	Establishes ambient air quality standards
	40 C.F.R. Part 50	Establishes air monitoring requirements
Virginia Water Protection Permit Regulations	VR 680-15-01	Requirements for dredging, filling and discharging to surface water (including wetlands)
Virginia Air Pollution Control and Abatement Regulations	VR 120-01	Establishes air emission standards
Virginia Erosion and Sediment Control Regulations	VR-625-02-00	Erosion control requirements for land-disturbing activities
Endangered Species Act; Virginia Endangered Species Act	16 U.S.C. 1531 <u>et seq.</u> Code of Virginia §§ 29.1 to 100 <u>et seq.</u>	Prevents taking of protected species and destruction of habitat; requires biological assessment to determine if threatened or endangered species are present
LOCATION-SPECIFIC ARARs and TBCs		
Chesapeake Bay Preservation Act Regulations	VR 173-02-01	Regulates land-disturbing activities in tidal and non-tidal wetlands in the Chesapeake Bay drainage area
Executive Order 11990 on Wetlands Protection; Virginia Wetlands Regulations	40 C.F.R. Part 6 (Appendix A) VR 450-01-0051	Regulates activities that impact wetlands; requires wetland protection and restoration

thermal desorption, the system would provide treatment equivalent to that required by a TSCA-permitted incinerator.

Alternatives D1, D2, E1, E2, F1, and F2 would meet action-specific ARARs for excavation, staging, transportation, and off-site disposal at a RCRA-permitted landfill.

3. LOCATION-SPECIFIC ARARs

Location-specific ARARs for the Site are limited to requirements to maintain the integrity of the wetlands surrounding the Site during remediation.

Alternatives B1, B2, C1, C2, D1, D2, E1, E2, F1, and F2 would impact wetlands to a similar degree, principally through excavation of contaminated sediments. Alternatives involving extraction, treatment, and discharge of ground water (Alternatives B1, C1, D1, E1, and F1) could potentially lower the water table beneath the wetlands and partially dehydrate them. This impact could potentially be minimized by discharging the treated ground water directly to the wetlands.

C. Long-Term Effectiveness and Permanence

Alternatives B1 and B2 rely on continued maintenance of the cap and the continued implementation of ground water treatment to provide long-term effectiveness. These alternatives are considered less effective over the long term than alternatives that remove contaminants from the Site through treatment or off-site disposal.

Alternatives C1, C2, D1, D2, E1, and E2 provide a significant level of long-term effectiveness through treatment of contaminated soils, sediments, and ground water. Alternatives F1 and F2 provide a similar level of long-term effectiveness through treatment of contaminated soils and ground water. Under Alternatives F1 and F2, sediments are also removed from the Site and disposed in an off-site landfill.

Alternatives E1 and E2 provide for long-term effectiveness by excavation and off-site disposal of contaminated soils and sediments in a RCRA-permitted landfill and through treatment of the ground water.

D. Reduction of Toxicity, Mobility, or Volume Through Treatment.

The cap component of Alternatives B1 and B2 do not involve treatment of soils and sediments and will not reduce the toxicity or volume of contamination in these media. The cap may, however, serve to reduce the mobility of soil and sediment contaminants by reducing erosion and downward percolation of water. The ground water treatment components of these alternatives will, however,

effectively reduce the toxicity, mobility, and volume of contaminants in ground water.

Alternatives C1 and C2 provide the highest reduction of toxicity, mobility, and volume through treatment. All media would be treated on-site to remove Site contaminants. Concentrated waste generated by the on-site treatment processes would then be taken off-site for further treatment and/or disposal.

Alternatives D1, D2, F1, and F2 also achieve significant reductions of toxicity, mobility, or volume through treatment. Under Alternatives D1 and D2, Site contaminants (with the exception of metals in soil) are removed from all media through treatment. Soils with metals contamination are disposed off-site (soils determined to be RCRA characteristic waste would be treated prior to disposal to meet Land Disposal Restrictions). Under Alternatives F1 and F2, Site contaminants are removed from soils and ground water. Sediments are disposed off-site. As with Alternatives C1 and C2, concentrated wastes generated by removing Site contaminants through on-site treatment processes would require further treatment and/or disposal off-site.

Alternatives E1 and E2 reduce the toxicity, mobility, and volume of Site contaminants via excavation of soils and sediments and ground water treatment.

E. Short-Term Effectiveness

Alternatives B1, B2, C1, C2, D1, D2, E1, E2, F1, and F2 would cause a temporary increase in the amount of dust produced, noise disturbance, and truck traffic. Alternatives D1, D2, E1, E2, F1, and F2 would produce greater amounts of truck traffic due to the increased use of off-site disposal. Alternatives C1, C2, D1, and D2 utilize on-site thermal desorption. Although this process produces an offgas, pollution control equipment would eliminate potential threats to nearby residents during operation. In situ steam stripping (Alternatives F1 and F2) also generates an offgas that would require treatment.

Alternatives B1 and B2 would require the least amount of time to implement. Alternatives E1 and E2 could be implemented faster than Alternatives C1, C2, D1, D2, F1, and F2, as no thermal desorption or in situ treatment would be carried out on-site. Groundwater treatment for Alternatives B1, B2, C1, C2, D1, D2, E1, E2, F1, and F2 would continue for many years, although the treatment duration for Alternatives B1 and B2 will likely be longer since the source of contamination will not be removed.

F. Implementability

The cap required in Alternatives B1 and B2 can be readily implemented. Most soil and groundwater treatment processes for Alternatives B1, B2, C1, C2, D1, D2, E1, E2, F1, and F2 could be readily implemented as well. As Alternatives F1 and F2 treat the soil *in situ*, it may be difficult to ensure that all contaminated soil is treated. The *in situ* groundwater treatment component of Alternatives B2, C2, D2, E2, and F2 may be difficult to implement if Site conditions prove unsuitable for promoting subsurface bacterial growth, or if other problems arise, such as difficulties in reinjecting treated water and/or providing sufficient oxygen to the groundwater plume. Treatability studies would be required during the remedial design to determine the implementability of the *in situ* ground water treatment component.

G. Cost Effectiveness

The costs of the alternatives increase from containment (B1 and B2), to primary off-site disposal (E1 and E2), to *in situ* treatment alternatives (F1 and F2), to the alternatives employing excavation and soil treatment (C1, C2, D1, and D2). *In situ* treatment is estimated to be slightly less costly than aboveground treatment. The low volatility of PCBs means that longer steam-stripping durations would be required. This increases the cost of this treatment and reduces the savings that can be realized through *in situ* treatment.

Table 11 is a summary of costs for all alternatives. The cost estimates presented here are much lower than those found in the Revised Proposed Remedial Action Plan because we are no longer considering the Site wastes to be listed RCRA wastes. Therefore, disposal costs are expected to be lower.

Table 11 - Cost Summary of Remedial Alternatives			
ALTERNATIVE	CAPITAL COST	PRESENT WORTH O & M	TOTAL COST
B1	\$886,423	\$3,604,850	\$4,491,273
B2	\$1,419,548	\$3,907,957	\$5,327,505
C1	\$5,155,532	\$3,604,850	\$8,760,382
C2	\$5,708,657	\$3,907,957	\$9,616,614
D1	\$3,729,275	\$3,604,850	\$7,334,125
D2	\$4,155,775	\$3,907,957	\$8,063,732
E1	\$2,341,432	\$3,604,850	\$5,946,282

E2	\$2,927,557	\$3,907,957	\$6,835,514
F1	\$4,632,007	\$3,604,850	\$8,236,857
F2	\$5,165,132	\$3,907,957	\$9,073,08

H. State Acceptance

VDEQ has had the opportunity to review and comment on all the documents in the Administrative Record and has participated in selecting the remedy for this Site. VDEQ has had the opportunity to comment on the draft ROD and, to the extent possible, the Commonwealth's comments have been incorporated into the ROD. The Commonwealth has not concurred with this ROD.

I. Community Acceptance

The community has been in general agreement with the alternative selected in this Record of Decision. Companies that are associated with the Site have, however, voiced opposition to some components of the chosen alternative. Oral and written comments on the remedial alternatives evaluated by EPA for implementation at the Site are included in Part III of this ROD.

X. SELECTED REMEDY AND PERFORMANCE STANDARDS

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives presented in the initial Proposed Remedial Action Plan and the Revised Proposed Plan using the nine criteria, and public comments, EPA has determined that Alternative E1 is the most appropriate remedy for the HH Burn Pit Superfund Site. The major components of the remedy and the required performance standards are listed below.

A. Soil/Sediment Excavation Performance Standards

1. All soils in the unsaturated zone above the water table that exceed the soil cleanup levels in Table 12 shall be excavated. To the extent practicable, excavation shall be performed when the water table is at the seasonally low elevation. The volume of soil to be excavated is estimated to be 5,400 yd³ based on existing information. The full extent of excavation shall be determined during the remedial design.
2. Sediments in the drainage system downgradient of the bermed disposal area, including but not limited to the intermittent stream and the Black Haw Branch, that exceed the sediment cleanup levels in Table 12 shall be excavated. The volume

Table 12 - Performance Standard Cleanup Levels		
Media	Hazardous Substance	Cleanup Level
SOIL:	PCBs	1 mg/kg
	Lead	400 mg/kg
SEDIMENT:	PCBs	1 mg/kg
	Copper	34 mg/kg
	Lead	200 mg/kg
	Zinc	150 mg/kg
GROUND WATER:	PCBs	0.02 ug/L ⁴
	Benzene	0.06 ug/L ⁵
	Bis(2-chloroethyl)ether	0.06 ug/L ⁶
	1,2-dichloroethane	0.01 ug/L ⁶
	1,1-dichloroethene	0.01 ug/L ⁶
	Vinyl chloride	0.03 ug/L ⁶
	2-butanone	4,693 ug/L

⁴ The lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point using Method 608, 40 C.F.R. Part 136, Appendix A.

⁵ The lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point using Method 503.1, Manual for the Certification of Laboratories Analyzing Drinking Water, September 1992, EPA-814B-92-002.

⁶ The lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point using Method 502.1, Manual for Certification of Laboratories Analyzing Drinking Water, September 1992, EPA-814B-92-002.

of sediment to be excavated is estimated to be 600 yd³ based on existing information. Additional sediment sampling and analysis shall be performed during the Remedial Design to determine the full extent of excavation.

3. A survey shall be performed to determine if any species protected by the Endangered Species Act (16 U.S.C. § 1531 et seq.) are present in the Black Haw Branch and other potentially affected waterways.
4. Excavation activities shall be conducted in manner that minimizes damage to the tributary ecosystem and surrounding wetlands. To the extent practicable, wildlife present in the areas to be excavated shall be moved to comparable natural areas prior to commencement of excavation activities. Any impacts to wetlands shall be mitigated.
5. Air monitoring for dust and Site contaminants shall be performed in accordance with 40 C.F.R. Part 50, to ensure any air emissions conform with the National Primary and Secondary Ambient Air Quality Standards. Fugitive dust emissions shall also be controlled in accordance with Virginia Air Pollution Control Board Regulations, VR § 120-01.
6. Erosion and sediment control measures shall be installed and maintained in accordance with the substantive requirements of the Virginia Erosion and Sediment Control Law, Code of Virginia §§ 10.1-560 et seq., the Virginia Erosion and Sediment Regulations, VR § 625-02-00. An erosion and sediment control plan shall be prepared and submitted to EPA for review.
7. All equipment used during excavation of contaminated soil shall be decontaminated before entering uncontaminated areas. The design and specifications for the decontamination facilities shall be approved by EPA as part of the remedial design. Any discharge of water generated from Site decontamination activities shall be in compliance with Virginia State Water Control Law, Code of Virginia §§ 62.1-44.2 et seq., and Virginia State Water Control Board Regulations (VR 680-21-00).
8. Excavated areas in the bermed disposal area shall be backfilled with clean fill and revegetated with native species.
9. Additional sampling and analysis of soil shall be performed prior to excavation to determine the full extent of contamination. Sampling and analysis shall also be performed after excavation has been completed to confirm that cleanup levels set forth in the performance standards

have been achieved. Methods for determining that the cleanup levels have been reached shall be finalized during remedial design and approved by EPA based on EPA 230/02-89-042, Methods for Evaluating the Attainment of Cleanup Standards, Vol I.

10. Excavated soil and sediment shall be temporarily staged on-site in accordance with 40 C.F.R. Part 264, Subpart L and VHWMR § 10.11, Waste Piles, if material can be staged in an area of existing contamination. If soil and sediment will be staged in a clean area, the waste material and soil shall be temporarily staged in containers in accordance with RCRA regulations contained in 40 C.F.R. Part 268, Subpart E; containers shall be in compliance with 40 C.F.R. Part 264, Subpart I and VHWMR § 10.8, Use and Management of Containers.

B. Soil/Sediment Treatment and Disposal Performance Standards

1. Excavated soil and sediments shall be tested to determine if the soil and/or sediments are hazardous, pursuant to 40 C.F.R. Part 261, Subpart C; contaminated soil and sediments that are not hazardous and do not exceed 50 mg/kg PCBs shall be disposed of off-site at a permitted RCRA Subtitle D landfill.
2. Soil and sediments that are hazardous, but do not exceed 50 mg/kg PCBs, shall be treated and disposed of off-site at a permitted RCRA Subtitle C facility.
3. Soil and sediments that exceed 50 mg/kg PCBs shall be disposed off-site in TSCA landfill in accordance with 40 C.F.R. § 761.60.
4. Transportation of hazardous waste from the Site shall be performed in accordance with VHWMR Part VII, Regulations applicable to Transporters of Hazardous Waste and RCRA requirements, set forth in 40 C.F.R. Parts 262 and 263, and 49 C.F.R. Parts 107 and 171-179.
5. Wastes shall be disposed of in accordance with the all applicable statutes and regulations including, but not limited to, regulations governing off-site disposal found at 40 C.F.R. § 300.440.

C. Ground Water Treatment System Performance Standards

1. Ground water that exceeds the ground water cleanup levels in Table 12 shall be extracted by a network of wells located to intercept contaminated ground water at the Site. If contaminants other than those listed for ground water in Table 12 are detected, the cumulative carcinogenic and

noncarcinogenic risks shall be calculated for all contaminants using the assumptions found in Appendix B. If the cumulative carcinogenic risk exceeds 10^{-4} or the cumulative noncarcinogenic hazard index is greater than one (1), ground water extraction shall be continued until acceptable cleanup levels are met (i.e., the cumulative carcinogenic risk is less than 10^{-4} or the noncarcinogenic hazard index is less than 1).

2. A network of ground water monitoring wells shall be established to verify the performance of the ground water treatment system. The wells shall be located and constructed in a manner that permits accurate characterization and monitoring of ground water throughout the contaminated area.
3. The monitoring wells shall be sampled quarterly during the first three years of operation of the ground water treatment system and semi-annually thereafter until the ground water cleanup requirements have been met throughout the contaminated area. When ground water cleanup criteria established in Section X.C.1. are achieved in samples collected for twelve consecutive quarters, operation of the ground water treatment system may cease. Semi-annual monitoring of the ground water shall continue for five years thereafter. If cleanup requirements are exceeded during monitoring performed after operation of the treatment system has ceased, operation shall be resumed until the above requirements are again met.
4. Ground water shall be treated in an on-site facility sufficient to achieve the criteria in Section X.C.5., below. Specifically, such ground water shall be treated to ensure removal of metals via precipitation and sedimentation, destruction of organic contaminants via UV oxidation, and carbon polishing as a final step.

An air sparging and soil vapor extraction system may be used to accelerate removal of contamination from the ground water and the saturated soils if a treatability study performed during the Remedial Design successfully demonstrates that:

- a. A sufficient quantity of air can be injected into the saturated soil and ground water to strip contaminants from the soil and/or water;
- b. Contaminants stripped from the saturated soil and ground water can be captured through the soil vapor and ground water extraction and treatment systems and will not be released to the ambient air; and

- c. Operation of the air sparging and soil vapor extraction system will not cause further migration of ground water contamination nor interfere with the other components of the selected remedy.

Air sparging and soil vapor extraction technologies were raised by several companies associated with the Site who wished to substitute these technologies for the ground water extraction system included in the Agency's preferred remedial alternative for the Site. While EPA recognizes that these technologies may accelerate the removal of certain contaminants in conjunction with the ground water extraction system, EPA is not requiring use of air sparging or soil vapor extraction as part of this remedial action.

5. Treated ground water shall be discharged to the drainage system downgradient of the bermed disposal area, or as provided in Section X.C.7. below. The discharge shall meet the effluent limits and flow rates established by the VDEQ Water Division in accordance with Virginia State Water Control Law, Code of Virginia §§ 62.1-44.2 et seq., and Virginia Pollution Discharge Elimination System Regulations (VR 680-14-00).
6. Chemical and biological monitoring shall be performed to evaluate the performance of the ground water treatment system and detect any impacts to the tributary, surrounding wetlands, and the nearest residences downgradient of the Site. The monitoring requirements shall be developed during the remedial design in accordance with Virginia State Water Control Law, Code of Virginia §§ 62.1-44.2 et seq., and Virginia Pollution Discharge Elimination System Regulations (VR 680-14-00) and shall be approved by EPA.
7. Operation of the extraction and treatment system shall not dehydrate the wetlands. In the event that any dehydration is observed, treated ground water may be diverted to the wetlands to minimize impact to the wetlands.
8. Sludges and other metal-containing waste generated by the ground water treatment process shall be tested using TCLP to determine if they exhibit characteristics of hazardous waste, pursuant to 40 C.F.R. Part 261, Subpart C; sludges that do not exhibit hazardous characteristics during testing shall be disposed of off-site at a permitted RCRA Subtitle D landfill; sludges that exhibit hazardous characteristics shall be treated and disposed of off-site at a permitted RCRA Subtitle C facility; sludges stored on-site prior to treatment and disposal shall be stored in compliance with the Virginia Hazardous Waste Management Regulations (VHWMR) § 10.8, Use and Management of Containers, or § 10.9, Tanks; transportation of sludges shall be in compliance with VHWMR

Part VII, Regulations Applicable to Transporters of Hazardous Waste and 49 C.F.R. Parts 107 and 171-179, regulating transportation of hazardous wastes. Carbon filters shall be disposed or regenerated offsite in accordance with applicable requirements and to ensure that Site contaminants are not transferred to other environmental media. Waste disposal shall comply with regulations found at 40 C.F.R. § 300.440.

9. Any air emissions from any onsite treatment system shall comply with Virginia Air Pollution Control Law, Code of Virginia §§ 10.1-1300 et. seq.; the Virginia Department of Air Pollution Control Regulations for the Control and Abatement of Air Pollution (VR 120-01-01); and the federal Clean Air Act, 42 U.S.C. § 7401 et seq.; and 40 C.F.R. Part 50.

XI. STATUTORY DETERMINATIONS

This remedy satisfies the remedy selection requirements of CERCLA and the NCP. The remedy is expected to be protective of human health and the environment, complies with ARARS, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. Because contaminated materials will be transported offsite for landfilling at permitted facilities, the remedy does not meet the statutory preference for treatment as a principal element of the remedy for soils and sediments. The following is a discussion of how the selected remedial action addresses these statutory requirements:

A. Overall Protection of Human Health and the Environment

The selected remedy will provide adequate protection of human health and the environment through the removal of soil and sediments contaminated with metals, PCBs, and organics and the extraction and treatment of metals- and organics-contaminated ground water. These actions will reduce the carcinogenic risk to within the acceptable EPA risk range of 10^{-4} to 10^{-6} and achieve a Hazard Index of less than one for non-carcinogenic risks.

There should be no unacceptable short-term risks or cross-media impacts posed by implementation of the selected remedial alternative.

B. Compliance with Applicable or Relevant and Appropriate Requirements (ARARS)

The selected remedy shall attain all action-, location-, and chemical-specific applicable or relevant and appropriate requirements for the Site.

C. Cost Effectiveness

EPA has determined that the selected remedy most effectively addresses all contaminated matrices while minimizing costs. The estimated present worth cost of the selected remedy is \$5,946,282. Other alternatives were either less expensive but less effective, or more expensive, but unable to offer a greater degree of protection.

D. Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner at the Site. The ground water treatment system will achieve a permanent reduction of Site risks associated with ground water because the UV oxidation process will destroy the organic contaminants. To address Site soils and sediments through alternative treatment technologies, several technologies would be required to address the various types of contamination present (i.e., metals, VOCs, semi-volatiles). Several alternatives were evaluated that treated soils and sediments; however, these technologies would not achieve greater overall remedial protection for the added costs.

E. Preference for Treatment as a Principal Element

The selected remedy utilized treatment as a principal element for ground water remediation. Site soils and sediments will be treated to the extent such action is necessary to meet RCRA Land Disposal Restrictions and requirements governing disposal of PCB-contaminated wastes. This methodology yields a more cost effective approach to the remediation of soils and sediments, since the combination of treatment technologies needed to address contamination in these matrices would not (as previously noted) achieve greater overall remedial protection for the added costs.

XII. DOCUMENTATION OF SIGNIFICANT CHANGES

Four significant changes from the Revised Proposed Remedial Action Plan appear in this Record of Decision. These changes relate to the extent of soils excavation, the required cleanup levels, the potential use of air sparging and soil vapor extraction, and the issue of RCRA listed hazardous wastes at the Site.

A. Soils Excavation

Alternative E1 in the Revised Proposed Remedial Action Plan required excavation of contaminated soils that exceeded cleanup levels. A limit on the depth of soils excavation was not stated. However, the volume of contaminated soil above the depth of six feet was used in estimating the cost of excavation for this alternative. The depth of six feet is the practical limit of excavation due to the presence of the water table. The Record of Decision clarifies the limit on the depth of excavation by explicitly stating that unsaturated soils above the water table that exceed the cleanup level shall be excavated.

B. Cleanup Levels

Table 2 of the Revised Proposed Remedial Action Plan presented proposed cleanup levels for ground water, soil, stream sediments, and surface water. Table 12 of the ROD establishes the final cleanup levels for ground water, soil, and sediments. Cleanup levels for surface water are not required since action to directly remediate surface water is not part of the selected remedy. Surface water quality is expected to attain acceptable levels following remediation of the contaminated sediments. The soil cleanup level did not change. Changes did occur, however, in the ground water and, to a lesser degree, the sediment cleanup levels.

The Revised Proposed Remedial Action Plan identified the Safe Drinking Water Act MCLs as the cleanup levels to be achieved for the contaminants posing carcinogenic risk. Further review of these levels indicates that the MCLs do not provide a sufficient level of protection. The cumulative carcinogenic risk associated with the MCLs for these contaminants exceeds 10^{-4} . When this occurs, Section 300.430(e)(2)(i)(D) of the NCP allows consideration of health-based criteria when determining cleanup levels to be attained. For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used, in accordance with Section 300.430(e)(2)(i)(A) of the NCP, as the point of departure for determining remediation requirements for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.

EPA calculated the ground water cleanup levels that would need to be attained for each of the seven contaminants to reduce the total carcinogenic risk to 10^{-6} for individuals exposed to ground water under the residential use scenario. These cleanup values were all below levels that can be reliably quantified using available analytical methods. Therefore, EPA has

established the minimum level for accurate analysis of contaminants as the cleanup levels in the ground water. These levels are presented in Table 12 of the ROD. EPA has calculated the total carcinogenic risk associated with these cleanup levels to be 5.1×10^{-5} . The selected remedy in the ROD requires extraction of ground water that exceeds the cleanup levels in Table 12. However, if contaminants other than those listed for ground water in Table 12 are detected, the selected remedy requires calculation of the cumulative carcinogenic and noncarcinogenic risks for all contaminants using the assumptions found in Appendix B. If the cumulative carcinogenic risk exceeds 10^{-4} or the cumulative noncarcinogenic hazard index is greater than one (1), ground water extraction shall be continued.

The Revised Proposed Remedial Action Plan did not include ground water cleanup levels for contaminants that pose unacceptable noncarcinogenic risk at the Site, such as 2-butanone. Cleanup levels for these contaminants have been included in Table 12.

The proposed sediment cleanup levels in the Revised Proposed Remedial Action Plan were based on human health risk for PCBs and the upper limit of the 90th percentile of the common range of values found in Eastern U.S. soils for lead, copper, and zinc. Upon further review, EPA has determined that the National Oceanic and Atmospheric Administration (NOAA) Screening Guidelines for Organics and Inorganics are more appropriate for protection of ecological receptors at this Site. The sediment cleanup levels in Table 12 of the ROD for copper and zinc are the NOAA Effects Range-Low (ER-L) values. These levels did not vary significantly from the cleanup levels in the Revised Proposed Remedial Action Plan. The copper cleanup level changed from 48.7 mg/kg to 34 mg/kg. The zinc cleanup level changed from 104 mg/kg to 150 mg/kg. The NOAA ER-L values for PCBs and lead are 23 ug/kg and 47 ug/kg, respectively. EPA has experienced difficulty achieving these levels in other sediment cleanups at Superfund sites in Region 3 and, therefore, has selected the levels found in Table 12 for these contaminants. In the case of PCBs, the sediment cleanup level does not change from the level presented in the Revised Proposed Remedial Action Plan (i.e., 1 mg/kg). The cleanup level for lead changes from 33 mg/kg to 200 mg/kg.

For sites involving lead contamination, EPA recommends, as a matter of policy (OSWER Directive #9355.4-12), that a soil cleanup level of 400 mg/kg be used as an average to be attained in residential areas. This cleanup level has been added to the soil cleanup levels in Table 12 of the ROD.

C. Air Sparging and Soil Vapor Extraction

During the public comment period, several commentors suggested the use of air sparging to address the VOCs in the

saturated soils and ground water. EPA did not evaluate this technology in the FS because air sparging would not address the PCB and inorganic contaminants present in the ground water. However, since most of the contaminants in the ground water are VOCs, air sparging could be effective in reducing the operation time for the ground water extraction and treatment system. Air sparging would have to be implemented in combination with soil vapor extraction and ground water extraction and treatment to avoid simply transferring contaminants from one media to another. There are several factors that would need to be investigated during a treatability study to determine if implementation of air sparging and soil vapor extraction would be possible. For example, the type of soils present at the Site would need to be evaluated to determine if adequate air flow can be achieved. The impact of the shallow water table on operation of the system would also need to be considered.

Because air sparging and soil vapor extraction, if implementable at the Site, could reduce the time required for operation of the ground water extraction and treatment system, EPA is allowing for potential use of these technologies at the Site. Section X.C.4. of the ROD identifies the circumstances under which these technologies may be implemented.

D. RCRA Listed Hazardous Waste Issues

The initial Revised Proposed Remedial Action Plan contemplated disposal of contaminated soils and sediments from the Site at a landfill regulated under Subtitle D of RCRA. In response to concerns raised during the comment period, EPA revisited the issue and proposed that Site wastes be considered "listed hazardous wastes" under RCRA and that, accordingly, such wastes be disposed of at a landfill regulated under Subtitle C of RCRA and after such waste were treated to the extent necessary to meet RCRA Land Ban Restrictions. The treatment requirements and disposal restrictions associated with management of RCRA listed hazardous wastes significantly increased EPA's cost estimate for several of the remedial alternatives detailed in the initial Proposed Plan. EPA accordingly issued a Revised Proposed Remedial Action Plan on December 22, 1994. The Revised Proposed Remedial Action Plan set forth the additional requirements and included revised costs estimates for those alternatives affected by the issue.

Following careful consideration of relevant comments submitted during the second comment period, of information relating to the source and generation of wastes found at the Site, and of the implications of this issue on protection of human health and the environment, EPA has decided to reverse its proposed view, set forth in the Revised Proposed Remedial Action Plan, that Site wastes be handled as RCRA listed hazardous wastes. Rather, Site wastes will be tested to determine whether

they warrant handling as RCRA characteristic hazardous waste pursuant to 40 C.F.R. Part 261, Subpart C, and shall be handled accordingly. The Responsiveness Summary found at Part III of this Record of Decision presents comments relating to this issue and the Agency's responses to such comments.

**RECORD OF DECISION
HH BURN PIT SUPERFUND SITE**

PART III - RESPONSIVENESS SUMMARY

Comments raised during the public comment periods on the Proposed Plan and the Revised Proposed Remedial Action Plan for the HH Burn Pit Site are summarized in this Responsiveness Summary. The first comment period was initially held from December 21, 1993 to January 19, 1994 to address the Proposed Plan. Upon request, the public comment period was extended until February 18, 1994. A second comment period to address the Revised Proposed Remedial Action Plan ran from December 23, 1994 through January 23, 1995. Upon request, this second comment period was extended through February 22, 1995.

Oral comments were presented at the Proposed Plan Public Meeting held on January 11, 1994. These comments and EPA's responses are presented in Section I of the Responsiveness Summary. A transcript of the first public meeting has been included in the Administrative Record for the Site.

EPA received three letters from concerned parties on the cleanup alternatives or other aspects of Site activity during the first public comment period. One letter was from a local resident concerned about the potential impact of site-related contamination on his residence. The other two letters were comments submitted jointly by several companies associated with the Site (Company Group). The comments presented in these letters and EPA's responses are presented in Section II of the Responsiveness Summary. These letters have been included in the Administrative Record for the Site.

The Company Group submitted additional comments after the close of the first public comment period. EPA has reviewed and responded to these comments in Section II of the Responsiveness Summary. This letter has also been included in the Administrative Record for the Site.

During the second comment period, EPA received several letters from the Company Group that contained comments pertaining particularly to the issue of listed wastes. These comments and EPA's responses are presented in Section III of the Responsiveness Summary.

I. ORAL COMMENTS FROM JANUARY 11, 1994 PUBLIC MEETING

- 1) A resident commented that given the age of this site, the contaminant plume is moving extremely slowly (only a couple of hundred feet in 15 years). Another resident commented

that we were treating the ground water as static, whereas the ground water flows.

Response: EPA has estimated the rate of ground water movement to be 20 feet per year in the overburden aquifer and 1,640 feet per year in the bedrock aquifer. Ground water movement, as a rule, does tend to be relatively slow, especially when compared with typical surface water flow.

- 2) A resident commented that a dug well averages about 40 feet with about 19 feet of water standing in them for domestic use and was concerned that we had not placed wells in ground water zones where the people in the area were using the water.

Response: EPA installed 16 wells at various depths in order to characterize the ground water at the Site. Eight wells were installed to collect ground water from depths of 8 - 24 feet. Four wells collected ground water at depths of 30 - 60 feet and four wells collected ground water at depths of 75 - 105 feet. With this network of wells, EPA was able to characterize both the overburden (shallow) and bedrock (deep) aquifers present at the Site and evaluate horizontal and vertical movement of contaminants. EPA also sampled residential wells directly to determine if contamination was present.

- 3) A resident commented that he had not read about a distribution of the contamination at 50 to 200 feet in the Proposed Plan.

Response: EPA responded that the main purpose of the Proposed Plan was to present a brief overview of the information. The Remedial Investigation Report, a copy of which is available at the Ashland Library, gives more specific and detailed information about the Site.

- 4) A resident expressed concern that EPA did not evaluate the condition of ground water further away from the Site. Another resident questioned whether there had been any extrapolation from the area of highest contamination to the wells further downgradient to determine how much further the plume might have extended and whether any modeling had been done to assess this situation.

Response: EPA explained that the goal of the remedial investigation was to find out if contamination is present and, if so, how far it has moved. To do this, EPA installed monitoring wells near the source of the contamination during the first phase of investigation since this would be the mostly likely area to find contamination in the ground water. Since contamination was found, additional wells were

installed during the second phase to estimate the outer boundary of the contamination plume. These wells were relatively free of contaminants; therefore, EPA determined that additional wells at greater distances from the Site were not necessary at the time. Figure 9 in the ROD illustrates the estimated extent of the ground water plume based on total VOC concentration. As indicated by the dashed line, the data was extrapolated to some extent to estimate the boundary of the plume.

Monitoring will continue at the Site during implementation of the remedy. If the contaminant plume appears to be migrating beyond the existing wells, EPA may determine that installation of additional wells is necessary.

- 5) Residents asked if there would be any more testing of the residential wells in the community, how often such testing would be done, and if any information obtained would be furnished to the owners of the property.

Response: The ROD requires continued monitoring of the nearest residential wells downgradient of the Site. The details of the monitoring plans will be developed during the design of the remedy. The results of any additional residential well sampling performed will be made available to the residents whose wells are sampled.

- 6) Several residents expressed concern that the contaminant plume has reached their wells because some contamination was detected.

Response: Twelve residential wells were sampled twice during the RI. Beryllium was detected in one well at a concentration of 5.8 ug/l, which exceeds the Safe Drinking Water Act Maximum Contaminant Level (MCL) of 4.0 ug/l. Trace levels of heptachlor epoxide and tetrachloroethene were detected in two additional wells; however, levels were below the MCLs. The well that contained heptachlor epoxide (RES-2) is located in an east-southeast direction from the Site and is hydraulically upgradient. Well construction information indicates that the well produces water from the overburden aquifer. These facts indicate that it is unlikely that this well is being impacted by the Site.

The well containing tetrachloroethene (RES-5) is located over a mile south-southwest of the Site on a hilltop on the opposite side of the Black Haw Branch. Shallow ground water most likely discharges to the Black Haw Branch from both sides of the stream. Available well construction information indicates that this home well is producing water from the overburden aquifer which suggests that the well is

isolated hydraulically from the Site.

Based on reported construction details, the well containing beryllium (RES-7) produces water from the bedrock aquifer. Beryllium was not detected in any of the on-site bedrock monitoring wells. Therefore, the Site does not appear to be a potential source of beryllium. The beryllium could be due to natural conditions, or from some other source.

- 7) A few residents expressed concern they had not received any information from EPA concerning the results of the residential well sampling.

Response: EPA did send letters to the residents whose wells had been sampled to report the findings. It appears that these residents did not receive their letters because the mailing addresses EPA had were incorrect. Correct addresses were obtained and another copy of the results were sent to the proper addresses.

- 8) Residents expressed concern that the value of their homes would be affected by the publicity of the Site. Residents questioned if the county takes these circumstances into consideration when it does a residential tax assessment and if residents would be required to tell prospective buyers of a house they are trying to sell that a hazardous waste site is present in the area.

Response: While EPA understands these issues to be of concern to the residents, the Superfund law does not specifically address these issues. Concerns about local taxes are best addressed at the local tax office. Local real estate agents should be aware of any disclosure requirements required by state laws or local regulations.

- 9) A resident expressed concern about the intermittent stream and whether the alternative chosen by EPA would address potential risks to someone drinking the water from the stream.

Response: The intermittent stream does contain Site-related contaminants, particularly PCBs that could pose a slight risk to people using the stream. However, contaminants in the stream pose a greater risk to wildlife that use the stream. The remedy selected by EPA for the Site will address the contaminated stream sediments.

- 10) A resident expressed concern about who will pay the cost of the chosen remedial alternative and if the property owner would be contributing to the costs.

Response: The Superfund law established several categories of persons who may be liable to perform or finance EPA's response actions. EPA has identified responsible parties and intends to contact them concerning implementation of the selected remedy. If these parties fail to implement the remedy, EPA will conduct the cleanup using federal funds and seek to recover the cleanup costs from these parties at a later date. EPA does not currently consider any of the residents as responsible parties.

- 11) A resident asked how the ground water would be treated and what kind of impact would this cleanup have on residents (e.g., noise, odor, etc.).

Response: Extraction wells with pumps would be used to extract the water from the wells and an on-site treatment unit would remove the contaminants from the water through several physical and chemical processes. EPA does not anticipate that nearby residents will experience any adverse effects from the ground water treatment operation. The most significant impact is likely to result from increased truck traffic involved in transporting contaminated soils and sediments from the Site for a period of time.

- 12) A resident expressed concern that 90 percent of his immediate family lives within 300 yards of the Site and has experienced a high incidence of cancer. He stated that over the last 14 years his family has lost four members from cancer and that another grandchild had cancer. He also mentioned that cases of cancer had been reported in the neighborhood across from him as well. The resident questioned whether the Site had any bearing on this incidence of cancer in the community.

Response: A health assessment was performed by the State in 1983, which determined at that point that the Site was not linked with an increased incidence of cancer in the area. EPA has contacted the Agency for Toxic Substances and Disease Registry (ATSDR) about this resident's concern. ATSDR has indicated that site conditions do not warrant further health assessment activities. Cancer incidence is often difficult to determine because there are so many factors involved in cancer risks including, among other things, family backgrounds, life style, and places of work. EPA provided a separate written response to this resident and suggested that concerned residents contact the State to inquire about follow up health assessments.

II. WRITTEN COMMENTS RECEIVED DURING THE FIRST PUBLIC COMMENT PERIOD

- 1) A resident expressed concern that his family was experiencing health problems and wanted to know if this could be due to Site ground water contamination even though he lived upgradient of the Site.

Response: EPA monitored the ground water upgradient of the Site and did not detect any contaminants present at unacceptable levels. It would be unlikely that the health problems experienced by this upgradient user are a result of contaminated ground water from the Site.

- 2) A group of companies associated with the Site (Company Group) commented that the nature and extent of contamination has not been fully defined for the ground water, sediment, and soil media at the Site.

Response: While EPA recognizes that the extent of contamination in the soils and ground water is not fully defined, EPA believes that the number and distribution of samples collected in the RI provide an adequate approximation of the extent of contamination in the different media in order to select an appropriate remedial alternative. It is common practice to collect additional information to further define the scope of cleanup actions during the Remedial Design (RD). The ROD indicates that additional investigation shall be performed during the RD to define the limits of excavation. Additional investigation may also be needed to properly locate the ground water extraction well network.

- 3) The Company Group stated that the nature and extent of contamination in surface soils has not been fully defined to the west of the berm. Limited contaminant distribution data exists between SS-9 and SS-11. As a result, the volume of soil to be excavated and associated costs could be significantly underestimated.

Response: The surface water runoff is the primary mechanism for transport of contaminants to the area west of the bermed disposal area. EPA collected one surface soil sample (SS-10) south of the intermittent stream draining the disposal area and ten sediment samples in and along the intermittent stream immediately west of the bermed disposal areas and along the first logging road west of the disposal area. EPA believes this data adequately characterizes the nature and extent of contamination in the area west of the bermed disposal area. Because surface water flow has been diverted from the intermittent stream by the first logging road, EPA is requiring additional investigation during the Remedial

Design to determine the limits of necessary excavation. Sediments containing Site-related contaminants are not expected to have migrated significant distances and are likely to be confined to a few depositional areas. In addition, contaminants in this area are expected to be confined primarily to a few inches in depth. While EPA agrees the volumes of soils and sediments could be higher than those estimated, EPA does not believe the change in volume would be of a magnitude that would cause the Agency to select another alternative.

- 4) The Company Group stated that the berm surrounding the former burn pits should also be sampled to evaluate whether or not it has been impacted by past Site activities. Should the berm soil contain constituents above the proposed cleanup levels, a significant increase in the volume of soils requiring remediation could be realized that has not been previously addressed.

Response: The berm surrounding the disposal area was reportedly constructed of native soil at the time the area was originally cleared prior to actual disposal. Therefore, EPA did not sample the berm soil during the RI. Soil in the berm will be sampled during implementation of the cleanup to determine the final disposition of these soils. While EPA agrees that the volume of soil to be addressed could increase if the berm soil is contaminated, EPA does not believe the change in volume would be of a magnitude that would cause the Agency to select another alternative.

- 5) The Company Group stated that, based on the laboratory analytical data from the soil borings, the vertical extent of residual contamination has not been adequately defined beneath the Site. This is evidenced by the elevated VOC and semi-volatile concentrations detected in the terminal sample collected from borings BH-8 and BH-9.

Response: The data collected from the soil borings indicated that VOC and semi-volatile contamination extends below the water table. VOC and semi-volatile contamination was also found in the ground water. This information was sufficient for EPA to effectively evaluate remedial alternatives. Further information on the vertical extent of VOC and semi-volatile contamination in the soil would be useful, but not necessary to evaluate appropriate remedial alternatives.

- 6) The Company Group contends that a detailed fracture trace analysis (FTA) is critical to the proper siting of monitoring well locations in a fractured bedrock system. The FTA conducted for the Site only used single aerial photographs in an attempt to interpret surface and

subsurface features. The Company Group believes this approach can be misleading when trying to interpret topographical features that exhibit a three-dimensional image when viewed stereoscopically.

Response: A fracture trace analysis was performed to help identify any potential lineaments with use of a single aerial photograph. Lineaments can be interpreted from one aerial photograph and use of a stereoscope with two aerial photographs would only aide the interpreter in visualizing three-dimensional topographic features. The interpreted lineaments must be confirmed in the field to verify that it is a potential fracture trace and not some man-made feature (such as power line, sewer line, or tilled earth). In addition, the bedrock monitoring wells installed during the second phase of the RI were located along the interpreted lineaments and appear to have successfully intersected water-bearing fractures in the shallow portion of the bedrock. With the installation of additional bedrock monitoring wells, another fracture trace analysis can be performed with the use of a stereoscopic analysis for a larger area surrounding the Site and to confirm the interpretations of the RI, if necessary.

- 7) The Company Group stated that there are currently no deep overburden or bedrock wells directly downgradient of the former burn pits in the area of MW-4 and in the area of MW-5. They contend that this is a significant data gap given the proposed remedial alternative of ground water extraction and treatment. They contend that further delineation of the nature and extent of contamination in this area is warranted during the RI/FS since the ground water concentrations used to assess the remedial alternatives may not be representative and knowledge of downgradient concentrations may affect the selection of ground water treatment technologies.

Response: EPA installed four deep overburden (saprolite) wells and four bedrock wells at the Site, as well as eight shallow wells to characterize ground water contamination. While a deep overburden or bedrock well was not located directly down gradient from MW-4 and MW-5, EPA believes the data from the existing monitoring well network characterizes the nature and extent of the ground water contamination in a manner sufficient to permit evaluation of ground water alternatives. Additional ground water investigation is typically necessary during the Remedial Design to properly design the ground water extraction well network.

- 8) The Company Group stated that, based on the well completion depths included in the RI, ground water quality in a 26 to 35 foot interval between auger refusal and competent bedrock

has not been adequately defined. This zone of highly weathered, densely fractured bedrock is generally referred to as the transition zone and can be the primary flow zone in piedmont aquifers (Powell and Abe, 1985). This transition zone should be addressed in order to adequately define the nature and extent of contamination.

Response: The Powell and Abe reference is a regional description of ground water availability in a typical Piedmont Physiographic geologic setting. This reference indicates that when the overburden is saturated for a significant thickness, as is the case at the Site, the overburden yields a significant amount of water for drinking water supply. At the Site, the overburden aquifer is approximately 60 - 70 feet in saturated thickness (Figure 4-3 and Appendix B of the RI).

Since the overburden, rather than the transition zone, appears to be the primary flow zone based on Site-specific information, shallow and deep overburden monitoring wells were installed during the RI. The criteria for installing deeper saprolite monitoring wells was that during drilling, if contamination was observed in the deeper portion of the overburden, then monitoring wells would be installed with the well intake across the area with the observed contamination. Residential wells which are most likely producing from the overburden aquifer were reported to be no greater in total depth than 50 feet below ground surface. Consequently, the deep overburden wells were installed to a total depth of 55 feet with the well intake interval at anywhere between 30 - 55 feet (See Table 3-6 in the RI).

As stated previously, additional ground water investigation is typically necessary during the Remedial Design to properly design the ground water extraction well network. Further characterization of the transition zone may be appropriate at that time.

- 9) The Company Group stated that no rock cores or samples were obtained to confirm or evaluate fracture locations, orientations, or other characteristics. The Company Group contends that the presence of fractures and water bearing zones were based on crude observations made by the driller and on-site geologist. Because fracture identification is essential in defining the contaminant distribution in a fractured bedrock aquifer system, coring, geophysical logs, and packer tests are an important element in evaluating the flow regime in a bedrock aquifer system. These techniques were not employed at the Site.

Response: The objective of the bedrock monitoring wells installed during Phase II of the RI was to monitor the water

quality of the shallowest water-bearing fracture(s) encountered during drilling. All the bedrock monitoring wells constructed during Phase II have relatively short well intake intervals (20 feet) and are constructed across zones which the driller and geologist identified during drilling. While coring rock, borehole geophysical logging, and packer tests would provide valuable data with respect to fracture distribution and yield of these fractures, identification of water-bearing zones and yield are normally performed by the driller and on-site geologist during the drilling process. It is common industry practice to rely on observations by both an experienced driller and geologist concerning borehole characteristics. EPA agrees that some of these techniques would be very useful in evaluating the extent of contamination in the bedrock aquifer and may be appropriate for inclusion in additional ground water investigation conducted during the Remedial Design.

- 10) The Company Group contends that when air rotary drilling is used in fractured bedrock systems, thin water bearing zones may not be discernible due to the air pressure in the borehole which sometimes exceeds the hydraulic pressure of the water-bearing zone. Additionally, they state that the combination and quality of dust in the air is sufficient enough to remove the small amount of moisture in a thin water-bearing zone. Therefore, these zones may have been masked during the drilling of the bedrock wells at Site.

Response: Air rotary is commonly used as a drilling technology at Superfund sites as well as by the environmental industry when drilling monitoring wells. While very low-yielding thin water-bearing zones may not be easily discernible while drilling with air rotary, the Phase II bedrock monitoring wells were constructed with the well intake open for 20 feet within the upper 30 feet of competent bedrock. The goal of the Phase II bedrock monitoring wells was to identify the shallowest significant water-bearing zone (greater than one gallon per minute) and screen the well across this zone based on driller and geologist observations. The drillers and on-site geologist did notice significant water-bearing zones within the top 30 feet of competent bedrock and, consequently, all Phase II monitoring wells were constructed in the upper portion of competent bedrock.

- 11) The Company Group contends that land use restrictions could be placed on this property which would provide for excavation restrictions and result in a less restrictive PCB clean-up goal for soils.

Response: EPA does not favor land use restrictions to limit future property use at this Site. Land use currently in the

vicinity of the Site is rural residential. The Hanover County Comprehensive Plan does not propose any changes in the vicinity of the Site that would attract more intense residential development (i.e., public sewer and water); nor does the plan advocate changes that would discourage continued construction of rural single-family homes (i.e., targeted future commercial or industrial use). Land use restrictions based on an incomplete cleanup would permanently reduce the options available for future use of the property. Such restrictions would additionally run counter to the statutory preference for reducing volume/toxicity of wastes through treatment. This result is consistent with newly issued guidance entitled "Land Use in the CERCLA Remedy Selection Process" [OSWER Directive No. 9355.7-04 (May 25, 1995)] .

- 12) The Company Group identified three errors in the calculations for the VOC cleanup goals presented in Tables 2-1 and 2-6 of the FS Report:
- a) Only ten of the 52 soil samples were analyzed for Total Organic Carbon (TOC). However, when calculating the mean percentage TOC, the values were totaled and divided by 52 rather than ten. Their correct mean TOC percentage is 0.0018 rather than 0.0004.
 - b) Incorrect units were reported for the K_{oc} and K_d values. The units should be in ml/g or L/kg rather than l/mg.
 - c) The K_d values presented are incorrect. There appears to have been errors made when converting the numbers to scientific notation.

Response: In response to this comment:

- a) The Company Group is correct in that the mean TOC (total organic carbon) of the ten subsurface soil sample results which were analyzed for TOC would be 0.0018 or 0.002. It appears, however, that K_{oc} was multiplied by 0.004 rather than 0.0004. Therefore, using the mean TOC concentration of 0.002 would lower the estimated contaminant concentration calculated for soil to be protective of ground water (as stated in Table 2-6 of the FS Report) by half of that listed.
- b) The correct units for K_{oc} and K_d would be L/kg. This error was evaluated and it is apparent that the use of the incorrect unit did not impact the estimated contaminant concentrations in soil for protection of ground water that are listed in Table 2-6 of the FS Report.

c) The Kd values are incorrect probably due to multiplying by a foc of 0.0004. In using the average TOC of 0.002 as the foc, the corrected Kd values would be half of the values depicted in Table 2-6 of the FS Report.

As noted, the values derived in these calculations would be lower than if the correct method had been used. However, since this modeling effort is not being utilized for the development of cleanup standards, the values are not relevant to the chosen alternative.

- 13) The Company Group contends that the approach used to establish VOC cleanup goals in soils is overly simplistic and resulted in extremely conservative soil cleanup goals. Relying on EPA's Pollution Technology Review, the Company Group states that the inorganic composition of deep aquifer materials can have a larger effect on sorption than the organic content which is typically low (<1%). When compared to the EPA Region 3 Risk-Based Concentration values for residential soil, the VOC cleanup goals presented in the FS for protection of ground water are, on average, three orders of magnitude lower. The Company Group recommends that site-specific data be generated to develop cleanup goals (i.e., column testing) or that, at a minimum, a more sophisticated model that includes dilution and attenuation factors be employed in calculating appropriate cleanup goals.

Response: The discrepancies have been noted and the estimated contaminant concentrations in soil in Table 2-6 of the RI Report would change to half of the originally estimated concentrations. EPA agrees that the method employed to estimate preliminary soil action levels protective of ground water is a conservative approach (i.e., predicts the lowest soil concentration allowable for ground water protection). However, this method of estimating soil clean-up levels has been used at several other Superfund sites (EPA/540/2-89/057, 1989) and is appropriate here as well. The estimated clean-up numbers protective of ground water are preliminary numbers for unsaturated soils which would normally be refined during the Remedial Design investigation. However, since the selected remedy does not require the use of soil cleanup goals for VOCs, this will not be necessary.

As a further note, it is not uncommon to establish soil clean-up levels protective of ground water for some contaminants which are several orders of magnitude lower than the risk-based concentration levels calculated for residential soils. The risk-based concentration for residential soil was not developed to be protective of ground water. On the whole, risk-based concentrations for drinking water are much lower for most chemicals than risk-

based concentrations for residential soils. For example, the risk based concentration for toluene in residential soils is 16,000 mg/kg (ppm) while for drinking water it is several orders of magnitude lower at 750 ug/l (ppb). In addition, VOCs are very mobile and have a tendency to move more rapidly through soil to the ground water. Consequently, estimated soil clean-up concentrations for protection of ground water derived from modeling for this group of compounds tends to be much lower than risk-based concentrations developed for residential soils.

- 14) The Ontario Ministry of Environment Sediment Quality Criteria was utilized to determine the PCB clean-up goal for sediments (0.041 mg/kg). The Company Group believes that this is inappropriate and that less restrictive standards could be calculated based on site-specific risk and an evaluation of PCB speciation. For instance, Aroclor 1248 has been assigned the same risk level as Aroclor 1260 when, in fact, it is less toxic.

Response: Upon further review, EPA has determined that the National Oceanic and Atmospheric Administration (NOAA) Screening Guidelines for Organics and Inorganics are more appropriate for protection of ecological receptors at this Site based on current information. The sediment cleanup levels in Table 12 of the ROD for copper and zinc are the NOAA Effects Range-Low (ER-L) values. The NOAA ER-L values for PCBs and lead are 23 ug/kg and 47 ug/kg, respectively. EPA has experienced difficulty achieving these levels in other sediment cleanups at Superfund sites in Region 3 and, therefore, has selected a PCB cleanup level of 1 mg/kg and a lead cleanup level of 200 mg/kg.

- 15) The Company Group stated that the surface water cleanup goal for Aroclor 1260 is below the analytical quantitation limit. Therefore, in actuality, the practical cleanup level would be the detection limit.

Response: EPA has not established cleanup levels for surface water in the ROD since the selected remedy does not require any direct remediation of surface water. Surface water is expected to achieve acceptable levels after contaminated sediments have been removed.

- 16) The Company Group states that the surface soil sample at SS-10 and the terminal soil samples from borings BH-8 and BH-9 exceed proposed cleanup standards, but volume estimates for excavation do not include these soils. They contend that the volume of material to be excavated and the associated costs could be significantly underestimated.

Response: The factor limiting depth of excavation will be

the water table, not the depth of contamination. Contaminants present in the saturated soil will be addressed through the ground water extraction and treatment process. The comment concerning volume of surface soil to be excavated was addressed previously in Comment #3 of this section.

- 17) The FS states that soils found to contain PCBs at concentrations below 50 mg/kg would be disposed of as a special waste by the Virginia Solid Waste Management Regulations and would be handled in accordance with VR 672-20-10, §8.7. In general, these regulations indicate that soils can be disposed of in a permitted sanitary or industrial (Subtitle D) landfill in Virginia if they pass TCLP, have total organic halogens (TOX) concentrations less than 100 mg/kg, have total petroleum hydrocarbon concentrations less than 1,500 mg/kg, and total BTEX concentration less than 10 mg/kg. The Company Group contends that it is unlikely that a landfill can be found that will accept the contaminated Site soils at the price used in the cost estimate.

Response: The disposal costs used in Alternative E1 were those available at the time the FS was developed. Costs may have increased since completion of the FS; however, for purposes of comparison, EPA believes the cost estimates provided are appropriate.

- 18) Stabilization was only considered in combination with steam stripping. The Company Group stated that stabilization/chemical fixation would seem to be better applied only to the upper soils (top 6 feet) and sediments where the constituents of concern are predominantly PCBs and metals. With this limitation, excavation and above ground fixation may be more appropriate than the in-situ technology. Other technologies could be used to address the deeper materials where the focus is predominantly VOCs.

Response: While the PCBs and metals may be the predominant contaminants in the upper soils, VOCs and semi-volatile organic compounds are present at levels that would require treatment if the soils were to remain on-site. Stabilization and chemical fixation alone would not be sufficient to address the upper soil.

- 19) The Company Group stated that air sparging was not identified and evaluated as a potential remedial technology to address the soils and shallow ground water impacted by VOCs.

Response: The commentor is correct that the Feasibility Study did not evaluate air sparging as a technology for

cleaning up soils and shallow ground water impacted by VOCs. However, while this may be an innovative technology to remediate VOC contamination, this technology could not address the PCBs, pesticides, and metals contamination which have been detected in soil and ground water at the Site. Since a large portion of the ground water contamination consists of very high concentrations of VOC contaminants, the selected remedy allows for use of (but does not require) an air sparging and soil vapor extraction system to enhance the overall performance of the ground water treatment system (See Section X.C.4. of the ROD).

Air sparging would have to be implemented in combination with soil vapor extraction and ground water extraction and treatment to avoid simply transferring contaminants from one media to another. A treatability study would have to be performed during the Remedial Design to determine if this technology would be effective. Several factors could impact the implementability of these technologies, including the type of soils present at the Site and the impact of the shallow water table on operation of the system. EPA will allow use of these technologies, however, if the treatability study demonstrates that they can be successfully implemented.

- 20) A treatment cost of \$300/CY for in-situ steam stripping of the soils plus an additional \$180/CY for in-situ stabilization seem excessive. Based on discussions with treatment vendors, the Company Group contends that treatment costs associated with this technology are generally in the \$200 to \$250/CY range.

Response: The treatment costs for in-situ steam stripping and in-situ stabilization were those available at the time the FS was developed. Costs may have decreased since completion of the FS; however, for purposes of comparison, EPA believes the cost estimates provided are adequate.

- 21) For low temperature thermal stripping (LTTS), EPA's contractor used a unit treatment cost of \$350/CY (approx. \$455/ton) to treat the soils for volatile and semi-volatile contaminants only. The Company Group contends that this seems excessive as treatment estimates of \$225 to \$260/ton to treat similar wastes for both volatiles and metals have been quoted in the past.

Response: The treatment costs for low temperature thermal stripping were those available at the time the FS was developed. Costs may have decreased since completion of the FS; however, for purposes of comparison, EPA believes the cost estimates provided are adequate.

- 22) The Company Group contends that the assumption of future residential use on the Site is unreasonable and that remedy selection for Superfund sites should be based on likely future use.

Response: EPA believes it is reasonable to consider residential development as a potential future use for the Site. The land use currently in the vicinity of the Site is rural residential. The Hanover County Comprehensive Plan does not propose any changes in the vicinity of the Site that would attract more intense residential development (i.e., public sewer and water); nor does the plan advocate changes that would discourage continued construction of rural single-family homes (i.e., targeted future commercial or industrial use). There are currently residential properties adjacent to the Site, including a newly constructed home along the Site access road. Several potential residents interested in building homes in the area indicated their concern regarding property value during the public meeting. This result is consistent with newly issued guidance entitled "Land Use in the CERCLA Remedy Selection Process" [OSWER Directive No 9355.7-04 (May 25, 1995)].

- 23) The Company Group contends that application of the linearized multistage model may not be appropriate for PCBs.

Response: While the Company Group is correct that the subject model is not appropriate in cases where the contaminant is not a genotoxic and is not an initiator, it should be noted that the mechanism of action by PCBs (and individual congeners of PCBs) has not been established. In the absence of adequate information to the contrary, the linearized multistage model continues to be applicable.

- 24) The Company Group contends that distinctions should be made in the tumorigenic potency of different Aroclors.

Response: As stated in the Integrated Risk Information System (IRIS): "Although it is known that PCB congeners vary greatly as to their potency in producing biological effects, for purposes of this carcinogenicity assessment Aroclor 1260 is intended to be representative of all PCB mixtures. There is some evidence that mixtures containing more highly chlorinated biphenyls are more potent inducers of hepatocellular carcinoma in rats than mixtures containing less chlorine by weight."

Hence, the Agency does note that there is some evidence that mixtures containing more highly chlorinated biphenyls are more potent. However, since slope factors are not currently available for individual congeners of PCBs (i.e., a slope factor is available for Aroclor 1260 only at this

time), it is conservatively assumed that all of the PCBs are at least as toxic as Aroclor 1260.

- 25) The Company Group contends that the scaling factor used by EPA to relate doses in animals and humans is inappropriate.

Response: It is agreed that the Agency currently recommends that the cross-species scaling factor for carcinogenic risk assessment be expressed in terms of body mass raised to the $3/4$ power (i.e., $\text{mg/kg}^{3/4}/\text{day}$). The recommended use of the $3/4$ power scaling factor was made in order to achieve consistency and uniformity among the different Federal Agencies (e.g., ATSDR, FDA, EPA, etc.). The consensus in the Agency and in the scientific community is that the use of a $3/4$ power scaling factor for body mass presents a better rationale for matching doses between sizes across species. The Agency has not yet finalized the policy to use the $3/4$ power as a scaling factor for body mass. In addition, the Agency is expected to continue to consider use of the $2/3$ power as valid and is not likely to require that all current toxicity criteria be recalculated using the $3/4$ power scaling factor for body mass. Furthermore, the difference in the resultant slope factor when a $2/3$ power or $3/4$ power is used as a scaling factor for body mass is only a factor of two which is generally not significant.

Since EPA believes that the previous policy was valid, and given all the uncertainty and the insignificance that a factor of two will make in the resultant slope factor, the Agency is not inclined to make a change in the scaling factor used to calculate the slope factor for PCBs.

- 26) The Company Group contends that the potency estimates for different aroclors should be based on the recent reevaluation of liver histopathology.

Response: The Agency's Office of Research and Development (ORD) is currently reviewing this data. It is not known when a final recommendation will be made.

- 27) The Company Group contends that, overall, the available data on PCB tumorigenicity indicate that alternative slope factors are scientifically warranted.

Response: As stated previously, the Agency recognizes that there may be differences in the carcinogenic potency of different PCB congeners. The new data currently available which was not previously used in the assessment of the slope factor is currently under review.

- 28) The Company Group contends that the use of an absorption factor of 0.06 for PCBs is overly conservative.

Response: It is clearly stated in the Dermal Exposure Assessment Guidance (1/92) that the 1.3% absorption factor (absorption factor recommended by the Company Group) is a value obtained for low organic carbon content soil. The total percent absorbed at 24 hours in vitro in human skin was 1.33%. This value was adjusted to reflect differences between absorption in vivo and in vitro in the rat, producing an estimate of 2.1% absorbed and bound to the skin after 24 hours for PCB applied in 6 mg soil/cm².

Note that absorption from high organic carbon content in soil was tested in vitro only in the rat. The Agency adjusted the estimated percent of PCB absorbed from low organic carbon content soil in human skin to reflect absorption from high organic carbon content soil. The estimated percent absorbed is 0.63%. The range of absorption is therefore between 2.1% for low organic content soil to 0.63% for high organic content soil. EPA decided "that any final recommendations for percent absorbed should span at least one order of magnitude to reflect the uncertainty." The final recommendation for percent PCB absorbed from soil is 0.6%-6%. Therefore, the use of 6% absorption for PCBs in the risk assessment is appropriate and consistent with Agency guidance. The use of 6% is likely a conservative estimate but also consistent with Agency policy to use conservative estimates in the risk assessment when limited data are available to make a more refined estimate.

- 29) The Company Group contends that the alternative analysis of the PCB surficial soil data is inappropriate.

Response: The use of the Phase I data in the risk assessment is appropriate given that this data represent surface soil sampling data which was not collected during the Phase II sampling round. The fact that the levels of PCBs are higher in the Phase I analyses indicate only that PCBs are present at higher levels in surface soil than in subsurface soil. Note that Phase II data include data from boreholes (0-2 ft, 2-4 ft, etc.), while Phase I data include data from surface soil (e.g., 0-15 cm or ~ 6 inches). Hence, the use of only Phase I data to determine risk from surface soil contact is appropriate.

- 30) The Company Group contends that the assumption of incidental ingestion (hand-to-mouth) exposure to chemicals in surface water is unreasonable and based on estimates of ingestion while swimming.

Response: It is agreed that this exposure route is probably not likely given that the highest water level of the stream

is not likely to be greater than one foot. However, at the time of the assessment, it was not clear how high the water levels would be, how much it would rain in the future, whether or not there were going to be significant time periods of dryness, etc. To be conservative, it was decided that it was necessary to include this exposure route in the assessment; albeit, we assume lower levels of water ingestion (e.g., 0.01 l/hr instead of 0.50 l/hr Agency default) to account for the fact that swimming was probably not a likely scenario.

- 31) The Company Group contends that incidental ingestion of contaminated sediments is an unreasonable exposure pathway and is improperly based on soil ingestion data.

Response: EPA believes that this exposure scenario is likely to occur, especially when the stream is dry. It is agreed, however, that the average soil ingestion parameters could probably be lower. At the time of this assessment, however, no other exposure parameters were available for use. Draft EPA guidance does currently recommend the use of 100 mg/day for a child and 50 mg/day for an adult as average soil ingestion exposure parameters. However, modification of the exposure parameters in the existing risk assessment will not result in a significant change in the risk estimate previously calculated.

- 32) The Company Group questioned the philosophy of the reasonable maximum exposure (RME).

Response: RME has been used at EPA since 1989. It is recognized that compounding a number of conservative values for exposure parameters in the baseline risk assessment can result in a characterization of potential exposure that cannot reasonably be expected to occur. However, that is precisely why the average (central tendency) risk estimate was calculated using central tendency exposure parameters available to us at the time of the assessment. The average risk estimate also indicates that the Site poses unacceptable carcinogenic and noncarcinogenic risks.

- 33) The Company Group contends that sample concentration distributions should have been prepared to support (or refute) the assumption of normally distributed data.

Response: In general, EPA prefers that the arithmetic mean be used in lieu of the geometric mean in cases where the sample size is small and not sufficient for determining the shape of the distribution present. This is the apparent case here. Note that the geometric mean is a biased estimator of the true mean if the distribution is not log normal. Given that the data sets were small and the data

from Phase I and Phase II were sampled independently and with different sampling designs, it was not possible to combine the two data sets. For example, while Phase I PCB sampling points were taken randomly across the Site within the bermed area, Phase II PCB sampling points were taken on a systematic grid pattern using bias sampling techniques (i.e., was not random) within the bermed area. Additional samples were taken in each burn pit area, primarily to investigate the vertical extent of contamination. In these cases, it is not appropriate to combine the data to achieve a greater sample number, especially for surface soil samples. The most conservative assumption in this case is to assume a normal distribution.

- 34) The Company Group stated that Phase I and Phase II data used to estimate exposure concentrations are not clearly shown.

Response: It is agreed that the Phase I and Phase II data used to calculate the concentration term are not clearly defined in the baseline risk assessment. Note that duplicate sample data points were averaged. In cases where the contaminant was detected in one sample but not detected in other samples, one-half the detection limit was used in the calculation of the concentration term. The Phase I and Phase II data used are as follows:

Phase I Surface Soil (0-6 inches): SS1A/1B, SS2A/2B, SS3A/3B, SS4A/4B, SS5A/5B, SS6A/6B

Phase I and Phase II Boreholes (0-2 feet):

Phase I	Phase II		
NE-1A	BH-1A	BH-8A	BH-17A
NE-2A	BH-2A	BH-9A	BH-18A
NE-3A	BH-3A	BH-10A	
W-4A	BH-4A	BH-11A	
W-5A	BH-5A	BH-14A	
W-6A	BH-6A	BH-15A	
MW-2A	BH-7A	BH-16A	

- 35) The Company Group stated that based on the discussion on page 8-5 of the RI, it was not possible to determine how the U-flagged data values were used.

Response: The statement on page 8-5 discussing the treatment of U-flagged values is incorrect. All contaminants that were detected at hazardous levels at the Site were assigned 1/2 the detection limit in cases where individual samples showed a non-detect level.

- 36) The Company Group questioned the use of cleanup levels that

are less than contract required quantitation limits.

Response: The cleanup levels for ground water have been established at the minimum level at which the entire analytical system gives a recognizable signal and acceptable calibration point. Cleanup levels for surface water have not been established since the selected remedy does not require direct remediation of surface water.

- 37) The Company Group contends that on-site leachate/runoff samples should not be considered representative of aquatic habitats.

Response: It is agreed that on-site leachate/runoff samples should not be considered representative of aquatic habitat. However, on-site leachate/runoff is a pathway of contaminant movement into the aquatic habitat. Moreover, on-site leachate/runoff, whether it is transported via a permanent stream, an intermittent stream, or merely an overland runoff drainage ditch, still represents a habitat where potential exposure to contaminants by ecological receptors (permanent or migratory) could occur. Therefore, EPA believes that on-site leachate/runoff samples are appropriate for use in evaluating ecological risk from Site-related contaminants.

- 38) The Company Group questions why the bioassay test results and aquatic and vegetation surveys were not used in the ecological assessment. They further contend that sediment remediation may not be necessary because the surveys conducted during Phase II suggest no significant risk to aquatic organisms offsite and that there is no true aquatic habitat on the Site.

Response: The ecological risk assessment performed for the Site used an approach similar to that used to quantitatively assess human health risks. Therefore, surface water and sediment chemical data, rather than bioassay results or aquatic and vegetation surveys, were the appropriate input parameters for calculating quantitative risk values. The purpose of the aquatic and vegetation surveys was to characterize the ecosystems and habitats of the area. It is incorrect to attempt to use such characterizations as a basis for calculating ecological risk. The bioassay test results and the aquatic and vegetation surveys were considered along with the quantitative risk values to evaluate the overall ecological impacts to the Site. The Company Group acknowledges this, in fact, in the next comment.

Even if there were no offsite aquatic impacts nor onsite aquatic habitat, this would not eliminate the need to remediate contaminated sediments. Contaminants have

migrated from the bermed disposal area to the intermittent tributary draining the area and downstream to the Black Haw Branch. Continued migration of contamination will continue to occur unless the contaminated sediments are remediated.

- 39) The Company Group contends that although the data presented in Tables 5-37 and 5-38 of the RI indicate toxicity at low dilutions of the samples collected, it is unreasonable to utilize this information in an ecological assessment because, as indicated in the previous comment, there is no suitable habitat for aquatic organisms on the Site.

Response: As indicated in the previous comment, EPA is concerned about potential impacts to downgradient receptors, not just impacts to receptors in currently contaminated areas. Therefore, EPA believes the toxicity data does have relevance to the overall ecological assessment.

- 40) The Company Group contends that the reference toxicant portion of the sediment bioassay was run for only 96 hours and thus does not truly show that the test system has been validated.

Response: The reference toxicant is an acute test used to verify the viability and response of a test organism population through time in the lab. The test concentrations should bracket the predicted LC50. In this case, the 96-hr LC50 was the desired outcome. The toxicity test for *Hyalella azteca* and *Chironomus tentans* are considered acceptable and valid if the per cent survival is greater than 80% and 70%, respectively, in the control chamber. The toxicity tests performed for the Site meets this criteria.

- 41) The Company Group contends that although toxicity was observed in the Phase II bioassay data, it is limited to samples very close to the bermed disposal area and suggests no potential risk to macroinvertebrates that may potentially occupy the ephemeral stream further west of the disposal area.

Response: Based on Page 10 (chapter 9 of the RI Report), only a macroinvertebrate survey of the ephemeral stream was conducted. The bioassay data was collected near the bermed area and cannot be compared to the locations in the ephemeral stream. Therefore, its results cannot be used to either dismiss or demonstrate toxicity at some other location. In addition, the area may not be acutely toxic, but there may be chronic effects which are not known at this time. In the absence of this actual bioassay data, we used the conservative approach and available chemical information. In doing so, reasonable worst-case assumptions were made to provide a conservative estimate. This

typically results in an assessment which overestimates rather than underestimates the risks of adverse ecological effects at the Site.

The RI Report risk assessment concluded that the bermed area of the Site is a source of environmental contamination in soil, sediment, and surface water on and near the Site, and that this contamination may present the potential for adverse toxicological effects to various taxa in the bermed area and in sediments downstream from that area.

A hazard index (HI) greater than one (1) would indicate the potential for chronic or acute toxicological effects to a given ecological receptor. The majority of HIs in each matrix and for all relevant contaminants of concern exceeded one (1), with numbers as high as 497 for arochlor in sediments.

- 42) The Company Group stated that the RI should have provided more information on the rationale for choosing the ecological exposure models and associated assumptions.

Response: Ecological receptors and potential exposure pathways were evaluated for inclusion in the ecological assessment (EA) on the basis of the Site contaminants, affected media identified, and the characteristics of receptors. The following exposure pathways were chosen for evaluation in the risk assessment:

- Aquatic biota in the unnamed ephemeral tributary and semi-aquatic species were chosen due to their potential exposure to elevated metal levels and PCB concentrations in the sediment and surface water.
- Plants growing on top of and along the edge of the Site were chosen due to the observation of stressed vegetation in some areas. This exposure pathway was incorporated into the secondary consumer pathway.
- Secondary consumers, especially small mammals using the Site, were chosen due to their potential exposure to elevated levels of metals, PCBs, and phthalates in the soil.
- Migratory birds using the Site were chosen due to their potential exposure to elevated levels of PCBs and metals contaminants in the soil and sediment.

Receptors and exposure pathways excluded from evaluation in

the EA were upland tertiary consumers and top carnivores due to the size of the Site relative to the necessary home range for these species. The potential for significant exposure of these groups to Site contaminants is considered minimal.

Copper, lead, and zinc were found at elevated concentrations in surface water samples collected up to the second logging road along the unnamed ephemeral tributary that drains the disposal area. Beyond the second logging road, only lead and zinc are present, though at concentrations substantially lower than the samples collected before the second logging road. Arochlor 1260 was detected in six of the 15 surface water samples collected from the unnamed ephemeral tributary prior to the second logging road. Therefore, the EA focused on copper, lead, zinc, and Arochlor 1260 in surface water.

In sediment, lead and copper were found in elevated concentrations along the unnamed ephemeral tributary immediately below the disposal area and downstream to the second logging road. Arsenic, aluminum, chromium, and zinc also were present at elevated concentrations along the same portion of the tributary. Of these six contaminants, lead and copper are present in substantially higher concentrations and are more widely distributed (i.e., they are present in elevated concentrations in more of the samples collected from the above-mentioned location). Therefore, even though all six metals are of concern, lead and copper received greater attention in the EA. Arochlor 1260 was detected in 14 of the 22 sediment samples collected in the unnamed ephemeral stream and was also addressed in the EA.

In soil, copper, lead, and zinc were found at concentrations above the upper limit of the 90th percentile of the common range found in Eastern United States soils. Aluminum, arsenic, and chromium were also found at elevated concentrations in all surface soils collected on the Site, and in one surface soil sample collected downgradient of the Site. While these inorganics are important, copper, lead, and zinc were the focus of the EA because of their toxicity and elevated concentrations compared to the other inorganics.

PCBs, especially Arochlor 1260 and 1248, were detected in soil at concentrations greater than the EPA Region 3 risk-based concentrations for residential soil. Bis (2-ethylhexyl) phthalate was detected in 12 of the 17 soil samples with a maximum concentration of 63,000 ug/Kg. Eleven of the 12 samples had concentrations significantly above background levels. PCBs and Bis (2-ethylhexyl) phthalate were the focus of the EA for organics in soil.

Based on potential exposure pathways and receptors, indicator species and assessment endpoints were selected. Ubiquitous indicator species were chosen based on their habitat requirements and the likelihood they would occur on the Site.

- 43) The Company Group contends that the RI is inconsistent in using the arithmetic mean to calculate contaminant concentrations in the human health assessment and the geometric mean in the ecological assessment. Rationale for their use in either case is not explained.

Response: EPA prefers that ecological and human health risk assessments be based upon the 95% Upper Confidence Limit (UCL) of the arithmetic mean rather than the geometric mean, since the arithmetic mean of the appropriate data set is generally more conservative. The potential for unacceptable ecological risk was identified for this Site even though the less conservative geometric mean was used in the ecological risk assessment.

- 44) The Company Group contends that the ecological assessment incorrectly assumes that incidental soil ingestion is 100 % of the diet and adds this amount to the estimate of total dietary intake. This effectively doubles the estimate of food consumed and more importantly would significantly overestimate risk.

Response: Although the approach used to estimate dietary exposure to Site contaminants is highly conservative, the overall conclusions of the ecological assessment are still valid. Several Site contaminants are highly elevated in Site soils and a risk to ecological receptors would be found even if a less conservative approach for estimating dietary exposure was used, such as assuming that the soil intake was only 10% of the intake of plant and animal material. (See response to Comment 46 in this section for Environmental Effects Quotients, which still show adverse effects to Site contaminants.)

- 45) The Company Group stated that the ecological assessment is incorrect in its assumption that meadow voles consume both plant and animal matter. Meadow voles are herbivores, as cited in the reference used in the assessment (Martin et. al. 1951).

Response: The diet for the meadow vole should have been 100% plant material. The fact that the vole diet used in the risk assessment was 50% plant material and 50% animal material (i.e., terrestrial invertebrates) generally results in a higher and thus more conservative estimate of exposure. This occurs because the contaminant levels in terrestrial

invertebrates were assumed to be the same as in soil, whereas contaminant levels in plants were calculated by multiplying the contaminant level in soil by a plant uptake factor that usually was less than 1.0. However, in the case of zinc, for example, the assumption of a diet of both plant and animal material results in lower exposure for the vole than a diet composed entirely of plant material, because the plant uptake factor for zinc is greater than 1.0 for plant stems and leaves. Although this assumption affected the estimated exposure of the vole to Site contaminants, the overall conclusions of the ecological assessment are valid (i.e., Site contaminants such as copper are highly elevated in Site soils and a risk to the vole would have been found with a diet composed entirely of plants). (Again, please refer to the Environmental Effects Quotients found in the response to Comment 46.)

- 46) The Company Group contends that it is inappropriate to compare an estimated dose value, as calculated for the green frog, with National Ambient Water Quality Criteria concentrations. These concentrations are reported in water and are reflective of "immersion"-type exposures, not ingested doses.

Response: Use of the extrapolation of frog ingestion to body contact (immersion) exposure is inappropriate in calculation of a hazard quotient for lead for the green frog; from an estimated intake in mg/kg/day and a toxicity endpoint in mg/L determined from an immersion study. These are two completely incomparable means of exposure. Consequently, it may not be possible to quantitatively evaluate potential risk of lead to the green frog, based on the predicted concentration of lead in its diet. However, a risk to the green frog is suggested because the average total lead concentration in surface water from the Site (57 ug/L) is considerably greater than the chronic USEPA Ambient Water Quality Criteria for lead (3.2 ug/L) (see Table 9-18 in Volume I of the RI Report).

III. COMMENTS RECEIVED DURING THE COMMENT PERIOD FOR THE REVISED PROPOSED REMEDIAL ACTION PLAN

EPA Region 3 received several documents and letters containing comments on the Revised Proposed Remedial Action Plan. The majority of the comments presented here were submitted by a group of companies associated with the Site ("Company Group"). The Company Group's comments primarily address components of the RI/FS Report and Revised Proposed Remedial Action Plan (with particular focus on the discussion of listed wastes at the Site). In addition, the Company Group presented a modified remedial alternative for EPA's consideration. Issues which have been addressed in the previous Responsiveness Summary Sections are not repeated here.

- 1) The Company Group asserted that EPA has not issued any revisions of the supporting technical documentation (i.e., the RI/FS) for public review and comment, therefore making an examination of the Revised Proposed Remedial Action Plan difficult. Additionally, the Company Group also stated that most of their comments on the original proposed plan were not considered.

Response: The Revised Remedial Action plan was issued based on the RI/FS and other documentation previously included in the Administrative Record. Upon further evaluation, EPA determined that the soil and sediment requiring cleanup contained a hazardous waste listed under RCRA. Therefore, off-site disposal of this material was revised in accordance with RCRA requirements for listed hazardous wastes. These changes were documented in the Revised Remedial Action Plan. (EPA reverted to its original position on this issue in the ROD.) The only other changes presented in the revised plan were changes in the proposed cleanup levels for the Site. Again, the basis for these changes were discussed in the Revised Proposed Remedial Action Plan. Further documentation of the cleanup level calculations was provided to the Company Group upon request. EPA's decision not to make other changes to the proposed alternatives did not constitute a rejection of comments made by the Company Group during the first comment period. Those comments have been fully considered and the ROD reflects many of the recommendations made by the Company Group.

- 2) The Company Group stated that no reassessment of the remedial alternatives was performed despite the significant changes in cleanup levels and costs.

Response: EPA fully evaluated the revised remedial alternatives in the Revised Remedial Action Plan in accordance with the requirements of Section 300.430(e)(9) of the NCP, 40 C.F.R § 300.430(e)(9).

The Company Group maintained that EPA's identification of three of the constituents of concern in the ground water (PCBs, beryllium, and manganese) is not supported. Below is a summary of their concerns on this issue as presented in the comments submitted in their February 22, 1995 document. These issues are also revisited and addressed later in discussion of risk assessment issues.

- 3) The Company Group expressed concern that EPA identified PCBs, beryllium, and manganese as contributors to ground water risk, because these constituents have a substantial impact (with respect to feasibility and cost) on the selection of remedy for the Site. This impact on the remedy is due to the fact that the presumption that PCBs (a semivolatile organic) and beryllium and manganese (inorganics) are in the ground water eliminates some ground water treatment technologies from consideration, and dictates the use of other technologies that may not be as effective, or necessary at all, in remediating ground water at the Site.

Response: EPA agrees that manganese and beryllium are probably naturally occurring substances in the area. However, the presence of elevated levels of manganese in some areas suggests that it may have leached due to the presence of chlorinated organics.

At the time the Feasibility Study was compiled, these three constituents were considered to be contaminants of concern in the selection of remedial alternatives for the Site. The Agency maintains that PCBs are still considered to be a possible ground water contaminant, despite the Company Group's assertions to the contrary. (See response to comment 5 of this section)

Treatability studies can be performed during the pre-design phase to identify whether air sparging and soil vapor extraction can be implemented along with the chosen ground water pump and treatment technology as an enhancement to the system. However, the hydrogeology in the area to be addressed, particularly the shallow water table and clay-rich soils, may limit the effectiveness of these technologies at the Site.

- 4) The Company Group suggests that the constituents of concern be limited to PCBs and metals in soils, and VOCs in ground water.

Response: The cleanup levels established in Table 12 of the ROD are consistent with the Company Group suggestion, with the exception of PCBs in ground water. The issue of inorganics in ground water is discussed in Comments 7, 12,

and 14 of this section.

- 5) Ground water samples were taken subsequent to the Remedial Investigation by the Company Group. The sample results indicated that PCBs were not actually present in filtered or unfiltered ground water samples. The Company Group concluded that the PCBs found by EPA may have been present due to well or sample contamination.

Response: There was low level detection of PCBs in ground water samples collected in some of the monitoring wells during the Remedial Investigation. The low level detection of Arochlor 1260 in MW-3D and MW-3B may be due to suspended soil particles that are contaminated by Arochlor 1260. However, high concentrations of solvents, such as toluene (2.5 mg/l) and 2-butanone (21.1 mg/l) that were found in MW-3D, suggest that the detection of Arochlor 1260 may have occurred because it was dissolved by, and moved downward along with, these solvents. Varying PCB detection results could also be attributable to seasonal fluctuation.

Based on the data collected in the RI, EPA has decided that it is premature to draw the conclusion that PCBs are not present in ground water. EPA recommends that additional sampling be performed during the remedial design phase of the project to further evaluate this issue.

- 6) The Company Group noted that since beryllium was found to occur at high concentrations both upgradient of the Site and in other wells in the area, the beryllium found at the Site is naturally occurring.

Response: The Agency agrees with this comment, and acknowledged this possibility in the FS and the original and Revised Proposed Remedial Action Plans. EPA Region 3 routinely calculates risk for all contaminants which are present at levels above risk-based concentrations and/or ARARs (e.g., MCLs), regardless of whether they are also found in background wells at the same level. EPA is not requiring cleanup of the beryllium present in the ground water because the Agency agrees it appears to be a natural occurrence. However, beryllium should still be considered when evaluating the cumulative risk posed by contaminants in the ground water at the Site.

- 7) Manganese was also felt by the Company Group to be a naturally occurring substance at the Site.

Response: EPA agrees that manganese occurs naturally in the ground water at the Site. However, isolated high levels of manganese are suspect and may have leached due to the high levels of solvents present in some areas. The levels of

manganese are expected to decrease concurrently with remediation of the chlorinated organics. It should be noted that manganese is not a hazardous substance under CERCLA and that manganese at the Site does not contribute significantly to the risks driving the cleanup.

- 8) It was requested that ground water in the area of the Site be classified as a Class III aquifer, and therefore not be considered as a potential source of drinking water, or be considered of limited beneficial use since it is contaminated with naturally occurring constituents. It was therefore further argued that such a determination would negate the need for any type of aquifer remediation.

Response: The aquifer at this Site could not be classified as a Class III aquifer as outlined in the EPA December 1986 Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy. In order to be classified as a Class III aquifer, any of the following conditions must be met:

- insufficient yield for an average sized family,
- ground water with a total dissolved solids (tds) concentration over 10,000 mg/l, or
- ground water that is "so contaminated by naturally occurring conditions, or by the effects of broad-scale human activity (i.e., unrelated to a specific activity), that they cannot be cleaned up using treatment methods reasonably employed in public water-supply systems."

None of the above conditions are present in the aquifer at the Site. That is, the aquifer at the Site does have sufficient yield for an average sized family (in fact many households surrounding the Site use home wells completed in the aquifer as their only source of water). While some inorganic constituents were detected and may appear to be naturally occurring (e.g., iron and, possibly, beryllium), these could be removed using treatment methods reasonably employed in public water supply systems. Consequently, the aquifer at the Site can not be classified as a Class III.

Since all residences immediately surrounding the Site use private wells as their only source of water, the aquifer at the Site would be classified, in accordance with EPA guidance entitled "Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy" [Office of Ground Water Protection Directive No. WH-550G (December 1986)], as Subclass IIA aquifers.

RCRA Listed Hazardous Waste Comments

- 9) The Company Group submitted several comments relating to EPA's decision, announced in the Revised Proposed Remedial Action Plan, to consider Site wastes as RCRA listed hazardous wastes. The Company Group contends that the evidence does not support such a conclusion, that the decision to treat the wastes as RCRA listed hazardous wastes would substantially increase the costs of the remedy while resulting in no corresponding increase in protectiveness, and that the decision runs counter to the Agency's goal of accelerating cleanups and streamlining the Superfund program. The Company Group further requested that the Agency identify the areal extent of contamination affected by RCRA listed hazardous wastes and the category of RCRA listed hazardous waste EPA believed to be present at the Site.

Response: Following the careful consideration of comments, information relating to the source and generation of wastes found at the Site, and of the implications of this issue on protection of human health and the environment, EPA has decided to reverse its proposed view that Site wastes be handled as RCRA listed hazardous wastes. Rather, Site wastes will be tested to determine whether they warrant handling as RCRA characteristic hazardous wastes pursuant to 40 C.F.R. Part 261, Subpart C, and shall be handled accordingly. The Agency notes that, while not directly relevant to the issue of whether Site wastes are properly considered RCRA listed hazardous wastes, the protectiveness of the remedy is not compromised by this decision.

- 10) The Company Group stated that the Agency should address the issue of a soil treatability variance for this Site, as referenced in the preamble to the NCP.

Response: A treatability variance can be granted by EPA only after a petitioner has demonstrated that wastes cannot be treated to meet the applicable treatment standards (40 C.F.R. § 268.44). Without such a demonstration, EPA cannot comment on a treatability variance for these wastes.

Comments on the Risk Assessment

- 11) The Company Group stated that exposure concentrations for many parameters appear to be significantly biased high by the incorrect use of values substituted for non-detects.

Response: EPA Region 3 acknowledges that there are some inconsistencies with respect to the use of one-half the Contract Required Quantitation Limit (CRQL) in the subject risk assessment with respect to the calculation of the

concentration term. A review of the methodology used in the risk assessment, to calculate the concentration term for vinyl chloride, for example, indicates that all samples with non-detected levels of vinyl chloride were assumed to have a contaminant level of zero. In fact, one-half the CRQL was not used. Therefore, the concentration term may have been underestimated in some instances. Even with this apparent underestimation of contaminant levels, there is substantial risk to warrant cleanup. Note that vinyl chloride was detected in monitoring well samples at levels up to 32.2 ppb (Table 5 of the RI Report). These levels exceed the risk-based concentration for vinyl chloride of 0.02 ppb, the Maximum Contaminant Level (MCL) of 2 ppb, and the CRQL of 10 ppb. Note that the RI Report does discuss the uncertainty in the use of the CRQLs and their risk levels. This information is noted in the Data Validation Section of the RI Report.

EPA also acknowledges that it is more appropriate to use the Sample Quantitation Limits (SQLs) than the CRQL in the calculation of the concentration term for the risk assessment. While SQLs do take into consideration dilution, matrix effects, etc., their use was not required at the time the Site was scoped several years ago. EPA disagrees with the Company Group's assumption that use of SQLs will result in a lower concentration term. In some instances, when there is substantial dilution and/or matrix effects, the SQLs are much higher than the CRQLs, especially if the Method Detection Limits used for analyses are high.

Review of Table 3-1 on page 13 of the Company Group's document (February 1994) illustrates that the contaminants that pose the most concern in ground water are above their respective Maximum Contaminant Levels (MCLs) and risk-based concentrations (RBCs). Therefore, such contaminants should be carried through as contaminants of concern (COCs). In addition, their risk level is probably biased low due to the use of zero for non-detects in calculating the concentration term.

While the EPA could consider a statistical approach for determining the concentration below the detection limit for non-detects, this approach is not necessary since the detected levels are much greater than the CRQLs. Also, the risk levels are above those calculated at the CRQLs.

Since the detected levels are so high, the arguments made for vinyl chloride and beryllium by the Company Group [such as the instance where they state that the minimum concentrations reported for vinyl chloride and beryllium are below the level assigned to non-detects, in which case it is estimated that this convention may lead to an overestimate

of exposure (and risk) by a factor of 5], are not valid.

Note that the uncertainty in the risk estimates is taken into consideration by presenting the average risk estimates for each exposure chemical for each exposure route of concern for all media. The risk summary tables in the Appendices to the RI Report indicate that the average risk level for ground water is still of concern for children. This is despite the elimination of beryllium and manganese as COCs. The risk is not due to the presence of high levels of "detectable" contamination at both the average and upper-bound concentration term estimates.

- 12) The Company Group stated that the documents reviewed indicate no scientific evaluation of background concentrations in the selection of contaminants of concern.

Response: EPA Region 3 has considered a scientific evaluation of background in the selection of COCs. The contaminant levels detected on-site for soil were compared to background levels for inorganics. In cases where the background levels were higher than the detected levels on-site, the contaminant was screened out. It was not considered a COC.

In the case of ground water, background levels of beryllium and manganese were considered. The EPA has eliminated beryllium and manganese from the risk assessment as COCs based on data which indicate that beryllium and manganese are naturally occurring. The isolated high levels of manganese are suspect and may have leached due to the high levels of solvents present in some areas.

Treatment of the ground water to remove beryllium or manganese is not required in the ROD. Levels of manganese and beryllium will be monitored during cleanup activities. The levels present will be considered in evaluating the overall performance of the ground water treatment system.

- 13) The Company Group stated that the analysis of uncertainty in the risk assessment is inadequate for policy and technical decisions; stating that the uncertainty analysis was qualitative and incomplete.

Response: EPA Region 3 did conduct quantitative analysis of the uncertainty. While this was not done using a Monte Carlo approach, it was done using a central tendency approach. The central tendency estimates the average risk at the Site using an average for the concentration term and average exposure parameters. All of the assumptions made and exposure parameters used are in the RI Report. The Phase I and Phase II data used were previously noted.

The Company Group asserted that several errors they noted in the RI/FS and EPA's Revised Proposed Remedial Action Plan have significant ramifications for risk results or policy decisions. A report was provided to EPA last year, by the Company Group, during the first public comment period on the original Proposed Remedial Action Plan (this report has been addressed by the Agency in the prior section). The Company Group submitted only selected issues which are summarized below.

- 14) The Company Group contends that EPA did not characterize regional background levels of inorganics in subsurface soils because the 90th percentile values for the eastern U.S., as reported by USGS, were used as a basis for comparison.

Response: Metals concentrations in soils naturally tend to be highly variable. Data for a small number of background soil samples at a site often do not adequately reflect the range of metals concentrations that could occur naturally. Therefore, EPA uses values reported by USGS to assist in evaluating background concentrations of metals at Superfund sites. By using the 90th percentile values, only 10% of the naturally occurring concentrations would be expected to exceed these values. Metals concentrations in Site soils that did not exceed these values were considered within background concentrations. A soil background sample (SS-7) and a sediment background sample (SED-16) were collected during the RI. The metals concentrations in both these samples were below the upper 90th percentile concentrations. EPA agrees that additional background sampling may have been useful at the Site. However, since metals contamination is not the basis for the cleanup actions selected in the ROD, further background sampling does not appear warranted.

- 15) EPA's Revised Proposed Remedial Action Plan states that beryllium has been associated with carcinogenicity while the RI states that cancer risk is not clearly associated with beryllium.

Response: According to IRIS (the Agency's Integrated Risk Information System), inhalation of high levels of beryllium is associated with lung cancer in laboratory animals. However, this issue is moot in as much as beryllium is not considered to be a site-related COC.

- 16) Page 8-12 of the RI/FS states that, because Site contamination was limited to the bermed area, it was the area evaluated for exposure. The Risk Assessment Guidance for Superfund (RAGS), Part B states on page 6-28 that, "in some cases, contamination may be unevenly distributed across a site, resulting in hot spots...exposure to the hot spot should be considered separately." Representative exposure characterization would identify the hot spot and calculate

exposure and risk with and without those data, not with those data alone.

Response: On-site hot spots were considered by performing separate risk analyses of the Phase I and the Phase I and Phase II (combined) data. The Phase I data include biased surface soil samples where hot spots were expected to occur. The Phase II data contained non-biased random surface and near-surface soil samples. The Phase I data were combined with the Phase II data in order to present a complete picture of the most reasonable risk at the Site for soil. However, the Phase I data were analyzed separately as well. In either case, the risk levels calculated were unacceptable, even when the central tendency estimate was considered.

- 17) EPA's Revised Proposed Remedial Action Plan and FS incorrectly list MCLs for beryllium and vinyl chloride as 1 ug/l, rather than 4 and 2 ug/l, respectively.

Response: EPA acknowledges this comment. These errors were considered in preparing the ROD.

- 18) The Company Group stated that risks attributable to the Site have been overestimated by the compounded effect of questionable methods and assumptions including:

- a. use of outdated PCB cancer slope factors,
- b. inclusion of beryllium and manganese as Site contaminants,
- c. improper calculation of exposure point concentrations, and
- d. use of unfiltered, turbid ground water samples.

Response: The Agency has already considered and/or taken into account points raised in items a through c. The issues presented in item b are valid and have been previously addressed in this section. With respect to item c, the Agency had mixed views with respect to the calculation of exposure point concentrations (see Comments 30 to 33 in Section II). The Agency does not agree with the conclusion of the Company Group with respect to item a (see Comment 25 in Section II) since it was pointed out that the difference in the resulting slope factor is increased by only a factor of two, which is generally not significant. With respect to item d, EPA does not routinely sample and analyze filtered organic samples. This is due to the fact that organics may be precipitated during preservation and lost in the filtrate, thereby biasing the concentration for organics

low.

- 19) The Company Group recalculated the human health risk associated with ground water for the Site by eliminating the risks associated with PCBs, beryllium, and manganese. The revised risk value was approximately 7.8×10^{-4} . The Company Group also recalculated the soil-related risk using an alternative cancer potency factor for PCBs, weighted for the relative occurrence of various Aroclors. The revised risk value was 2.8×10^{-4} . The Company Group concluded that the total baseline risk, from these few revisions, was approximately half that determined by EPA (1.1×10^{-4}).

The Company Group estimated a residual risk associated with EPA's proposed remedy of 7.4×10^{-4} . Therefore, the Company Group contends that EPA's remedy only achieves marginal risk reduction.

Response: EPA does not believe that PCBs, beryllium, and manganese should be eliminated from the overall risk calculation for ground water at the Site. EPA calculated the risk for future potential residents using ground water at the Site to be 1.1×10^{-3} for adults and 5.3×10^{-4} for children less than 6 years old. Likewise, EPA used current guidelines for evaluating the risk associated with PCBs in soil. EPA's risk calculations are 8.3×10^{-4} for adults and 6.0×10^{-4} for children less than 6 years old. EPA has also calculated the residual risk at the Site, after the remedy selected in the ROD is implemented, at 5.1×10^{-5} .

Even with the assumptions made by the Company Group, the risks associated with ground water and soil at the Site exceed 1×10^{-4} , which is the level established in the NCP (40 C.F.R. § 300.430(e)) for triggering action at Superfund sites. The remedy selected in the ROD reduces the Site risks to a level that is within the acceptable risk range (i.e., 1×10^{-4} to 1×10^{-6}) and is, therefore, considered to be effective in protecting human health and the environment.

Comments on the Feasibility Study

- 20) The Company Group stated that some on-site treatment technologies that would appear to have merit were not identified or were misapplied and, as a result, ruled out. The example cited was stabilization, which was only considered in combination with steam stripping. They felt that stabilization/chemical fixation would seem to be better applied only to the top six feet of soil in the former burn pit area and sediments along the intermittent stream where the constituents of concern are predominately PCBs and

metals. With this limitation, the Company Group felt excavation and above-ground fixation may be more appropriate than an in-situ technology. They also felt that other technologies (which they did not mention) could be used to address the deeper material where the focus is predominately VOCs. They also stated that air sparging was not identified to address the soils and shallow ground water impacted by VOCs.

The Company Group concluded by stating there is no indication in EPA's Revised Proposed Remedial Action Plan that these alternatives were considered, and no justification in the documents publicly available as to why they were omitted.

Response: With respect to the use of stabilization, the FS (on Page 2-41) ruled out the use of this treatment alternative where organics-contaminated soil is present. The Agency is confident that the selected alternative will effectively address the contamination at the Site in the most cost effective manner. However, as mentioned earlier, air sparging and soil vapor extraction can be considered if pre-design treatability testing shows them to be successful in addressing conditions on the Site.

The Company Group's Review of EPA's Revised Proposed Remedial Action Plan

- 21) The Company Group Stated that EPA misapplied and misinterpreted the TSCA PCB Spill Policy as an ARAR at the Site as a result of a statement they referenced from the FS, page 2-6, which states that the only chemical-specific ARAR identified for soil remediation identified at the Site is the TSCA requirement for the remediation of soils contaminated with PCBs.

In defense of their position, the Company Group referenced a December 6, 1994 Federal Register notice of a proposed revision to PCB regulations, and the Guidance on Remedial Actions for Superfund Sites with PCB Contamination (OSWER Directive 9355.4-01 (August 1990)), which both indicate that the TSCA policy is not an ARAR.

Response: The TSCA PCB Spill Cleanup Policy of 1987 requires stringent cleanup of PCBs to different levels depending upon spill location, the potential for exposure to residual PCBs, etc. in non-restricted access areas where there is greater potential for human exposure to spilled PCBs. Much less stringent requirements apply where there is little potential for human exposure.

Although the 1987 policy was intended to be applicable to "new" spills of PCBs, the policy has also been used in the cleanup of historic spills, particularly in the case of CERCLA remediations (as is the case at this Site).

Since 1990, the Superfund program has adopted an approach to cleanup of PCBs that relies heavily on the 1987 TSCA policy. Because the TSCA PCB Spill cleanup Policy is not a binding regulation, it is not an ARAR for Superfund response actions. However, as a codified policy reflecting substantial scientific and technical evaluation, it has been considered as important guidance in developing cleanup levels at Superfund sites.

According to the TSCA PCB Spill Policy at 40 C.F.R. § 761.120, it is recommended that, in the case of a future residential use scenario, PCB spills be cleaned up to less than 1 ppm on the surface to address threats posed by direct contact. Where soil with concentrations greater than 1 ppm is left in place in these cases, the depth of soil cover is determined by site specific conditions.

In August 1990, EPA issued several CERCLA guidance documents regarding remediation of PCBs at Superfund sites. Among other provisions, these guidance documents establish guidelines for the CERCLA Program to follow in setting preliminary remediation goals for PCBs for soil, ground water, and sediment contaminated with PCBs at Superfund Sites. (See "A Guide on Remedial Actions at Superfund Sites with PCB Contamination", OSWER Directive No. 9355.4-01 FS (August 1990) ["PCB Guide"].)

- 22) The Company Group stated that the proposed cleanup levels for metals and volatiles in ground water are instrument response levels, not quantification levels, and are not technologically feasible for compliance determination.

Response: The proposed cleanup levels for metals and volatiles in ground water are not instrument response levels (IRLs). They are minimum levels (MLs) of detection and are derived based on three times the method detection limit (MDL). The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The ML is three times the MDL. The MLs are more reliable than the MDLs and the IRLs, and are therefore, appropriate for compliance determination.

- 23) The Company Group stated that inclusion of manganese as a contaminant requiring strict cleanup standards is inconsistent with its status as an essential micronutrient.

Response: As previously stated above in comments 7, 12, and 14, manganese is considered to be a naturally occurring substance and has been eliminated as a COC and is also not considered to be a hazardous substance. The Company Group should refer to the IRIS database for further information regarding the toxicity of manganese. The Reference Dose (RfD) for manganese for drinking water of $5\text{E-}03$ mg/kg/day is based on human chronic ingestion data. There is one epidemiologic study of manganese in drinking water performed by Kondakis et al., 1989 (See IRIS database for reference) which describes toxicologic responses in humans consuming manganese dissolved in drinking water. A variety of symptoms were reported including weakness/fatigue, gait disturbances, tremors, and the lack of muscle tonicity.

- 24) The Company Group stated the FS and Revised Proposed Remedial Action Plan do not take into account the residual risks associated with contaminants remaining after implementation of the proposed remedy.

Response: The FS contains a qualitative assessment of the residual risks. A quantitative assessment is attached for the ground water exposure route. Residual cancer risks for ground water are estimated to be a total of $5.1\text{E-}05$. PCBs contribute the most to this residual risk. A total hazard index of 0.113 is calculated.

Residual risks for soil were limited to PCBs and lead. There are no toxicity criteria available for lead. The residual cancer risk for PCBs at a cleanup level of 1 ppm is $1\text{E-}05$. The total residual cancer risk for soil and ground water is estimated to be $6.1\text{E-}05$. The total hazard index is estimated to be 0.113.

- 25) The Company Group stated that short-term risks associated with various remedial alternatives, residual risk, and risk-based benefits of implementation time are not considered in this remedy selection.

Response: EPA qualitatively evaluated the short-term risks associated with all the alternatives in the RI/FS and both the original and revised Proposed Remedial Action Plans. EPA also conducted a quantitative evaluation of residual risk associated with the remedy selected in the ROD as discussed in the previous comment. The short-term risks associated with the ROD remedy can be readily controlled. A quantitative assessment of short-term risks can be performed as part of the Remedial Design after the detailed specifications of the control measures have been determined.

- 26) The Company Group stated that the Proposed Remedial Action Plan relies too heavily on the preference for the treatment

and is directly contrary to the intent of policy makers as expressed in the remedy selection proposal put forth by EPA in April 1994 during the reauthorization debate.

Response: The remedial alternative chosen for this Site consists of off-site disposal of contaminated soil and sediment in an approved landfill and requires little, if any, treatment to address soil contamination. Ground water will be treated to reduce the threat from contamination. This alternative most effectively addresses all contaminated matrices while minimizing costs. Other alternatives were either less expensive but less effective, or more expensive, but unable to offer a greater degree of protection than the chosen alternative.

In addition, the proposed bill was not enacted, and is therefore not relevant to this remedy selection.

- 27) The Company Group stated that EPA's preferred alternative involves extensive excavation and disposal of contaminated soils and sediments. They contend that the risks associated with the implementation of such large excavation activities are significant and have not been addressed.

Response: The ROD requires that air monitoring for dust and Site contaminants be performed during the excavation in accordance with Federal and state regulations to protect the health and safety of on-site workers and nearby residents. The ROD also requires that measures be taken to control fugitive emissions. Such measures can be readily implemented to prevent any unacceptable releases of Site contaminants.

- 28) The Company Group stated that it is highly unlikely that the proposed pump and treat technology will be capable of restoring the shallow ground water aquifer system to drinking standards due to the local background concentrations of inorganic compounds. The Company Group also asserts that localized treatment of beryllium and manganese in ground water will only cause a temporary reduction in the presence of these contaminants since they are naturally occurring.

Response: The filtered ground water sample at monitoring well MW-3 is slightly above the drinking water standard for beryllium. Currently, there is no standard for manganese. EPA agrees that the levels of beryllium and manganese are naturally occurring and the remedy selected in the ROD does not require extraction and treatment of inorganic compounds in the ground water.

- 29) The Company Group stated that EPA's remedy allows for institutional controls to be removed at the end of 30 years, which will cause an increase in the residential exposure risk to ground water.

Response: Thirty years was a projection of the time it would take to complete the action (clean-up the aquifer) in order to estimate the cost of the remedy. Institutional controls will not be removed until the remedial action is complete and the performance standards are met.

- 30) The Company Group claims that prevention of exposure equates to negation of risk, therefore removal of hot spots followed by installation of a cap, along with air sparging and institutional controls, would not only be sufficient to eliminate risk at the Site, but would be 20 times more protective of human health.

Response: EPA does not consider preventing exposure to be equivalent to cleaning up contamination as a method for eliminating human health and environmental risk at Superfund sites. By allowing contamination to remain at a site, the potential for future exposure also remains. Deed restrictions to prevent use of the property and a soil cover to prevent direct contact both require perpetual oversight and maintenance to ensure their effectiveness. In addition, it may be difficult and costly to implement an air sparging technology at the Site given the heterogeneous nature of the aquifer materials, the occurrence of a clay-rich (lower permeability) layer in the upper portion of the aquifer underlying the burn pits at this site, and the limited thickness of a vadose zone. EPA has determined that the selected remedy provides the best balance among the nine criteria set forth in the NCP and provides for effective long-term protection of human health and the environment. The ROD does provide the opportunity to evaluate (i.e., conduct a treatability study) and potentially implement the air sparging and soil vapor extraction technologies as part of the selected alternative.

- 31) The Company Group stated that the cleanup goals for ground water have been set well below any federal or state drinking water standard (i.e., ARARs) and are also below any available detection methods.

Response: The cleanup levels for ground water were set at the lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point using the methods specified in Table 12 of the ROD. These levels correspond to a total residual risk of $5.1E-05$. If the cleanup levels specified in ARARs (e.g., MCLs) were merely attained and not exceeded, the total residual risk would

have exceeded the acceptable risk range 1.0E-04 to 1.0E-06.

- 32) The Company Group stated that, not only will the ground water treatment system create a discharge to local surface waters that will be subject to applicable requirements, but that the ability to comply with such applicable requirements has not been demonstrated.

Response: The performance standards in the ROD require that treated ground water be discharged to the drainage system downgradient of the bermed disposal area, or be diverted to the wetlands to minimize impact to the wetlands. The discharge shall meet the effluent limits and flow rates established by the VDEQ Water Division in accordance with Virginia State Water Control Law, Code of Virginia §§ 62.1-44.2 et seq. and Virginia Pollution Discharge Elimination System Regulations (VR 680-14-00). EPA does not anticipate difficulty in achieving the effluent limits to be established by VDEQ.

- 33) The Company Group maintained that EPA's preferred alternative would generate much greater risks, relative to their proposed remedy, from ground water discharge and treatment emissions, heavy equipment, and truck traffic (which would transport contaminated soil to the nearest acceptable landfill).

Response: The risks inherent in the actual cleanup activities required for this Site can all be readily controlled by properly designing and implementing appropriate precautions. The component of the remedy that may pose the greatest potential for risk during implementation is the air sparging and soil vapor extraction proposed by the Company Group. However, EPA believes that even these technologies, if properly designed and implemented, can be used without adverse impact to human health or the environment.

The Company Group submitted a modified remediation alternative for EPA's consideration. Although EPA received this information after the close of the comment period, EPA reviewed it carefully. Listed below are the primary components of the modified alternative and EPA's responses.

- 34) The Company Group's alternative proposes institutional site controls, which would limit future use of the burn pit area to nonresidential uses consistent with the proposed commercial property cleanup level. These controls consist of access [deed] restrictions, which would prohibit residential use of the Site, and installation of a drinking

water well at the Site as well. This restricted area is proposed to cover all contaminated portions of the Site and a large buffer area.

Response: Institutional controls appear limited to restrictions on groundwater use and restrictive covenants. As noted earlier in comment #11 of Section II, EPA does not believe that reliance on institutional controls to restrict future use would be appropriate in this case. The land use currently in the vicinity of the Site is rural residential. The Hanover County Comprehensive Plan does not propose any changes in the vicinity of the Site that would attract more intense residential development (i.e., public sewer and water); nor does the plan advocate changes that would discourage continued construction of rural single-family homes (i.e., targeted future commercial or industrial use). There are currently residential properties adjacent to the Site, including a newly constructed home along the Site access road. Several potential residents interested in building homes in the area indicated their concern regarding property value during the public meeting. Land use restrictions based on an incomplete cleanup would permanently reduce the options available for future use of the property. Use of such restrictions would additionally run counter to the statutory preference for reducing volume/toxicity of hazardous substances through treatment.

- 35) The Company Group's modified alternative would require that hot spot soils and sediments in the unsaturated zone with concentrations exceeding [The Company Group's] Site cleanup goals for subsurface soils or sediments be excavated. Excavation would include contaminated areas within the bermed disposal area, as well as in the ephemeral stream. All soils within the unsaturated zone with concentrations in excess of EPA's proposed cleanup goal of 400 mg/Kg for lead would be removed. All soils in the unsaturated zone with PCB concentrations greater than 10 mg/Kg would be removed. All sediments with concentrations in excess of EPA's proposed cleanup goals for protection of ecological receptors (PCB's >1 mg/Kg, lead >200 mg/Kg, and copper >34 mg/Kg) would also be removed and then consolidated beneath a cap in the former burn pit area.

Based on existing analytical data, the Company Group estimates that approximately 2,850 in-place (bank) cubic yards of soil and 370 cubic yards of sediment require excavation and disposal. These soil volumes include the top six (6) feet of soils located in hot spots at the Site and all of the sediments identified as having lead concentrations greater than 400 mg/Kg and PCB concentrations above 10 mg/Kg.

Response: The selected remedy differs from that of the Company Group, with respect to soil excavation and disposal, particularly since it calls for excavation of PCBs down to 1 mg/Kg, and requires that all excavated soils be disposed of offsite. EPA has determined that PCB-contaminated soils should be cleaned up to a level of 1 mg/Kg down to a depth of six feet in order to be protective of human health. This reflects EPA's residential use assumption. The Company Group assumed an industrial use scenario for the Site. The Agency believes that application of the residential use assumption is appropriate in this instance and is consistent with newly issued guidance entitled "Land Use in the CERCLA Remedy Selection Process" [OSWER Directive No. 9355.7-04 (May 25, 1995)].

- 36) The Company Group proposes covering any surficial soils beyond the bermed former burn pit area that have contaminant concentrations in excess of the applicable Site cleanup goals. Sediments above acceptable levels will be used as backfill in the former bermed burn pit area. A soil cover (incorrectly referred to as a "cap" by the Company Group) would then be placed over the bermed area to provide a physical barrier to prevent physical contact with the underlying soil and to prevent transport of soil from the Site via stormwater runoff or wind erosion.

The Company Group cited two other Superfund sites in EPA Region 3, C&R Battery and L.A. Clarke, where this approach was used.

Response: The Company Group's proposal would allow contaminants to remain on-site above health-based cleanup levels. Although the soil cover would prevent direct contact and the potential spread of contamination via surface water runoff, future use of the Site would be inhibited and protectiveness would rely heavily on land use controls preventing excavation. EPA believes the selected remedy provides a substantially greater benefit to the community at a reasonable cost by removing the contamination and ultimately allowing for unlimited future use.

The examples cited by the Company Group are distinguishable from this Site. The cleanup at the C&R Battery Site required excavation, onsite stabilization, and offsite disposal of over 11,000 cubic yards of lead-contaminated soil. The only soils that were allowed to be covered were found on the adjacent property, an active commercial facility. The C&R Battery Site and the L.A. Clark Site are both located in historically industrial use areas. The L.A. Clark Site is bisected by a railroad, thereby making residential use all but impossible. Yet even at the L.A. Clark Site, the required cleanup involves treatment of the

contaminated soil prior to allowing the placement of one foot of clean fill.

EPA Alternative B, which examined capping soils and sediment, required additional sampling to determine the exact limits of excavation. The Company Group's proposal did not indicate that additional sampling would take place. Alternative B of the ROD stated that direct contact with contaminated soil and sediment would be eliminated by the installation of a RCRA Subtitle C multi-layer cap. The Company Group's alternative proposed a cap consisting of at least one foot of clean fill with a revegetated surface. This method would be less protective of environmental receptors than a RCRA Subtitle C cap because it would not prevent infiltration of surface water and continued migration of contaminants. Continued implementation of groundwater treatment would be required to provide long-term effectiveness. The most effective long-term alternative would remove Site contaminants through excavation and disposal of contaminants off-site.

Finally, there is no provision for sampling and analysis of soil either before or after excavation in the Company Group's alternative (to determine the full extent of contamination) and following excavation (to confirm that cleanup concentrations have been achieved).

- 37) The Company Group's alternative proposed treatment of ground water via air sparging/vapor extraction to remove volatiles.

Response: The selected remedy allows for the use of an air sparging and soil vapor extraction system to attempt to enhance the operation of the ground water treatment system if a treatability study performed during the Remedial Design demonstrates that these technologies can address Site-related contaminants in an effective manner. Air sparging would have to be implemented in combination with soil vapor extraction and ground water extraction and treatment to avoid simply transferring contaminants from one media to another or causing ground water contamination to further migrate. EPA does not believe that the use of air sparging can replace the need for ground water extraction and treatment. The Company Group's document states that air sparging is as effective as pump and treat in the remediation of dissolved contaminants. However, it may be difficult and costly to implement an air sparging technology at this Site given the heterogeneous nature of the aquifer underlying the burn pits at this Site and the limited thickness of a vadose zone.

The selected remedy accommodates these additional technologies to accelerate the removal of contamination from

the groundwater and saturated soils, which would reduce the need for long-term operation of the ground water treatment system. Additionally, the ROD clearly states that the use of these additional technologies cannot interfere with the implementation of other required components of the chosen remedy.

General Comments

- 38) The Company Group requested that comments distributed at a meeting held in the Region 3 Office on 2/15/95 be made part of the Administrative Record.

Response: These comments will be placed in the Administrative Record.

- 39) The Agency was asked to revisit comments on the risk assessment that were submitted in February 1994.

Response: These comments were thoroughly addressed by the Agency after the first comment period. These comments/responses can be found in Section II of the Responsiveness Summary.

- 40) It was stated that preference should be given to alternatives that can be implemented quickly, bring the Site to an acceptable permanent risk level with remedial work that is of the shortest possible duration, will not result in potentially hazardous discharges to the creek, and will limit truck traffic and the threat of possible spillage of contaminated materials on public highways.

Response: The alternative chosen by the Agency has been screened against the criteria set forth at 40 C.F.R. § 300.430(e)(9)(iii) (see Section IX of the ROD "Comparison of Alternatives"), which is used for all potential remedial actions examined at Superfund Sites. EPA has determined that, of the available options, the selected remedy embodies the best combination of actions to effectively protect human health and the environment.

APPENDIX A

Administrative Record Index

The index can be found in the beginning of Volume I of the
H & H Burn Pit Administrative Record File.

AR302679

APPENDIX B

Ground Water Cleanup Level Risk Calculations

Groundwater Cleanup Levels - H and H Burn Pits Superfund Site

Contaminant	Volatile	RfDI	RfDo	CPDI	CPDo	Cleanup Level (noncancer)	Cleanup Level (cancer)	MCL	Cleanup Level for Noncarcinogenic Effects**	Final Cleanup Level
Noncancer										
2-Butanone	y	2.67E-01	6.00E-01			477(636)			636.679	636.6766
Cancer										
Vinyl Chloride	y			3.00E-01	1.90E+00		0.0032	2		0.0032
Bis(2-chloroethyl)ether	y			1.10E+00	1.10E+00		0.0015			0.0015
Acrotox 1280					7.70E+00		0.0015	0.5		0.0015
Benzene	y	1.71E-03	1.71E-03	2.90E-02	2.90E-02	2.601	0.0607	5	3.466	0.0607
1,2-Dichloroethane	y	2.66E-03	2.66E-03	9.10E-02	9.10E-02	4.350	0.0194	5		0.0194
1,1-Dichloroethane	y	9.00E-03	9.00E-03	1.75E-01	9.00E-01	13.668	0.0073	7	16.250	0.0073
Total Risk							1.00E-06			

*Cleanup levels are in ug/l

**Final Cleanup Level based on Noncancer ingestion and/or inhalation risk for COCs posing both Noncancer and Cancer Risk

Note: Cancer Risk is based on an child-adult exposure with an age adjusted algorithm as in Roy Smith's RBC Table 7-11-94.

Note: Non-cancer risk is based on an algorithm for child exposure only as in Roy Smith's RBC Table 7-11-94 except for volatile where an adult combined inhalation/ingestion exposure scenario was assumed.

Note: All calculations for volatile contaminants are based on risk for ingestion and inhalation. Risk(s) from the dermal exposure route was not expected to be significant when compared with the risk from ingestion and inhalation. Therefore, this route was not included in the derivation of the cleanup level.

Note: Risk calculations for non-volatile contaminants are based on ingestion only

Note: Toxicity criteria were substituted with oral and/or inhalation toxicity criteria as in the RBC Table (refer to page 8)

Note: If the APAR for a contaminant is less than the risk-based cleanup level, the APAR is the cleanup level. The levels for some contaminants may already be at the cleanup level.

Note: The cleanup level for 2-butanone that is in parentheses was based on a hazard quotient of 1/3 of the total hazard index for contaminants contributing to non-cancer risk.

H&H Burn Pit Superfund Site
Reference doses and carcinogenic potency slope factors.
Groundwater -- Cleanup Levels

Contaminant	Oral RfD mg/kg/d	Inhaled RfD mg/kg/d	Oral Slope Factor kg•d/mg	Inhaled Slope Factor kg•d/mg
PCBs			7.70E+00	
Bis(2-chloroethyl)ether			1.10E+00	1.16E+00
1,1-DCE	9.00E-03		6.00E-01	1.75E-01
Vinyl Chloride			1.90E+00	3.00E-01
1,2-Dichloroethane		2.86E-03	9.10E-02	9.10E-02
Benzene		1.71E-03	2.90E-02	2.90E-02
2-Butonone	6.00E-01	2.86E-01		

H&H Burn Pit Superfund Site
Adult resident drinking water ingestion.

Concentration	mg/L	CW
Ingestion rate	L/d	2 IR
Exposure frequency	d/y	350 EF
Exposure duration	y	24 ED
Body weight	kg	70 BW
Averaging time carc.	d	25550 AT
Averaging time ncarc.	d	8760 AT

$$\text{Intake (mg/kg-day)} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Contaminant	ML* Conc. mg/L	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
PCBs	2.00E-04	1.88E-06	5.48E-06	1.45E-05	--
Bis(2-chloroethyl) ether	6.00E-05	5.64E-07	1.64E-06	6.20E-07	--
1,1-DCE	1.00E-05	9.39E-08	2.74E-07	5.64E-08	3.04E-05
Vinyl Chloride	3.00E-05	2.82E-07	8.22E-07	5.35E-07	--
1,2-Dichloroethane	1.00E-05	9.39E-08	2.74E-07	8.55E-09	--
Benzene	6.00E-05	5.64E-07	1.64E-06	1.63E-08	--
2-Butanone	6.40E-01	6.01E-03	1.75E-02	--	2.92E-02
Total				1.57E-05	2.93E-02

*ML - Minimum Level -- lowest level at which a contaminant can accurately be detected.

Note: The concentration for 2-butanone used in the calculation is 1/3 of the total hazard index for non-cancer effects that may be contributed by benzene, 2-butanone and 1,1-DCE.

H&H Burn Pit Superfund Site
Child resident drinking water ingestion.

Concentration	mg/L	CW
Ingestion rate	L/d	1 IR
Exposure frequency	d/y	350 EF
Exposure duration	y	6 ED
Body weight	kg	15 BW
Averaging time carc.	d	25550 AT
Averaging time ncarc.	d	2190 AT

$$\text{Intake (mg/kg-day)} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Contaminant	ML* Conc. mg/L	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
PCBs	2.00E-04	1.10E-06	1.28E-05	8.44E-06	--
Bis(2-chloroethyl)ether	6.00E-05	3.29E-07	3.84E-06	3.62E-07	--
1,1-DCE	1.00E-05	5.48E-08	6.39E-07	3.29E-08	7.10E-05
Vinyl Chloride	3.00E-05	1.64E-07	1.92E-06	3.12E-07	--
1,2-Dichloroethane	1.00E-05	5.48E-08	6.39E-07	4.99E-09	--
Benzene	6.00E-05	3.29E-07	3.84E-06	9.53E-09	--
2-Butanone	6.40E-01	3.51E-03	4.09E-02	--	6.82E-02
Total				9.16E-06	6.83E-02

*ML - Minimum Level -- lowest level at which a contaminant can accurately be detected.

Note: The concentration for 2-butanone used in the calculation is 1/3 of the total hazard index for non-cancer effects that may be contributed by benzene, 2-butanone and 1,1-DCE.

H&H Burn Pit Superfund Site
Adult resident showering exposure concentrations.

L-phase t.c. CO2	cm/h	20
G-phase t.c. H2O	cm/h	3000
Water visc. at 20C	cp	1.002
Water visc. at 45C	cp	0.568
Shower temp	K	318
Droplet diameter	mm	1
Drop time	s	2
Shower flow rate	L/min	20
Shower stall volume	m3	2.90E+00
Shower duration	min	1.20E+01
Air exchange rate	min-1	0.0166667 (RANGE: .5 TO 1.5 PER HOUR)

Contaminant	ML* Conc. mg/L	Mol. Wt. g/mol	Henry's Constant atm-m3/mol	K1 cm/h	Kg cm/h	Overall Trans. Coeff. KL cm/h	Temp-adj. Trans. Coeff. Kst cm/h	Conc. leaving H2O Cwd mg/L	VOC Gener. Rate S mg/m3-min	Air Conc. at Shower End mg/m3	Avg. Air Conc. in Shower mg/m3
PCBs	2.00E-04	3.28E+02	1.07E-03	7.33E+00	7.03E+02	5.94E+00	7.95E+00	4.86E-06	3.21E-04	3.48E-03	1.80E-03
Bis(2-chloroethyl) ether	6.00E-05	1.43E+02	1.31E-05	1.11E+01	1.06E+03	5.52E-01	7.39E-01	1.46E-08	1.01E-05	1.10E-04	5.66E-05
1,1-DCE	1.00E-05	9.70E+01	3.40E-02	1.35E+01	1.29E+03	1.34E+01	1.79E+01	4.50E-06	3.10E-05	3.37E-04	1.74E-04
Vinyl Chloride	3.00E-05	6.30E+01	8.19E-02	1.67E+01	1.80E+03	1.67E+01	2.23E+01	1.57E-06	1.06E-04	1.18E-03	6.10E-04
1,2-Dichloroethane	1.00E-05	9.90E+01	9.78E-04	1.33E+01	1.28E+03	1.05E+01	1.42E+01	3.78E-06	2.80E-05	2.83E-04	1.46E-04
Benzene	6.00E-05	7.80E+01	5.59E-03	1.50E+01	1.44E+03	1.44E+01	1.93E+01	2.64E-06	1.96E-04	2.13E-03	1.10E-03
2-Butanone	6.40E-01	7.20E+01	2.74E-05	1.56E+01	1.50E+03	1.54E+00	2.07E+00	4.29E-02	2.94E-01	3.20E+00	1.65E+00

na= not applicable

*ML= Minimum Level= lowest level at which a contaminant can accurately be detected.

Note: The concentration for 2-butanone used in the calculation is 1.6 of the total residue index for non-cancer effects that may be contributed by benzene, 2-butanone and 1,1-DCE.

H&H Burn Pit Superfund Site
Adult resident showering inhalation.

Concentration	mg/m3	CA
Inhalation rate	m3/min	0.0138889 IR
Exposure frequency	d/y	350 EF
Exposure duration	y	24 ED
Body weight	kg	70 BW
Averaging time carc.	d	25550 AT
Averaging time ncarc.	d	8760 AT
Shower duration	min/d	12 ET

$$\text{Intake (mg/kg-day)} = \frac{\text{CA} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Contaminant	ML* Conc. mg/m3	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
PCBs	1.80E-03	1.41E-06	4.12E-06 **	--	--
Bis(2-chloroethyl) ether	5.66E-05	4.43E-08	1.29E-07	5.14E-08	--
1,1-DCE	1.74E-04	1.36E-07	3.98E-07	2.39E-08	--
Vinyl Chloride	6.10E-04	4.78E-07	1.39E-06	1.43E-07	--
1,2-Dichloroethane	1.46E-04	1.15E-07	3.34E-07	1.04E-08	1.17E-04
Benzene	1.10E-03	8.62E-07	2.51E-06	2.50E-08	1.47E-03
2-Butanone	1.65E+00	1.29E-03	3.77E-03	--	1.32E-02
Total				2.54E-07	1.48E-02

na- not applicable

**an inhalation toxicity criteria is not available

H&H Burn Pit Superfund Site
Child resident drinking water dermal contact.

Concentration	mg/L	CW
Surface area	cm ²	7200 SA
Exposure frequency	d/y	350 EF
Exposure duration	y	6 ED
Body weight	kg	15 BW
Averaging time carc.	d	25550 AT
Averaging time ncarc.	d	2190 AT
Bath duration	h/d	0.33 ET
Conversion Factor	l/cm ³	1.00E-03 CF
Dermal Permeability Constant (chemical specific)	cm/hr	PC

Absorbed Dose (mg/kg-day) =

$$\frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Contaminant	ML* Conc. mg/L	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient	Dermal Permeab. Coeff.* cm/h
PCBs	2.00E-04	3.38E-06	3.95E-05	2.61E-05	--	1.30E+00 **
Bis(2-chloroethyl)ether	6.00E-05	1.64E-09	1.91E-08	1.80E-09	--	2.10E-03
1,1-DCE	1.00E-05	2.08E-09	2.43E-08	1.25E-09	2.70E-06	1.60E-02
Vinyl Chloride	3.00E-05	2.85E-09	3.33E-08	5.42E-09	--	7.30E-03
1,2-Dichloroethane	1.00E-05	6.90E-10	8.05E-09	6.28E-11	--	5.30E-03
Benzene	6.00E-05	7.81E-08	9.11E-07	2.27E-09	--	1.00E-01
2-Butanone	6.40E-01	4.17E-05	4.86E-04	--	8.10E-04	5.00E-03
Total				2.61E-05	8.13E-04	

*ML - Minimum Level -- lowest level at which a contaminant can accurately be detected.

Note: The concentration for 2-butanone used in the calculation is 1/3 of the total hazard index for non-cancer effects that may be contributed by benzene, 2-butanone and 1,1-DCE.

**Note: Kp value for PCB-chlorobiphenyl, 4- was used for PCBs.

All Kp values were obtained from the Dermal Guidance, 1/82

H & H Burn Pit Superfund Site
Groundwater Cleanup Levels*

	Cancer Risk	Hazard Index
Adult resident drinking water ingestion.	1.57E-05	2.93E-02
Child resident drinking water ingestion.	9.16E-06	6.83E-02
Adult resident showering inhalation.	2.54E-07	1.48E-02
Child resident drinking water dermal contact.	2.61E-05	8.13E-04
Total Risk	5.12E-05	1.13E-01

*Total Risk for Cleanup Levels based on the Minimum Level of Detection except for 2-butanone which is based on the Risk-Based Concentration.
The Minimum Level of Detection for 2-butanone is 1 ppb.

APPENDIX C

Glossary of Superfund Terms

GLOSSARY

of Superfund Terms

This glossary defines terms often used by the U.S. Environmental Protection Agency (EPA) staff when describing activities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly called Superfund), as amended in 1986. The definitions apply specifically to the Superfund program and may have other meanings when used in different circumstances. Underlined words included in various definitions are defined separately in the glossary.

Administrative Record: A file which is maintained and contains all information used by the lead agency to make its decision on the selection of a response action under CERCLA. This file is to be available for public review and a copy is to be established at or near the site, usually at one of the information repositories. Also, a duplicate file is held in a central location, such as a Regional or State office.

Air Stripping: A treatment system that removes, or "strips," volatile organic compounds from contaminated ground water or surface water by forcing an airstream through the water and causing the compounds to evaporate.

Aquifer: An underground rock formation composed of materials such as sand, soil, or gravel that can store and supply ground water to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

Carcinogen: A substance that causes cancer.

Carbon Adsorption: A treatment system where contaminants are removed from ground water or surface water when the water is forced through tanks containing activated carbon, a specially treated material that attracts the contaminants.

Cleanup: Actions taken to deal with a release or threatened release of hazardous substances that could affect public health and/or the environment. The term "cleanup" is often used broadly to describe various response actions or phases of remedial responses such as the remedial investigation/ feasibility study.

Comment Period: A time period during which the public can review and comment on various documents and EPA actions. For example, a comment period is provided when EPA proposes to add sites to the National Priorities List. Also, a minimum 3-week comment period is held to allow community members to review and comment on a draft RI/FS and proposed plan.

Community Relations (CR): EPA's program to inform and involve the public in the Superfund process and respond to community concerns.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The Acts created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either:

- o Pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work; or
- o Take legal action to force parties responsible for site contamination to clean up the site or pay back the Federal government for the cost of the cleanup.

Cost-Effective Alternative: The cleanup alternative selected for a site on the National Priorities List based on technical feasibility, permanence, reliability, and cost. The selected alternative does not require EPA to choose the least expensive alternative. It requires that if there are several cleanup alternatives available that deal effectively with the problems at a site, EPA must choose the remedy on the basis of permanence, reliability, and cost.

Emergency: Those releases or threats of releases requiring initiation of on-site activity within hours of the lead agency's determination that a removal action is appropriate.

Enforcement: EPA's efforts, through legal action if necessary, to force potentially responsible parties to perform or pay for a Superfund site cleanup.

Feasibility Study (FS): See Remedial Investigation/Feasibility Study.

Ground Water: Water found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. In aquifers ground water occurs in sufficient quantities that it can be used for drinking water, irrigation and other purposes.

Hazard Ranking System (HRS): A scoring system used to evaluate potential relative risks to public health and the environment from releases or threatened releases of hazardous substances. EPA and States use the HRS to calculate a site score, from 0 to 100, based on the actual or potential release of hazardous substances from a site through air, surface water, or ground water to affect people. This score is the primary factor used to decide if a hazardous waste site should be placed on the National Priorities List.

Hazardous Substance: Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

Hydrology: The science dealing with the properties, movement, and effects of water on the earth's surface, in the soil and rocks below, and in the atmosphere.

Incineration: Burning of certain types of solid, liquid, or gaseous materials under controlled conditions to destroy hazardous waste.

Information Repository: A file containing current information, technical reports, and reference documents regarding a Superfund site. The information repository is usually located in a public building that is convenient for local residents -- such as a public school, city hall, or library.

Leachate: A contaminated liquid resulting when water percolates, or trickles, through waste materials and collects components of those wastes. Leaching may occur at landfills and may result in hazardous substances entering soil, surface water, or ground water.

Monitoring Wells: Special wells drilled at specific locations on or off a hazardous waste site where ground water can be sampled at selected depths and studied to determine such things as the direction in which ground water flows and the types and amounts of contaminants present.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The Federal regulation that guides the Superfund program.

National Priorities List (NPL): EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response using money from the Trust Fund. The list is based primarily on the score a site receives on the Hazard Ranking System (HRS). EPA is required to update the NPL at least once a year.

Operation and Maintenance (O&M): Activities conducted at a site after a response action occurs, to ensure that the cleanup or containment system is functioning properly.

Parts Per Billion (ppb)/Parts per Million (ppm): Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm; 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition-size swimming pool, the water will contain about 1 ppb of TCE.

Potentially Responsible Party (PRP): An individual(s) or company(ies) (such as owners, operators, transporters, or generators) potentially responsible for, or contributing to, the contamination problems at a Superfund site. Whenever possible, EPA requires PRPs, through administrative and legal actions, to clean up hazardous waste sites they have contaminated.

Preliminary Assessment: The process of collecting and reviewing available information about a known or suspected hazardous waste site or release. EPA or States use this information to determine if the site requires further study. If further study is needed, a site inspection is undertaken.

Proposed Plan: A public participation requirement of SARA in which EPA summarizes for the public the preferred cleanup strategy, the rationale for the preference, reviews the alternatives presented in the detailed analysis of the remedial investigation/feasibility study, and presents any waivers to cleanup standards of §121(d)(4) may be proposed. This may be prepared either as a fact sheet or as a separate document. In either case, it must actively solicit public review and comment on all alternatives under Agency consideration.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at National Priorities List sites. The record of decision is based on information and technical analysis generated during the remedial investigation/feasibility study and consideration of public comments and community concerns.

Remedial Action (RA): The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a site on the National Priorities List.

Remedial Design (RD): An engineering phase that follows the record of decision when technical drawings and specifications are developed for the subsequent remedial action at a site on the National Priorities List.

Remedial Investigation/Feasibility Study: Investigative and analytical studies usually performed at the same time in an interactive, iterative process, and together referred to as the "RI/FS." They are intended to:

- o Gather the data necessary to determine the type and extent of contamination at a Superfund site;
- o Establish criteria for cleaning up the site;
- o Identify and screen cleanup alternatives for remedial action: and
- o Analyze in detail the technology and costs of the alternatives.

Remedial Project Manager (RPM): The EPA or State official responsible for overseeing remedial response activities.

Remedial Response: A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious, but does not pose an immediate threat to public health and/or the environment.

Resource Conservation and Recovery Act (RCRA): A Federal law that established a regulatory system to track hazardous substances from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent new, uncontrolled hazardous waste sites.

Response Action: A CERCLA-authorized action at a Superfund site involving either a short-term removal action or a long-term remedial response that may include, but is not limited to, the following activities:

- o Removing hazardous materials from a site to an EPA approved, licensed hazardous waste facility for treatment, containment, or destruction.
- o Containing the waste safely on-site to eliminate further problems.
- o Destroying or treating the waste on-site using incineration or other technologies.
- o Identifying and removing the source of ground water contamination and halting further movement of the contaminants.

Responsiveness Summary: A summary of oral and/or written public comments received by EPA during a comment period on key EPA documents, and EPA's responses to those comments. The responsiveness summary is a key part of the ROD, highlighting community concerns for EPA decision-makers.

Site Inspection (SI): A technical phase that follows a preliminary assessment designed to collect more extensive information on a hazardous waste site. The information is used to score the site with the Hazard Ranking System to determine whether response action is needed.

Superfund: The common name used for the Comprehensive Environmental Response, Compensation, and Liability Act, also referred to as the Trust Fund.

Superfund Amendments and Reauthorization Act (SARA): Modifications to CERCLA enacted on October 17, 1986.

Surface Water: Bodies of water that are above ground, such as rivers, lakes, and streams.

Volatile Organic Compound: An organic (carbon-containing) compound that evaporates (volatizes) readily at room temperature.