40280

RECORD OF DECISION

ARROWHEAD PLATING SUPERFUND SITE
MONTROSS, VIRGINIA

PREPARED BY
VIRGINIA DEPARTMENT OF WASTE MANAGEMENT
SEPTEMBER 1991

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DECLARATION

DECLARATION

I. SITE NAME AND LOCATION

Arrowhead Plating
Montross, Virginia

II. STATEMENT OF BASIS AND PURPOSE

This decision document presents the remedial action selected for the Arrowhead Plating Superfund Site (Site), located in Montross, Virginia, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision contained herein is based on information included in the Administrative Record for this Site. An index of documents for the Administrative Record for this Site is included in Appendix E.

Both the Commonwealth of Virginia Department of Waste Management (VDWM) and the Environmental Protection Agency (EPA) support the selected remedy.

III. ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the remedial action selected in this Record of Decision (ROD), present an imminent and substantial endangerment to public health, welfare, or the environment.

IV. DESCRIPTION OF THE SELECTED REMEDY

The selected remedial action addresses contaminated groundwater and contaminated soils that act as secondary sources of contamination. The major components of the selected remedy include:

- A groundwater extraction network to remove contaminated groundwater from the aquifer for treatment;

- Precipitation of inorganic contaminants from the extracted water;

- Treatment of organic contaminants in the extracted water by air stripping and carbon adsorption;

- Discharge of the treated water to Scates Branch, a small stream originating onsite and flowing into Weavers Millpond and Pierce Creek;

- Defining the extent of contamination in the soils and in-situ vapor extraction of volatile organics in the contaminated soils;

- Capture and treatment using carbon adsorption of offgas from treatment trains for soils and groundwater prior to discharge to the atmosphere;

- Implementation of an environmental monitoring plan to evaluate the effectiveness of the remedial action and to ensure the protection of environmental receptors in Scates Branch; and

- Implementation of appropriate institutional control measures prohibiting the use of contaminated groundwater to ensure protection of public health and the environment.

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. By treatment of contaminated groundwater and soils at the Site, the selected remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

During the implementation of the selected remedy, the contaminants in the groundwater could remain at concentrations above health-based levels. Consequently, a review will be conducted within five (5) years after the commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

____________________ 9/30/91

for Edwin B. Erickson — Date
Regional Administrator, Region III

VIRGINIA
DEPARTMENT OF WASTE MANAGEMENT

____________________ 9/30/91

William L. Woodfin, Jr. — Date
Director

PART II

DECISION SUMMARY

I. SITE NAME AND LOCATION

The Arrowhead Plating Site is located two miles southeast of the Town of Montross, Virginia. This town is located in Westmoreland County, which is a part of Virginia's Northern Neck region, situated between the Rappahannock and Potomac Rivers. The Site occupies approximately 30 acres of land on the east side of State Route 3 in Westmoreland County (Figure 1). The western portion of the Site consists of a one-story brick manufacturing building, a parking lot, and an 817-foot-deep well, which supplies drinking water to the workers. The eastern portion of the Site covers an area of five former sludge settling ponds and a treated wastewater pond. Currently, two sewage water treatment ponds are located near the eastern edge of the property. These ponds are used to treat sanitary wastewater generated by the facility. In addition, one chlorinated solvent tank and one acid tank are located along the northern edge of the facility; both are above-ground and empty. Figure 2 depicts the major features at this Site.

Bordering the Site is Chandler's Chevrolet dealership to the south, the Manning and Meinhardt Garage and Montross Hardwood to the north, agricultural land and woods to the east and agriculture land to the west. Approximately 47% of the land in Westmoreland County is used for agricultural purposes. The population of the Town of Montross is about 500, and the majority of the residents are located more than one mile west and north of the Site.

Groundwater is the only source of drinking water for the Site and the surrounding area. The shallow groundwater aquifer flows towards Scates Branch and the South Fork Scates Branch. Surface waters within a three-mile radius of the Site are used primarily for recreational purposes. No irrigation of agricultural land in the vicinity of the Site reportedly occurs.

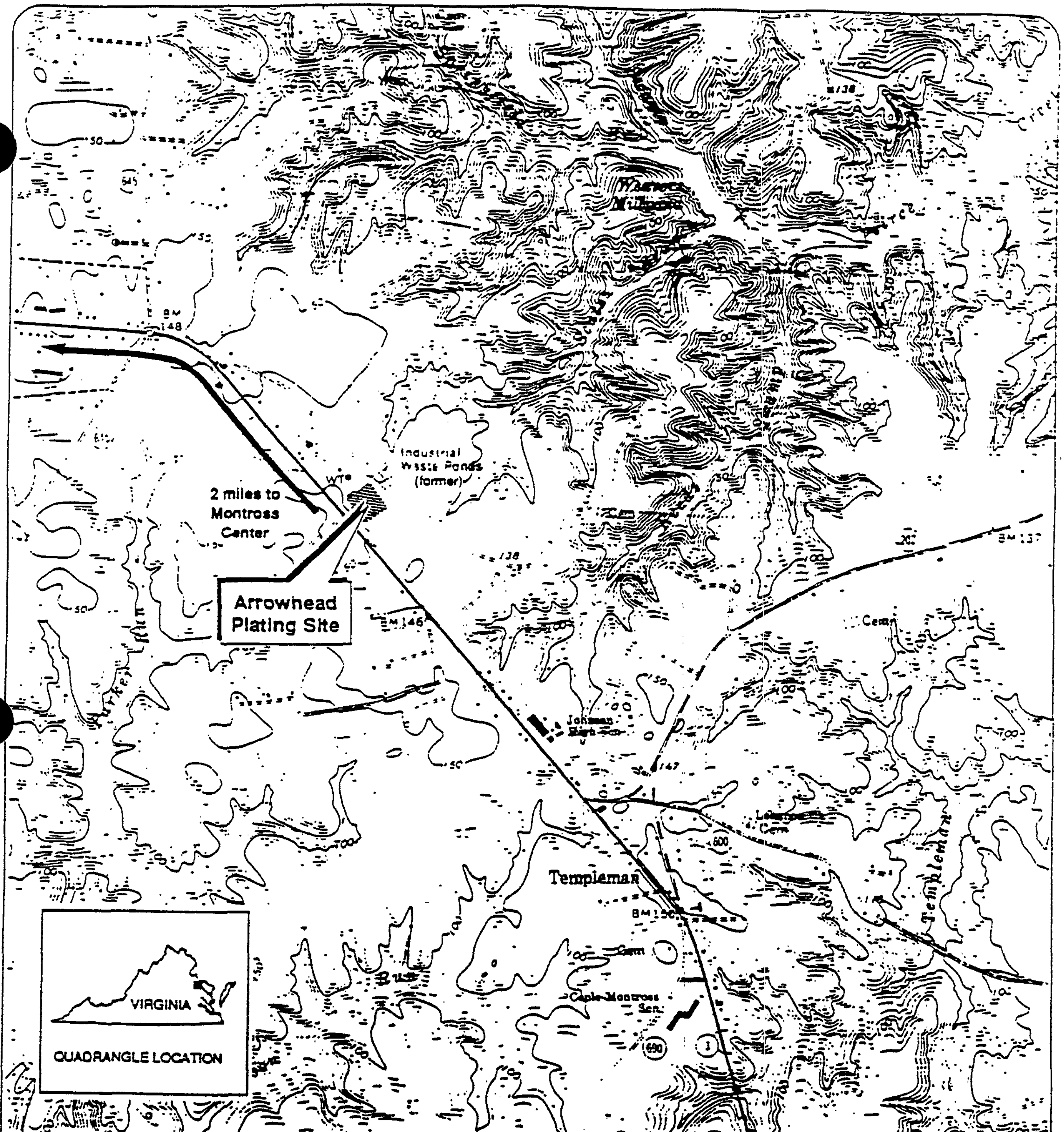

Figure 1 **Site Location**
Arrowhead Plating Site

SCALE 1:24000
0 1/2 1 MILE

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Source: U.S. Department of the Interior, Geological Survey. Montross Quadrangle, Virginia. 7.5-minute topographic 1968, photorevised 1981.

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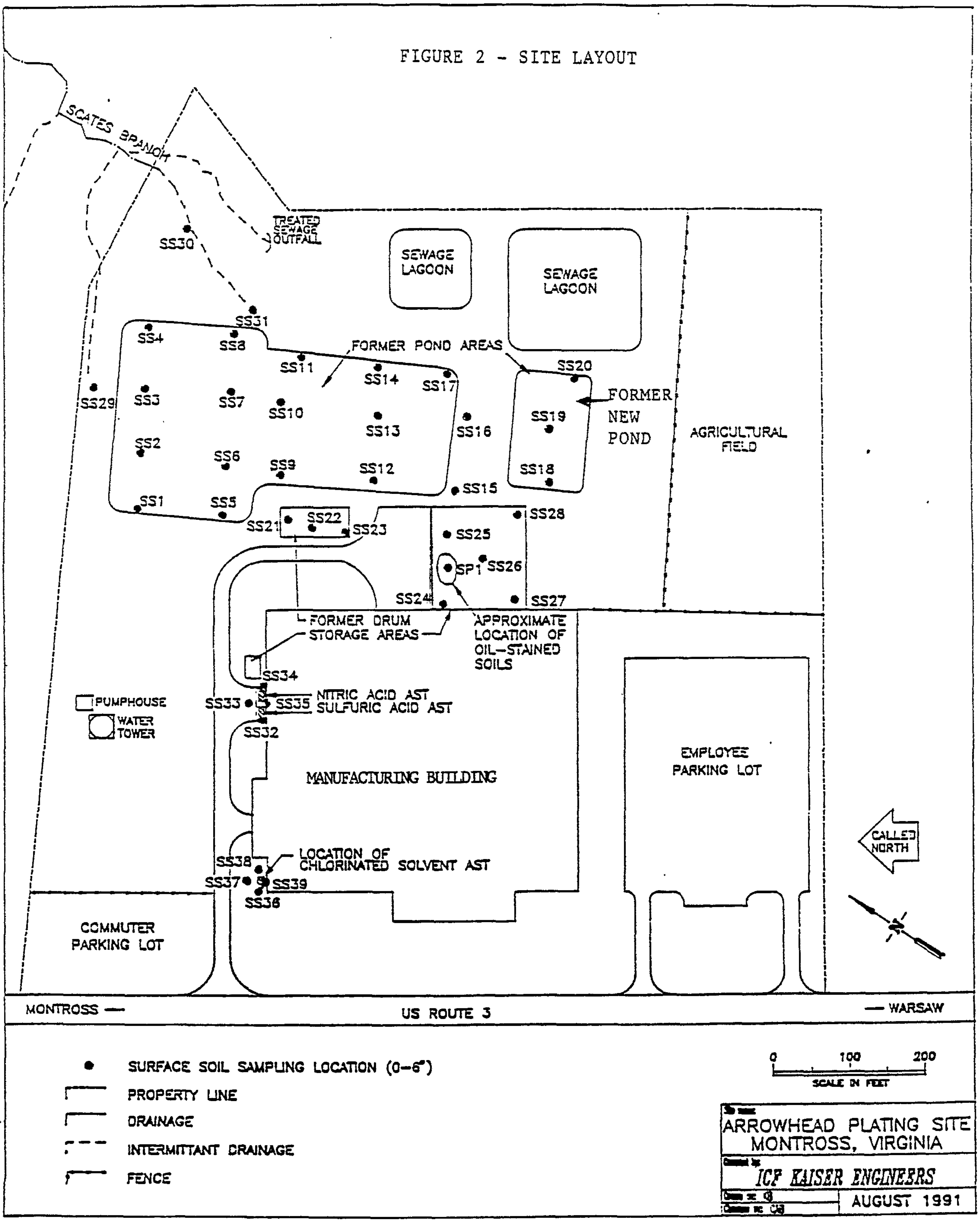
FIGURE 2 - SITE LAYOUT



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II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. Site History

Westmoreland Industrial Development Corporation originally procured the land and constructed the manufacturing building. The property was leased to Scovill Inc. (Scovill) in 1966. In 1972, Arrowhead Associates (Arrowhead) purchased the business and facility assets, and subsequently subleased the property from Scovill. In 1983, Arrowhead reopened business under new ownership as the A.R. Winarick Company.

From 1966 to 1979, the facility manufactured cosmetic cases using electroplating, lacquering and enameling processes. Most of the cases were either brass- or zinc-plated with a small portion of the cases silver-plated. Copper, zinc, cyanide, and acid and alkali solutions were used in these plating operations, while a chlorinated solvent was used for degreasing prior to lacquering or enameling plated cases. During this period, wastewaters from the brass, zinc, and silver electroplating operations were conveyed to a treatment system located inside the manufacturing building for oxidation and neutralization prior to discharge to the onsite settling ponds. Supernatant from these ponds was either reused in the plant or discharged to Scates Branch under a National Pollutant Discharge Elimination System (NPDES) permit. Chlorinated solvents were recovered by distillation of the spent solvent generated by the degreasing process. Still bottom wastes and small amounts of other spent materials were accumulated in drums that were periodically shipped offsite for management at another Scovill facility. In 1979, Arrowhead Associates terminated these manufacturing operations and switched to cosmetic-case filling operations, which are still being performed at the facility. Also in 1979, use of the five sludge settling ponds and the treated wastewater pond was terminated.

In the early 1980's, Mattatuck Manufacturing began manufacturing automobile wire harnesses at the Site and in 1988, Virginia Elastics started using the former plating area as warehouse space.

2. Enforcement Activities

In July 1986, Scovill and EPA Region III entered into an Administrative Order on Consent that required Scovill to conduct a two phase removal action. Phase I action, from December 1986 to September 1987, removed wastes and contaminated materials including residual process wastes, drums, damaged tanks, interior piping, and deteriorated concrete inside the manufacturing building. During Phase II action, which began in November 1987 and continued until November 1988, approximately 395 cubic yards of contaminated soils from the former drum storage areas were removed offsite. Phase II action also consisted of treating and disposing of wastewaters, sludges, and soils in the former settling ponds. In April 1990, filling and grading of the pond areas occurred, and erosion control measures were installed in October 1990.

The Site was proposed to the National Priority List (NPL) in June 1988, and finalized on the NPL in February 1990. In July 1989, Scovill entered an Administrative Order on Consent with VDWM to conduct a remedial investigation/feasibility study (RI/FS), which characterizes the extent and nature of contamination at the Site, and identifies remedial alternatives. The RI/FS work plan was approved in February 1990. Table 1 includes a chronology of Superfund actions at the Site.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The primary issues of concern to most Montross-area residents include issues that affect the Nomini Creek, Chesapeake Bay or local waters and wetlands; agriculture; maintaining the natural

TABLE 1 - SITE CHRONOLOGY

DATE	SITE OPERATOR/ACTIVITY	DESCRIPTION OF EVENT
1966-1972	Scovill, Inc.	Electroplated cosmetic cases.
1972-1979	Arrowhead Assoc.	Electroplated cosmetic cases.
1979	Arrowhead Assoc.	Ceased electroplating operations.
1979-1983	Arrowhead Assoc.	Filled cosmetic cases.
Early 1980s-present	Mattatuck Manufacturing	Fabricates automobile wire harnesses.
1983-present	A.R. Winarick	Fills cosmetic cases.
March 1985	Scovill—Internal Site Assessment	Internal report disclosing findings and recommending an investigation be conducted.
July 1985	Scovill—Site Assessment (conducted by Law Environmental)	Results of assessment shared with state.
Feb. 1986	Commonwealth of Virginia (Department of Health)—Preliminary Assessment	Site inspection conducted after meeting with Scovill to review July 1985 assessment (no sampling conducted). Resulted in "Preliminary Assessment" report dated Mar. 28, 1986.
Feb. 1986	U.S. EPA ERT—Site Inspection	At VADWM's request and following VADWM's site inspection, U.S. EPA ERT conducted their site inspection (no sampling conducted).
July 3, 1986	Consent Agreement and Order	Agreement to conduct a two-phase Immediate Removal Action.
Dec. 1986-Feb. 1987	Phase IA—Initial Waste Removal	Removal of residual process wastes, drums, and damaged process tanks.
Sept. 1987	Phase IB—Interior Cleanup	Removal of interior piping, deteriorated concrete, etc.
Nov. 1987	Phase IIA—Soil Removal	Removed soil from drum storage areas.
June 1988	Proposed NPL Listing	Listed on proposed NPL.
July-Nov. 1988	Phase IIB—Pond Abatement	Removal of wastewaters, sludges, and soils from settling ponds.
1988-present	Virginia Elastics	Warehouse (in former plating area).
July 14, 1989	Administrative Order by Consent	Agreement to conduct the RI/FS.
Apr.-June 1990	Completion of Pond Closure	Filled and graded former pond areas. (Additional erosion controls implemented in Oct. 1990.)
March 1990-present	RI/FS	RI conducted to assess nature and extent of chemicals; FS conducted to evaluate remedial alternatives.

beauty of the area; and the recent influx of people from the Northern Virginia area who are buying land around Nomini Creek, and what impact this development will have on the area. The Westmoreland Environmental Council has taken an active role in addressing these issues and has shown interest in Superfund activities at the Site.

Community members played an important role in the compilation of the Community Relations Plan (CRP), which was drafted in January, 1990. One month later, residents were notified that the RI/FS work plan had been approved. Throughout the RI/FS, updates on site activities were provided on a quarterly basis and VDWM responded to questions from residents and officials. On June 12, 1990, VDWM conducted an RI/FS workshop for area residents. The purposes of the workshop were to discuss the Superfund program, explain the activities conducted in the RI/FS, and inform community members of the current Site status.

As activities in the RI/FS stage progressed, VDWM maintained communications with community members and determined that an update to the Community Relations Plan was needed. Many residents in Montross were contacted to assess changes in interest levels concerning the Superfund activities at the Site. Two months later, Community relations staff from VDWM came into the community to address the Westmoreland Environmental Council. This served as an opportunity to present the Superfund Program in detail and answer any questions.

In according with CERCLA § 113(k)(2)(B)(i-v) and § 117(a), the Proposed Plan was drafted, based on the results of the RI/FS, and its availability for review was announced in the July 25, 1991 edition of The Fredricksburg Freelance Star and Westmoreland News. This same public notice also publicized the start of the Public Comment Period on July 26, 1991 and the public meeting held at the American Legion on August 6, 1991. The public comment period ended

August 26, 1991.

At the public meeting, representatives from VDWM presented an overview of the Superfund process, a summary of the Proposed Plan, and answered questions from community members. EPA officials were also present to address any of the residents' concerns. A formal response to questions and comments put forth during the public meeting and comment period can be found in Part III of this document, the Responsiveness Summary. Community participation activities such as additional meetings, per request, and quarterly mailings will continue through the remedial design/remedial action phase for the Site. A detailed outline of Arrowhead community relations activities can be found in Appendix B.

All documents utilized in the determination of site activities can be found in the Administrative Record located in the office of the County Administrator on Peach Grove Lane, Montross, Virginia. An index of these documents are included in the in Appendix E.

IV. SCOPE AND ROLE OF RESPONSE ACTION

The Remedial Investigation Report for the Site documents the actual and potential releases of hazardous substances into the environment and the risks posed by the Site. The existing principal risk associated with the Site was determined to be the organic contamination of the shallow, unconfined aquifer. This contamination poses a threat to the deeper aquifer. Groundwater is the only drinking water source for residents in the area. Additionally, discharge of contaminated groundwater to the nearby Scates Branch has impacted the aquatic life in the stream. It is an expectation of the NCP that groundwater will be remediated to its beneficial uses. The goal of this response action is to restore the groundwater to beneficial use by achieving cleanup levels whenever practicable.

In addition to the contaminated groundwater, contaminated soils at the Site also present a threat associated with contaminant releases from the soils into the groundwater. Since most of the contaminated soils were removed during Phase II Removal, the remainder of the contaminated soils at the Site acts as a low-level threat. The remedial action selected in this ROD is expected to address the remainder of the contaminated soils to prevent contaminants from leaching into the groundwater, thereby facilitating the groundwater treatment process.

V. SUMMARY OF SITE CHARACTERISTICS

This section discusses site hydrological and geological characteristic, identifies areas of concern, summarizes the sampling results obtained during the RI/FS, and discusses major fate and transport phenomena concerning the contaminants found at the Site.

1. Site Characteristics

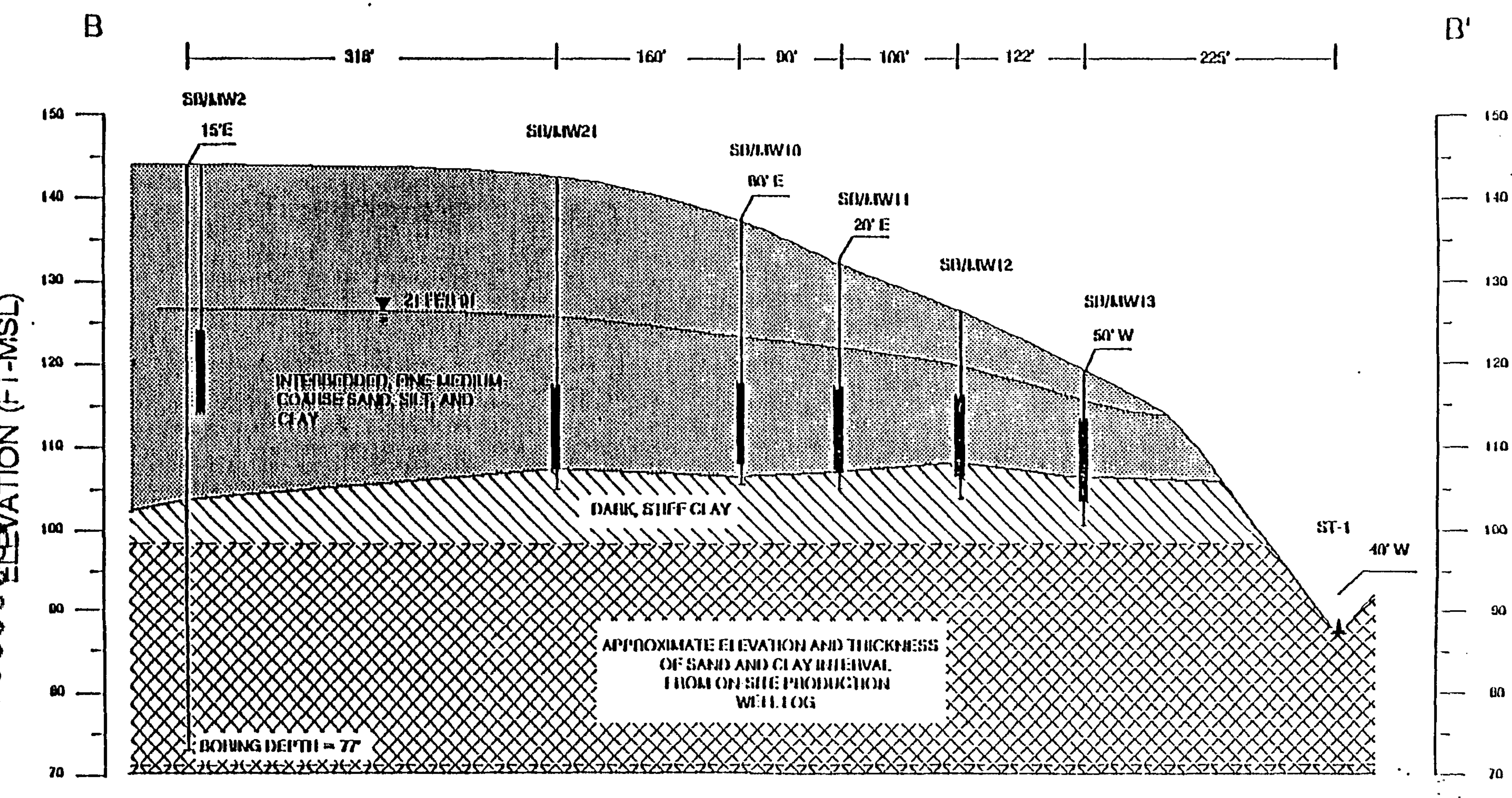
Local geology was characterized by a soil survey for Westmoreland County and the onsite deep water supply well. Soil in the Montross area is identified as Suffolk sandy loam having 10 inches of brown sandy loam overlying 40 inches of sandy loamy sand. Surface soil samples taken during the RI ranged from clayey silts to sandy silts with some organic matter. Approximately 40 feet of the top sediment belong to the Bacons Caste Formation, a thin bed composed of laminated clayey silt and silty fine sand with local sandy intervals. The underlying 200 feet of strata belongs to the Upper Chesapeake Group formations, including the Yorktown and Eastover formations; these formations contain interbedded and poorly sorted clay, silt, and sand. Between 240 feet and 340 feet below the ground lies the lower Chesapeake Group formations, which are dominantly sand, shells, and silts.

Within the Bacons Caste Formation, heterogenous mixtures of sand, silt, and clay exist. Silt, coarse sand and gravel, and clay lenses are common while fine and medium sand are the most abundant grain sizes in this unit. A discontinuous layer of cemented sand was also encountered. The observed thicknesses of this formation range from 0 feet in the Scates Branch, where it has been completely eroded, to 40 feet (Figure 3). Underlying the Bacons Caste Formation is a clay-rich continuous layer that belongs to the Upper Chesapeake Group. This layer, considered the bottom of the shallow aquifer, is a hydraulic boundary through which there is no significant flow of groundwater. This layer can be observed in the bottom of Scates Branch and along the walls of the valley of Scates Branch where the contact between the Bacons Caste and Yorktown/Eastover formations outcrops.

The shallow, unconfined aquifer exhibits a great deal of heterogeneity. In general, permeability varies over short distances, and the soils are more permeable in the horizontal direction than in the vertical direction. Slug tests conducted during the RI indicated a range of horizontal hydraulic conductivities from 9×10^{-4} to 5.4×10^{-3} ft/min with an arithmetic average value of 2.7×10^{-3} ft/min. Depths to groundwater occur from 2 to 22 feet below the ground surface. Groundwater discharges to both Scates Branch and the South Fork Scates Branch (Figure 3) with an average velocity of 0.21 ft/day. Typically, the potentiometric surface of the groundwater table of an unconfined aquifer displays a subdued expression of the surface land topography. As Figure 3 indicates, the closer a location is to the Scates Branch or its tributaries, the lower the groundwater table. A groundwater divide probably exits near State Route 3, and another is present on the property and continues into the agricultural field east of the Site where groundwater discharges to different branches of Scates Branch.

FIGURE 3

GEOLOGIC CROSS SECTION B-B'
ARROWHEAD PLATING SITE



2. Areas of Concern

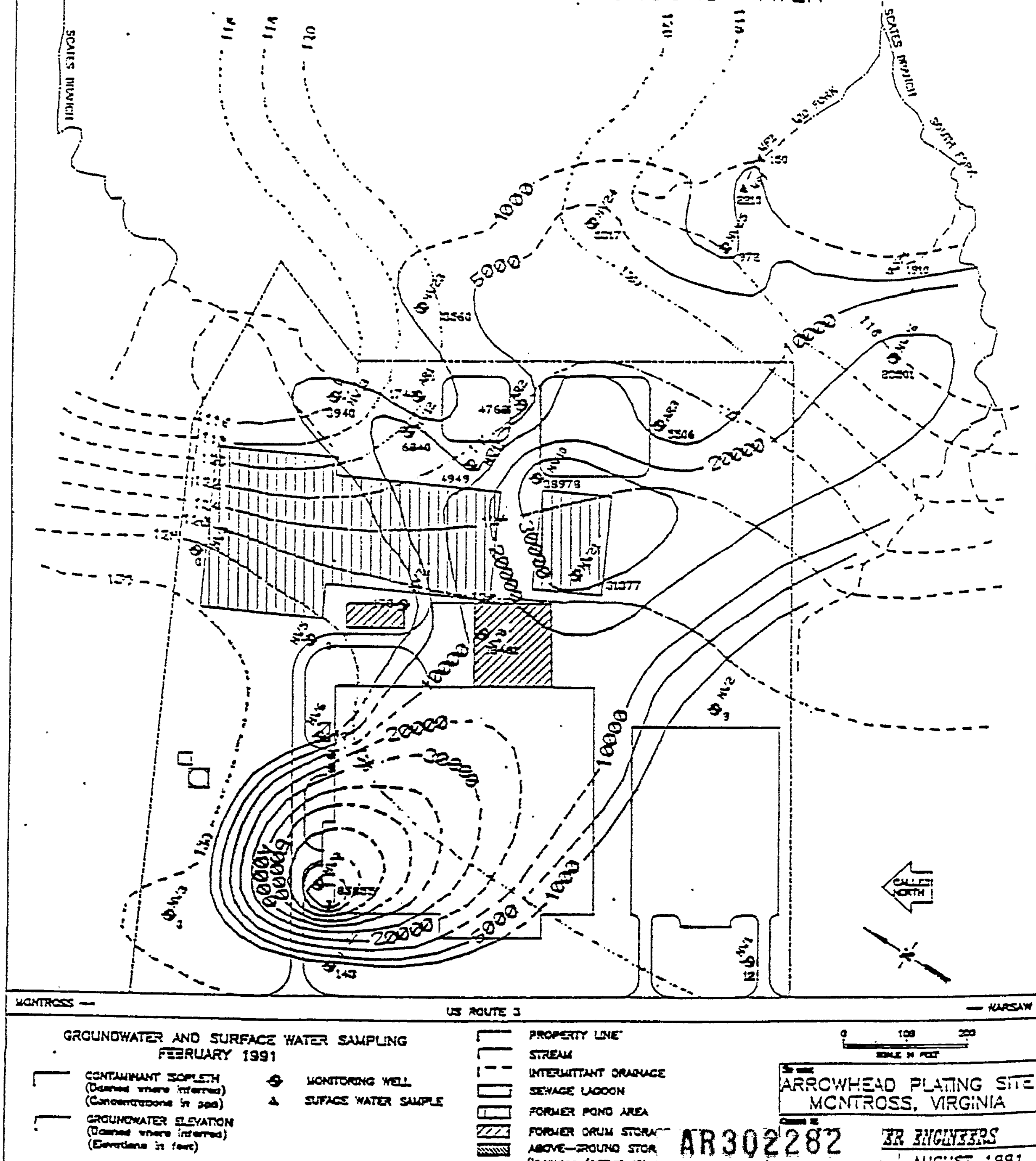
Areas of concern identified in the RI/FS included the chlorinated solvent tank, the former drum storage areas, the former ponds areas, the acid tanks area, the drainage lines, and the stained area (Figure 2). These area are discussed below.

Chlorinated Solvent Tank. The solvent tank is located outside the northwestern corner of the manufacturing building. It was installed horizontally upon 4-foot high concrete supports. With a capacity of approximately 1,200 gallons, it was used from around 1966 until 1980 or 1981. The solvents stored in the tank were conveyed into the manufacturing building through an underground piping system. According to a registration report submitted to the Virginia Department of Air Pollution Control (VDAPC), trichloroethene (TCE) was stored in the tank until 1973; "Chlorothane," possibly containing 1,1,1-trichloroethane (1,1,1-TCA), was stored until 1979; and "Perconne 2," possibly containing perchloroethene (PCE), was stored later. Groundwater underneath the tank contained the highest concentration of total volatile organics (VOCs) found in the aquifer underneath the Site, indicating the tank or the underground piping was a primary source of groundwater contamination at the Site (Figure 4). The tank was emptied during the Initial Waste Removal.

Former Drum Storage Areas. It is estimated that these areas were used for drums storage from late 1970's to 1985. During the removal actions, Scovill conducted offsite removal of approximately 270 drums containing waste solvent and paints, electroplating waste sludges and cosmetic production wastes, or rain water. Signs of leakage and visual evidence of releases onto the soils in these areas were observed. Also removed were soils contaminated with cyanide, chromium, copper, and zinc. An action level of 2 mg/kg of cyanide in

FIGURE 4

EXTENT OF TOTAL VOCs IN GROUND WATER



the soils was achieved in these areas. These areas, particularly the large drum storage area, may also have contributed to the VOCs contamination in the groundwater at the Site as a result of leakages from drums that were stored in these areas.

Former Ponds Areas. Each of the five former sludge settling ponds (approximately 8-10 feet deep), and the former treated wastewater pond (about 4-6 feet deep) received wastewaters from the electroplating operation, which contained significant amounts of copper, zinc, cyanide, silver, lead, and possibly chromium. The sludges in these ponds were removed offsite during Phase II Removal, and the areas have been graded and vegetated. The RI data indicate that inorganics compounds were not widespread in soils or groundwater underneath these areas, only small pockets of inorganic contamination appear to remain.

Acid Tanks Area. Two 5,000-gallon tanks were used to store nitric acid and sulfuric acid. They were located along the north side of the manufacturing building just outside the former electroplating area. This area was investigated to determine if spillage had occurred.

Drainage Lines. The drainage lines were used to convey the treated wastewater to Scates Branch. It is possible that overflow from the former wastewater ponds or from the drainage lines occurred, resulting in infiltration of contaminants into the groundwater.

The Stained Area. Located near the northern edge of the large drum storage area, this area contained dark stained soils. A spill of chemicals could have occurred in this area, indicating a potential source of contamination.

3. Sampling Results

A summary of chemicals of concern found during the RI/FS in each of the areas discussed above is presented in Table 2.

Surface soil sampling results did not indicate widespread distribution of VOCs and inorganics of concern. VOCs and metals were detected at elevated levels in the drum storage areas and in one sample near the solvent tank area. Cyanide was found at high concentrations in a few samples from the drum storage areas. Semi-VOCs were detected in a few samples at concentrations well below the health-based levels of concern.

Regarding subsurface soil contamination at the Site, analytical results indicate no widespread contamination, but significant contaminant levels were found at several locations. VOCs were present at high concentrations in the small and large drum storage areas and in one soil boring drilled in the location of the former new pond. Elevated VOCs levels were encountered at or below the groundwater table in many cases. High levels of inorganics were encountered mostly in the former pond area, while cyanide concentrations in all subsurface soil samples were generally low (less than 2 mg/kg). No semi-VOCs were detected in the subsurface soils.

As Figure 4 shows, the groundwater contamination associated with VOCs at the Site is extensive and significant. The contamination plume extends offsite and into Scates Branch and the South Fork Scates Branch where groundwater discharges to the surface system. Primary VOCs of concern include PCE, 1,1,1-TCE, and associated degradation products including 1,1-dichloroethene (1,1-DCE), and 1,2-dichloroethene (1,2-DCE). Vinyl chloride is also an end product of chlorinated ethane degradation, and has been detected at the detection limit level (10 ppb) in one sample. No semi-VOCs were detected in the groundwater. Although some metals

TABLE 2
SUMMARY OF CHEMICALS OF CONCERN FOR THE ARROWHEAD PLATING SITE

Chemical	Surface Soil: Drum Storage Areas	Surface Soil: Acid Tank Area	Surface Soil: Solvent Tank Area	Surface Soil: Drain Lines Area	Surface Soil: Stained Area	Sub-Surface Soil	Ground Water	Surface Water	Sediment
Organics:									
Acetone	X	X	X			X	X		X
Benzoic acid									X
Bis(2-ethylhexyl)phthalate	X	X			X			X	X
Carbon tetrachloride	X					X			
4-Chloroaniline						X			
Chloroform							X		
1,1-Dichloroethane							X		
1,1-Dichloroethene							X		
1,2-Dichloroethene (total)					X		X	X	X
Di-n-butylphthalate	X								
Methyl ethyl ketone	X	X				X			X
Methylene chloride	X					X	X		
Phenanthrene			X						
Tetrachloroethene	X		X		X	X	X	X	X
Toluene						X			
1,1,1-Trichloroethane	X		X				X		
Trichloroethene	X						X	X	X
Xylenes (total)						X			
Inorganics:									
Aluminum	X	X	X	X		X	X	X	
Barium	X	X	X	X		X	X		
Cadmium			X				X		
Calcium	X	X	X	X		X	X	X	X
Chromium	X	X	X	X		X	X		
Copper	X	X	X	X		X	X	X	
Cyanide	X	X				X	X	X	
Iron						X	X	X	
Lead	X	X	X	X		X	X		
Mercury (inorganic)		X	X	X			X		
Nickel	X	X	X	X		X	X		X
Potassium	X	X	X	X		X	X	X	
Silver	X		X				X		
Sodium	X	X	X	X		X	X	X	X
Zinc	X	X	X	X		X	X		

X = Selected as a chemical of potential concern in this medium.

were detected in the groundwater at levels above applicable standards, metal contamination in the groundwater at the Site is limited and localized. Cyanide was found at low levels in several onsite wells and two offsite wells, but cyanide contamination is much more limited than the VOCs plume.

The sampling results also indicate that VOCs in the groundwater are discharged to the surface water in Scates Branch and its tributaries; however, VOCs were present only in upstream locations. Elevated metal and cyanide levels also occurred sporadically. Surface water in Weavers Millpond was found not to be impacted by the Site. In the sediments, low levels of VOCs were detected in upstream samples while no significant concentrations of semi-VOCs or metals were detected. Cyanide was not detected in any sediment samples taken from Scates Branch or Weavers Millpond.

4. Fate and Transport

Major transport mechanisms at this Site include (1) runoff of surficial soils into surface waters; (2) vertical migration of contaminants into groundwater through soils; (3) advection and dispersion of contaminants within the aquifer; and (4) groundwater discharge to surface water. Migration of contaminants via volatilization of contaminants from soil and via suspended particles were determined to be insignificant.

Key factors influencing the VOCs migration at the Site are: (1) the relatively high solubilities of the VOCs of concern; (2) the permeable sandy soils; (3) the flow of groundwater; and (4) the presence of an impermeable layer at the bottom of the shallow aquifer, which prevents vertical migration of contaminants. VOCs released from the solvent tank, underground piping, and from the large drum storage area appear to have migrated downward through soils into the groundwater, where advection, dispersion and natural degradation occur. Although the subsurface contamination in these areas has not been fully defined, high concentrations of VOCs of concern are possible and could act as ongoing residual sources for many years to come as contaminants migrate into groundwater through rain water percolation. In addition, dense, nonaqueous-phase liquids (DNAPLs) may exist in the subsurface or in the aquifer. Because DNAPLs are heavier than water and immiscible, they can form a distinct layer in the groundwater that act as an ongoing source of contamination. Plumes of individual VOCs of concern appear thin and parallel to the groundwater flow directions (eastward with branching to the southeast and northeast), indicating that the VOCs are probably moving at approximately the same rate as the groundwater, and that the VOCs are probably not significantly retained in the aquifer. As groundwater seeps into the surface system at the interface along the walls of Scates Branch and its tributaries, VOCs are transported as solutes, with dilution, dispersion and volatilization causing rapid concentration decrease in surface water.

Metals found in the groundwater at the Site did not display any distinct patterns. In soils above the groundwater table, metals contamination occurred sporadically. Since metals are charged species that adsorb readily to clay particles, sediments, and organic materials, most are relatively immobile in soils and groundwater. Among the metals of concern, zinc and copper are of significance. Cyanide is another inorganic of concern, and appears in the groundwater east of the manufacturing building with a distribution more distinct than that of the metals. Cyanide was present at levels well below the Proposed Maximum Contaminant Level (PMCL) of 200 $\mu g/l$, and its occurrence in the groundwater was localized.

VI. SUMMARY OF SITE RISKS

Human health and environmental risk assessments were performed with information obtained from the remedial investigation and other background information. The risk assessment was conducted in accordance with EPA risk assessment guidance for Superfund (OWSER Directive 9285.7-01a, 9/1989). The human health risk assessment consists of four major steps: identification of chemicals of concern, exposure assessment, toxicity assessment, and risk characterization.

Identification of chemicals of concern. After review of the collected data, all potentially site-related organic chemicals were selected as chemicals of concern (Table 2). For inorganics, only those compounds that are present at concentrations above the corresponding background levels were selected. The background concentrations were determined from samples taken at upgradient locations. Table 2 includes the chemicals of concern for the Site in different media. VOCs make up the majority of organic chemicals of potential concern.

Exposure Assessment. Currently, the closest residential area is approximately one mile away. No public or private recreational areas are located near the Site. Consequently, trespassing is likely to be infrequent. As the Site is an active commercial facility, the primary human receptor population of the contamination is the employees of the facility. The RI identified several potential exposure pathways including present and future land use scenarios for the human populations potentially exposed to the contamination at the Site. It is possible that the Site could be developed into a residential area in the future. The following are exposure pathways considered significant in the risk assessment for the Site.

- Current land use conditions: VOCs that have volatilized from contaminated surface soils and transported indoors where workers spend most of their time could result in inhalation exposures of relatively long duration;

- Future land use conditions: it is possible that future residents would be exposed to the contamination by (1) using the contaminated groundwater for drinking purposes, resulting in exposures via ingestion; (2) inhalation of VOCs of concern; (3) dermal contact of contaminated soils; (4) incidental soil ingestion; and (5) children wading in surface water and contacting sediments and surface water.

Exposure parameters for different exposure pathways are presented in Tables 3 through 9.

Toxicity Assessment. EPA has classified chemicals into two distinct categories of chemical toxicity depending on whether they exhibit carcinogenic (cancer-causing) or noncarcinogenic effects. Health effects criteria have been developed for risk assessment purposes and are discussed below.

For estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals, EPA has developed slope factors, expressed in units of $(mg/kg\text{-}day)^{-1}$, to calculate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to these chemicals. The term "upper bound" reflects the conservative estimate of the risk 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. The extent to which a given substance is carcinogenic in humans is reflected by the *weight-of-evidence* assigned to that substance. A weight-of-evidence classification is determined by experimental or epidemiological studies involving exposure to the substance in question with "A" meaning high confidence and "E" meaning that there is no evidence of carcinogenicity from exposure to the substance.

TABLE 3

EXPOSURE PARAMETERS USED TO ESTIMATE INHALATION EXPOSURES FOR WORKERS INSIDE THE MANUFACTURING BUILDING AT THE ARROWHEAD PLATING SITE

Parameter	Value
Inhalation Rate	2.1 m3/hour (a)
Exposure Duration	8 hours/day (b)
Exposure Frequency	250 days/year (c)
Years of Exposure	30 years (b)
Average Body Weight Over Exposure Period	70 kg (b)

(a) Based on EPA (1989b).
(b) Based on EPA (1989a).
(c) Assumes workers work 5 days/week, 50 weeks/year.

TABLE 4

EXPOSURE PARAMETERS USED TO ESTIMATE EXPOSURES FOR FUTURE RESIDENTS INGESTING GROUND WATER AT THE ARROWHEAD PLATING SITE

Parameter	Value
Ingestion Rate	1.9 l/day (a)
Exposure Frequency	365 days/year (b)
Years of Exposure	30 years (b)
Average Body Weight Over Exposure Period	48 kg (c)

(a) Weighted average based on EPA (1989b). Assumes that children age 1-3 years (up to 10 kg) ingest 1 l/day, and individuals over 10 kg ingest 2 l/day.
(b) Based on EPA (1989a).
(c) Based on EPA (1989b). Average for individuals 1-30 years of age.

TABLE 5

EXPOSURE PARAMETERS USED TO ESTIMATE INHALATION EXPOSURES FOR FUTURE RESIDENTS AT THE ARROWHEAD PLATING SITE

Parameter	Value
Inhalation Rate	18 m^3/day (a)
Exposure Frequency	365 days/year (b)
Years of Exposure	30 years (b)
Average Body Weight Over Exposure Period	43 kg (c)

(a) Weighted average for individuals 1-30 years of age based on NRCP (1984) and EPA (1985b) data.
(b) Based on EPA (1989a).
(c) Based on EPA (1989b).

TABLE 6

EXPOSURE PARAMETERS USED TO ESTIMATE DERMAL CONTACT
EXPOSURES FOR FUTURE RESIDENTS
AT THE ARROWHEAD PLATING SITE

Parameter	Value
Soil Contact Rate	9,480 mg/day (a)
Absorption Factor	
VOCs	0.1 (b)
Bis(2-ethylhexyl)phthalate	0.05 (c)
metals	0 (d)
cyanide	1.0 (e)
Exposure Frequency	152 days/year (f)
Years of Exposure	30 years (g)
Average Body Weight Over Exposure Period	48 kg (h)

(a) Based on feet, legs, hands, and forearms surface area of 6,540 cm2/day from EPA (1985b), and a soil to skin adherence factor of 1.45 mg/cm2 (EPA 1989a).
(b) Assumed value based on analogy to other chemicals and chemical-physical properties.
(c) Based on analogy to PCDDs/PCDFs (Poiger and Schlatter 1980).
(d) Based on Skog and Wahlberg 1964, Wahlberg 1968, and Lang and Kunze 1948.
(e) Cyanide, in solution as hydrogen cyanide, is known to be absorbed through the skin. Since no absorption is available for cyanide, the absorption fraction is conservatively assumed to be 100%.
(f) Based on NOAA (1978) data collected at Richmond, VA. Assumes that residents spend time outdoors from March through October (279 days, or 40 weeks), and that children up to 12 years of age play outdoors 5 days/week, and individuals over 12 years of age are outdoors 3 days/week.
(g) Based on EPA (1989a).
(h) Based on EPA (1989b). Average for individuals 1-30 years of age.

TABLE 7

EXPOSURE PARAMETERS USED TO ESTIMATE SOIL INGESTION
EXPOSURES FOR FUTURE RESIDENTS
AT THE ARROWHEAD PLATING SITE

Parameter	Value
Ingestion Rate	120 mg/day (a)
Fraction of Ingested Soil Which is from Contaminated Areas	1 (a)
Organic Chemicals:	
Bis(2-ethylhexyl)phthalate	0.5 (b)
All others	1.0 (c)
Frequency	152 days/year (d)
Years of Exposure	30 years (a)
Average Body Weight Over Exposure Period	48 kg (e)

(a) Based on EPA (1989a).
(b) Estimated based on 2,3,7,8-TCDD (Poiger and Schlatter 1980, McConnel et al. 1984, Lucier et al. 1986, Wendling et al. 1989, and van den Berg et al. 1986, 1987).
(c) Assumed value.
(d) Based on NOAA (1978) data collected at Richmond, VA. Assumes that residents spend time outdoors from March through October (279 days, or 40 weeks), and that children up to 12 years of age play outdoors 5 days/week, and individuals over 12 years of age are outdoors 3 days/week.
(e) Based on EPA (1989b). Average for individuals 1-30 years of age.

TABLE 8

EXPOSURE PARAMETERS USED TO ESTIMATE DERMAL CONTACT EXPOSURES FOR CHILDREN WADING IN SURFACE WATER AT THE ARROWHEAD PLATING SITE

Parameter	Value
Surface Area Exposed	5,980 cm2 (a)
Dermal Permeability	
Organic Chemicals	0.0008 cm/hr (b)
Cyanide	0.0008 cm/hr (b)
Inorganic Chemicals	0 cm/hr (c)
Exposure Duration	2 hours/day
Exposure Frequency	77 days/year (d)
Years of Exposure	6 years (e)
Average Body Weight Over Exposure Period	31 kg (f)

(a) Based on EPA (1985b). Surface area of hands, arms, feet, and legs for 6-12 year old children.
(b) Based on EPA (1989a). Assumes that all organic chemicals penetrate skin at same rate as water. Cyanide also is known to penetrate skins and is assumed to penetrate skin at the same rate as water.
(c) Dermal permeability of inorganic chemicals is assumed to be negligible.
(d) Assumes that children 6-12 years wade in water 3 days/week during months when average daily temperature is over 65oF (6 months: April - September).
(e) Assumes children wade in stream from age 6 to age 12.
(f) Based on EPA (1989a). Average body weight for children 6-12 years old.

TABLE 9

EXPOSURE PARAMETERS USED TO ESTIMATE DERMAL CONTACT
EXPOSURES FOR CHILDREN CONTACTING SEDIMENT
AT THE ARROWHEAD PLATING SITE

Parameter	Value
Sediment Contact Rate	1,035 mg/cm2 (a)
Dermal Permeability	
Organic chemicals	0.1 (b)
Metals	0
Bis(2-ethylhexyl)phthalate	0.03
Exposure Frequency	77 days/year (c)
Years of Exposure	6 years (d)
Average Body Weight Over Exposure Period	31 kg (e)

(a) Based on feet surface area of 714 cm2 from EPA 1989b and an assumed sediment to skin adherence factor of 1.45 mg/cm2 (the same as soil, from EPA 1989a).
(b) Dermal permeability of chemicals in sediment is assumed to equal that of the same chemicals in soils. See Table 6-21 for basis of values.
(c) Assumes that children 6-12 years wade in water 3 days/week during months when average daily temperature is over 65oF (6 months: April - September).
(d) Assumes children wade in stream from age 6 to age 12.
(e) Based on EPA (1989a). Average body weight for children 6-12 years old.

For chemicals with the potential to cause adverse health effects other than cancer, EPA has developed levels that human, including sensitive subpopulations can be exposed to on a long-term daily basis without experiencing any adverse effects. These levels are called reference doses (RfDs), and are expressed in units of mg/kg-day. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived in a similar fashion to slope factors. Uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects.

Table 10 and 11 present health effects criteria for chemicals of concern found at the Site.

Risk Characterization. Excess lifetime cancer risks are determined by multiplying the intake level with the slope factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$, or 0.000001). An excess lifetime cancer risk of $1x10^{-6}$ indicates that, as a plausible upper bound, an individual has one in one million chance of developing cancer as a result of exposure to a carcinogen over a 30-year period under the specific exposure conditions at a site. EPA considers a total cancer risk at Superfund sites acceptable if the risk is $1x10^{-6}$ or less. However, depending on site-specific circumstances, a risk within the range of $1x10^{-6}$ to $1x10^{-4}$ may also be acceptable.

Risks associated with exposures to noncarcinogens is expressed as a Hazard Index (HI), which is the ratio of the long-term daily exposure rate (typically called the chronic daily intake) to the RfD. The overall HI is the sum of the ratios of chronic daily intakes to the RfDs for all chemicals under consideration. The overall HI provides a useful reference point for gauging the potential significance of multiple contaminant exposure within a single medium or across media. In general, hazard indices that are

TABLE 10

CHRONIC ORAL TOXICITY VALUES FOR CHEMICALS OF POTENTIAL CONCERN

Chemical	Chronic Reference Dose (mg/kg-day) [Uncertainty Factor] (a)	Target Organ (b)	Reference Dose Source	Cancer Slope Factor (mg/kg-day)-1	USEPA Weight of Evidence Classification (c)	Slope Factor Source
Organics						
Acetone	1E-01 [1000]	Liver, kidney	IRIS	--	D	--
Benzoic acid	4E-00 [1]	Irritation	IRIS	--	D	IRIS
Bis(2-ethylhexyl)phthalate	2E-02 [1000]	Liver	IRIS	1.4E-02	B2	IRIS
Carbon tetrachloride	7E-04 [1000]	Liver	IRIS	1.3E-01	B2	IRIS
Chloroform	1E-02 [1000]	Liver	IRIS	6.1E-03	B2	IRIS
1,1-Dichloroethane	1E-01 [1000]	Kidney	HEAST	(d)	C	HEAST
1,1-Dichloroethene	9E-03 [1000]	Liver	IRIS	6E-01	C	IRIS
1,2-Dichloroethene (total)	2E-02 [1000]	Blood serum	IRIS	--	D	--
Di-n-butylphthalate	1E-01 [1000]	Mortality	IRIS	--	D	IRIS
Methylene chloride	6E-02 [100]	Liver	IRIS	7.5E-03	B2	IRIS
Methyl ethyl ketone	5E-02 [1000] (f)	Fetus	IRIS	--	D	IRIS
Phenanthrene (e)	4E-03 [10000]	Eye	IRIS	--	D	IRIS
Tetrachloroethene	1E-02 [1000]	Liver	IRIS	5.1E-02 (g)	B2	HEAST
1,1,1-Trichloroethane	9E-02 [1000]	Liver	IRIS	--	D	IRIS
Trichloroethene	7.35E-03 [1000]	Liver	HA	1.1E-02	B2	HEAST
Inorganics						
Aluminum	--	--	--	--	D	--
Barium	7E-02 [3]	Blood pressure	IRIS	--	D	--
Cadmium (food)	1E-03 [10]	Kidney	IRIS	--	B1	IRIS
(water)	5E-04 [10]	Kidney	IRIS	--	B1	IRIS
Calcium	--	--	--	--	D	--
[illegible]mium (h)	5E-03 [500]	Nervous system	IRIS	--	D	--
[illegible]r	3.7E-02 (i)	GI	HEAST	--	D	IRIS
[illegible]ide	2E-02 [500]	Thyroid	IRIS	--	D	IRIS
[illegible]ron	--	--	--	--	D	--
Lead	--	--	--	--	B2	IRIS
Mercury (inorganic)	3E-04 [1000]	Kidney	HEAST	--	D	IRIS
Nickel	2E-02 [300]	Body weight	IRIS	--	D	--
Potassium	--	--	--	--	D	--
Silver	3E-03 [2]	Argyria (skin)	IRIS	--	D	IRIS
Sodium	--	--	--	--	D	--
Zinc	2E-01 [10]	Anemia	HEAST	--	D	--

(a) Uncertainty factors used to develop reference doses generally consist of multiples of 10, with each factor representing a specific area of uncertainty in the data available. The standard uncertainty factors include the following:
- A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- A 10-fold factor to account for the uncertainty in extrapolation animal data to the case of humans;
- A 10-fold factor to account for uncertainty in extrapolating from less than chronic NOAELs to chronic NOAELs; and
- A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(b) A target organ is the organ most sensitive to a chemical's toxic effect. RfD's are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, an organ or system known to be affected by the chemical is listed.

(c) EPA Weight of Evidence for Carcinogenic Effects: [A] = Human carcinogen based on adequate evidence from human studies; [B2] = Probable human carcinogen based on inadequate evidence from human studies and adequate evidence from animal studies; [C] = Possible human carcinogen based on limited evidence from animal studies in the absence of human studies; [D] = Not classified as to human carcinogenicity; and [E] = Evidence of noncarcinogenicity.

(d) Withdrawn by EPA.

(e) Toxicity criteria for naphthalene are used in the absence of criteria for phenanthrene.

(f) Based on route to route extrapolation. Being reconsidered by the RfD workgroup.

(g) Under review by CRAVE workgroup.

(h) Toxicity criteria reported is for chromium VI, as all chromium is conservatively assumed to be in the form of chromium VI.

(i) Drinking water standard reported in mg/l is converted to mg/kg-day by assuming a 70 kg adult consumes 2 liters of water per day.

NOTE: IRIS = Inteegrated Risk Information System - October 1, 1990
HEAST = Health Effects Assessment Summary Tables - July 1, 1990
HA = Drinking Water Health Advisory
EPA = Environmental Protection Agency
-- = No information available

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TABLE 11

CHRONIC INHALATION TOXICITY VALUES FOR CHEMICALS OF POTENTIAL CONCERN

Chemical	Chronic Reference Dose (mg/kg-day) [Uncertainty Factor] (a)	Reference Dose Source	Target Organ (b)	Cancer Slope Factor (mg/kg-day)-1	USEPA Weight of Evidence Classification (c)	Slope Factor Source
Organics						
Acetone	--	--	--	--	D	--
Bis(2-ethylhexyl)phthalate	--	--	--	--	B2	IRIS
Carbon tetrachloride	--	--	--	1.3E-01	B2	IRIS
1,2-Dichloroethene	--	--	--	--	D	--
Di-n-butylphthalate	--	--	--	--	D	--
Methylene chloride	8.57E-01 [100] (d)	HEAST	Liver	1.6E-03 (e)	B2	IRIS
Methyl ethyl ketone	9E-02 [1000]	HEAST	CNS	--	D	IRIS
Phenanthrene	--	--	--	--	D	--
Tetrachloroethene	--	--	--	1.8E-03 (f)	B2	HEAST
1,1,1-Trichloroethane	3E-01 [1000]	HEAST	Liver	--	D	--
Trichloroethene	--	--	--	1.7E-02 (g)	B2	HEAST
Inorganics						
Aluminum	--	--	--	--	D	--
Barium	1E-04 [1000]	HEAST	Fetus	--	D	--
Calcium	--	--	--	--	D	--
Copper	--	--	--	--	D	--
Cyanide	--	--	--	--	D	--
Lead	--	--	--	--	B2	IRIS
Mercury (inorganic)	8.57E-05 [30] (d)	HEAST	Nervous system	--	D	--
Silver	--	--	--	--	D	--
Sodium	--	--	--	--	D	--
Zinc	--	--	--	--	D	--

(a) Uncertainty factors used to develop reference doses generally consist of multiples of 10, with each factor representing a specific area of uncertainty in the data available. The standard uncertainty factors include the following:
- A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- A 10-fold factor to account for the uncertainty in extrapolation animal data to the case of humans;
- A 10-fold factor to account for uncertainty in extrapolating from less than chronic NOAELs to chronic NOAELs; and
- A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(b) A target organ is the organ most sensitive to a chemical's toxic effect. RfDs are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, an organ or system known to be affected by the chemical is listed.

(c) EPA Weight of Evidence for Carcinogenic Effects: [A] = Human carcinogen based on adequate evidence from human studies; [B2] = Probable human carcinogen based on inadequate evidence from human studies and adequate evidence from animal studies; [C] = Possible human carcinogen based on limited evidence from animal studies in the absence of human studies; [D] = Not classified as to human carcinogenicity; and [E] = Evidence of noncarcinogenicity.

(d) Value reported in mg/m3 converted to mg/kg-day by assuming that a 70 kg adult inhales air at a rate of 20 m3/day.

(e) Reported as 4.7E-7 (ug/m3)-1; assuming a 70 kg individual inhales 20 m3/day, this is equivalent to 1.6E-3 (mg/kg/day)-1.

(f) Reported as 5.2E-7 (ug/m3)-1; assuming a 70 kg individual inhales 20 m3/day, this is equivalent to 1.8E-3 (mg/kg/day)-1.

(g) Based on a metabolized dose.

NOTE: IRIS = Integrated Risk Information System - October 1, 1990
HEAST = Health Effects Assessment Summary Tables - July 1, 1990
EPA = Environmental Protection Agency
-- = No information available

not greater than one (1) are not likely to be associated with any health risks.

Under the current land use conditions, inhalation of volatile chemicals in ambient air by onsite workers is the only existing exposure pathway. The Site presents an upper-bound excess lifetime cancer risk of $1x10^{-7}$, and the associated overall HI for noncarcinogenic risks is less than 1 (Table 12).

For the future potential residential land use scenario, only risks associated with use of contaminated drinking water in the aquifer underneath the Site are of concern. The estimated upper-bound excess lifetime risk is $8x10^{-2}$, indicating an unacceptable risk to human health, and the associated overall HI is greater than one (Table 13), indicating the risks of adverse noncarcinogenic effects such as liver and kidney damage are unacceptable. The reason for the high risk is the heavily contaminated groundwater beneath and downgradient of the Site as shown in Figure 4. The contaminants include numerous VOCs, the major ones being 1,1,1-trichloroethane, trichloroethylene (TCE), and tetrachloroethylene (PCE). Combined concentrations of VOCs ranged as high as 180,850 parts per billion (ppb). Under the Safe Drinking Water Act (42 U.S.C. § 300), safe levels or Maximum Contaminant Levels (MCLs) have been set to protect humans. For 1,1,1-trichloroethane, the MCL is 200 ppb. The MCL for TCE and PCE are 5 ppb. Of the major contaminants, TCE and PCE are considered by EPA to be probable human carcinogens.

Some of the contaminants found in groundwater were also detected in soils. Areas of contamination include an above-ground chlorinated solvent tank area, drum storage areas, and a former lagoon. These areas could be contributing to contamination of the groundwater through the downward migration of VOCs or the leaching action of infiltrating rainwater. The risk resulting from human contact with the contaminated soils was found to be minimal due to

TABLE 12

POTENTIAL RISKS ASSOCIATED WITH CURRENT INHALATION EXPOSURE AT THE ARROWHEAD PLATING SITE (a)

Chemicals Exhibiting Carcinogenic Effects	Estimated Chronic Daily Intake (CDI) (mg/kg-day)	Slope Factor (mg/kg-day)-1	Weight of Evidence Class (b)	Upper Bound Excess Lifetime Cancer Risk
Carbon tetrachloride	7.19E-08	1.3E-01	B2	9E-09
Methylene chloride	6.12E-08	1.6E-03	B2	1E-10
Tetrachloroethene	4.81E-05	1.8E-03	B2	9E-08
Trichloroethene	2.34E-07	1.7E-02	B2	4E-09

TOTAL				1E-07

Chemicals Exhibiting Noncarcinogenic Effects	Estimated Chronic Daily Intake (CDI) (mg/kg-day)	Reference Dose (RfD) (mg/kg-day) (c)	[Uncertainty Factor]	Target Organ (d)	CDI:RfD Ratio
Methyl ethyl ketone	1.06E-06	9E-02	[1000]	CNS	1E-05
Methylene chloride	1.43E-07	9E-02	[1000]	CNS	2E-06
1,1,1-Trichloroethane	1.21E-06	3E-01	[1000]	Liver	4E-06

HAZARD INDEX					<1 (2E-05)

(a) Chemicals of concern which are not presented due to lack of inhalation toxicity criteria are: acetone, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, trans-1,2-dichloroethene, and phenanthrene.
(b) EPA Weight of Evidence for Carcinogenic Effects: [B2] = Probable human carcinogen based on inadequate evidence from human studies and adequate evidence from animal studies.
(c) Uncertainty factors used to develop reference doses generally consist of multiples of 10, with each factor representing a specific area of uncertainty in the data available. The standard uncertainty factors include the floowing:
- A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- A 10-fold factor to account for the uncertainty in extrapolation animal data to the case of humans;
- A 10-fold factor to account for uncertainty in extrapolating from less than chronic NOAELs to chronic NOAELs; and
- A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(d) A target organ is the organ most sensitive to a chemical's toxic effect. RfDs are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, an organ or system known to be affected by the chemical is listed.

TABLE 13

SUMMARY OF EXCESS LIFETIME CANCER RISKS AND HAZARD INDICES FOR THE ARROWHEAD PLATING SITE

Exposure Pathway	Drum Storage Area		Acid Tank Area		Solvent Tank Area		Drain Lines Area		Stained Area	
	Excess Lifetime Cancer Risk	Hazard Index	Excess Lifetime Cancer Risk	Hazard Index	Excess Lifetime Cancer Risk	Hazard Index	Excess Lifetime Cancer Risk	Hazard Index	Excess Lifetime Cancer Risk	Hazard Index
Ingestion of Ground Water [a]	8E-02	>1	8E-02	>1	8E-02	>1	8E-02	>1	8E-02	>1
Inhalation of Airborne VOCs	1E-08	<1	--	<1	1E-07	<1	--	<1	4E-09	--
Dermal Contact and Incidental Ingestion of Surface Soil	2E-08	<1	4E-09	<1	7E-07	<1	--	<1	5E-08	<1
Dermal Contact of Surface Water and Sediment by Residents (Children)	1E-08	<1	1E-08	<1	1E-08	<1	1E-08	<1	1E-08	<1
	-----	----	-----	----	-----	----	-----	----	-----	----
TOTAL	8E-02	>1	8E-02	>1	8E-02	>1	8E-02	>1	8E-02	>1

-- = No chemicals exhibiting this effect (carcinogenic or noncarcinogenic) were present in this medium and source area, or inadequate toxicity data to evaluate carcinogenic or noncarcinogenic effects of chemicals present in this medium and source area.

[a] The excess lifetime cancer risks and hazard indices are based on the future residential use scenario.

the limited extent of the contamination associated with soils at the Site. Inorganic substances were detected in groundwater above background levels, but these levels were not of concern for human health.

Contaminated groundwater is also discharging to Scates Branch, a small creek which eventually discharges to Weaver's Millpond about one mile downstream. None of the volatile contaminants were detected in the pond. Concentrations of contaminants in surface water and sediment do not present a significant risk to local residents who might utilize these areas.

In addition to the human health risk assessment, an environmental risk assessment was also conducted to determine the significance of the impact the Site has to the environment. In this assessment, the eastern tiger salamander and aquatic organisms as a group were identified as potential environmental receptors near the Site. The eastern tiger salamander was selected because it is on the State Endangered Species list and had potential to be found near the Site. This salamander is not a Federal endangered species. Exposure potential for most terrestrial animals is minimal because the chemicals of concern at the Site show little potential for bioaccumulation. The state endangered eastern tiger salamander, an amphibian, is terrestrial as an adult, but it lays eggs in surface water. The eggs hatch into aquatic larvae, where direct contact with surface water and sediment occurs.

The results of the environmental assessment indicate that groundwater discharging to surface water could adversely affect aquatic life. Several inorganic substances were detected in surface waters at concentrations that slightly exceed criteria to protect aquatic life, including copper, cadmium, and cyanide. Consequently, it is possible that aquatic life in the surface water near the Site may be negatively impacted. Groundwater also discharges some VOCs from the aquifer to the nearby surface water.

Concentrations of VOCs in seep samples were high enough to have a potential adverse effect on aquatic life. However, due to the volatility of these substances, a high percentage will likely evaporate to the air within a short distance downstream.

VII. DESCRIPTION OF ALTERNATIVES

During the FS, several technologies potentially applicable to remediating the Site problems were screened based on their effectiveness, implementability and cost. The screening process identifies those technologies that are most appropriate for reducing the toxicity, mobility and volume of the groundwater contamination at the Site. Since soil remediation would facilitate the restoration of the contaminated portion of the aquifer, remedial technologies applicable to the treatment of contaminated soils were also screened. To achieve the cleanup levels, remedial technologies are combined to form the following remedial alternatives:

Alternative 1: No Action

Alternative 2a: Groundwater Extraction and Treatment by Precipitation, Air Stripping, and Carbon Adsorption. Soil Treatment by In-situ Vapor Extraction. Institutional Controls.

Alternative 2b: Groundwater Extraction and Treatment by Precipitation, Air Stripping, and Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Offsite Disposal. Institutional Controls.

Alternative 3a: Groundwater Extraction and Treatment by Precipitation, Ultraviolet Oxidation, and Carbon Adsorption. Soil Treatment by In-situ Vapor Extraction. Institutional Controls.

Alternative 3b: Groundwater Extraction and Treatment by Precipitation, Ultraviolet Oxidation, Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Offsite Disposal. Institutional Controls.

Alternative 4a: Groundwater Extraction and Treatment by Precipitation, Steam Stripping, and Carbon Adsorption. Soil Treatment by In-situ Vapor Extraction. Institutional Controls.

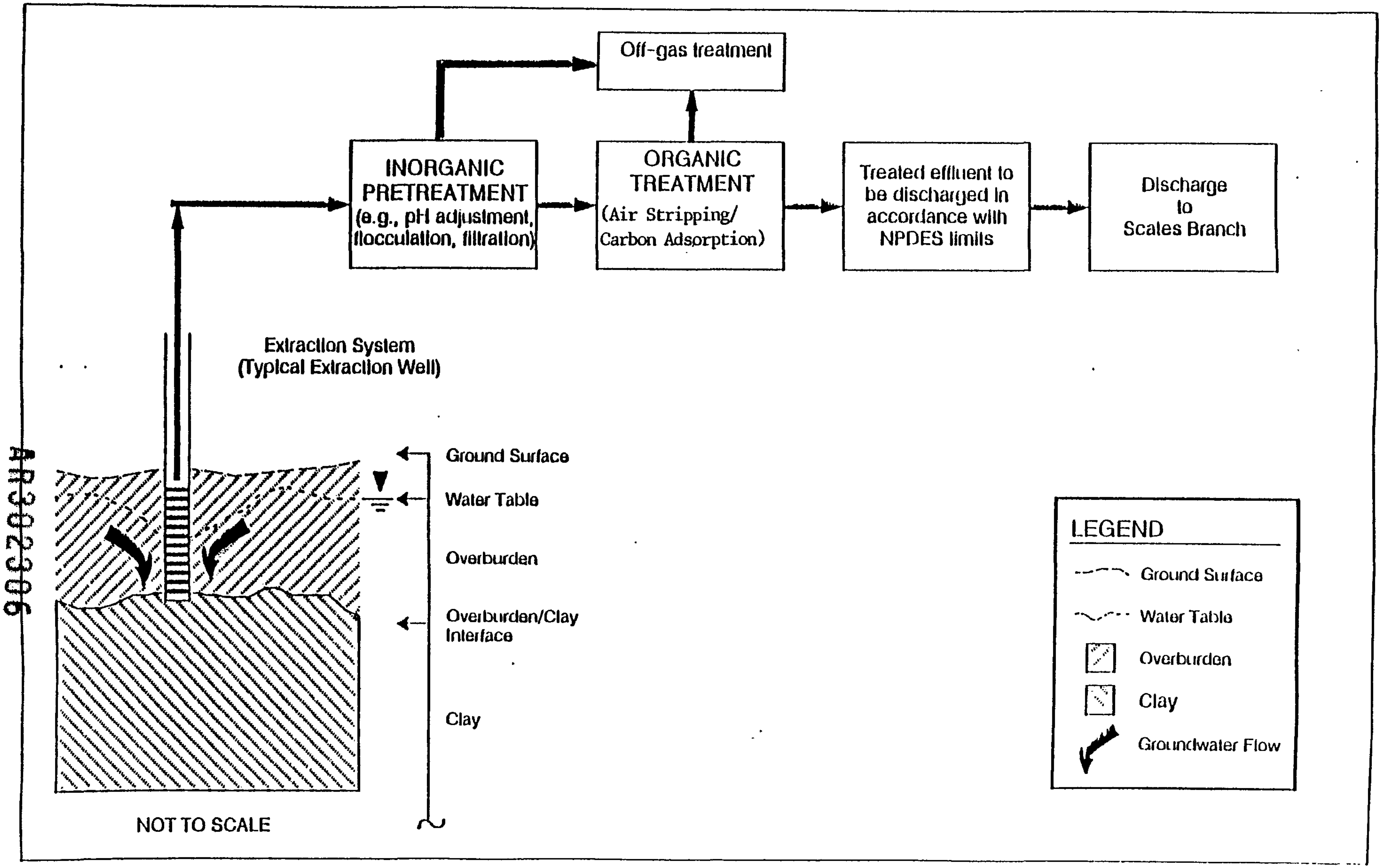
Alternative 4b: Groundwater Extraction and Treatment by Precipitation, Steam Stripping, and Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Offsite Disposal. Institutional Controls.

Common Elements. Except for Alternative 1, all alternatives would include a groundwater extraction system designed to minimize migration of the contaminated groundwater and to remove contaminated groundwater from the aquifer for treatment. The initial estimate for the groundwater extraction network consists of approximately 8 to 10 extraction wells, resulting in a total pumping rate of 30 gallons per minute. Pumping tests will be necessary to determine the optimal design for a groundwater extraction system. The extracted groundwater would be conveyed to a treatment system composed of units that meet the definition of tanks as specified in Virginia Hazardous Waste Management Regulations (VHWMR) § 10.9, and prevent the escape of volatilized contaminants. The treated water would be discharged to Scates Branch (Figure 5). Groundwater monitoring would be periodically conducted. At a minimum, the influent of the treatment system will be sampled monthly and selected wells will be sampled quarterly for volatile organics, metals (target analyte list), and total cyanide. In addition, monitoring to ensure protection of aquatic life in the nearby surface water would also be conducted. The environmental monitoring requirements are specified in more detail in the Section IX of this ROD, which is entitled *Selected Remedy and Performance Standards*. Periodic review of the overall effectiveness of the remedy will be conducted at a minimum of every five (5) years after the initiation of the remedial action. For the purpose of cost estimate, it is assumed that the groundwater treatment period would extend approximately 30 years, although this period may be longer or shorter depending on how the aquifer responds to the pump-and-treat system. As part of the soil remedy, all alternatives, except the No Action Alternative, would define more precisely the extent of VOCs contamination in the soils at the Site.

The discharge of treated water to surface water is expected to meet Virginia Pollution Discharge Elimination System (VPDES) (Code of Virginia §§ 62.1-44.2 et seq.) requirements developed by the Virginia State Water Control Board (VSWCB) pursuant to the Federal Clean Water Act and Virginia State Water Control Law. Section IX specifies in more detail the VPDES requirements for the groundwater remedy at the Site. Air emissions from the treatment system are expected to meet requirements under the National Emission Standards for Hazardous Air Pollutants (NESHAPs) developed under the Federal Clean Air Act and the Virginia Regulations for the Control and Abatement of Air Pollution (VRCAAP). Air monitoring will be conducted to ensure that emissions are protective of onsite workers

FIGURE 5

Groundwater Extraction, Treatment, and Discharge Process Schematic



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and the nearby community. Residual wastes generated by the treatment process would be disposed in accordance with treatment, storage, and disposal regulations under the Resource Conservation and Recovery Act (RCRA), including Land Disposal Restrictions (LDRs), and VHWMR. Carbon filters used in the process will be disposed offsite or regenerated according to LDRs under RCRA. Transportation of the wastes from the Site is expected to be in compliance with VHWMR, Part VII, and U.S. Department of Transportation Rules for transportation of Hazardous Materials.

Treatability tests for both groundwater treatment system and soil treatment system are necessary to determine design parameters for all alternatives, except Alternative 1.

Alternative 1 - No Action

Under the NCP, the "No Action" alternative must be developed to provide a base line for comparison of other alternatives. This alternative would include semi-annual sampling of contaminated groundwater, and groundwater sampling review every five (5) years. The estimated cost for this alternative is 1.25 million dollars.

Alternative 2a - Groundwater Extraction and Treatment by Precipitation, Air Stripping, and Carbon Adsorption. Soil Treatment by In-situ Vapor Extraction. Institutional Controls.

<u>Groundwater</u>. This alternative utilizes a groundwater extraction system and treatment of the contaminated water by precipitation, air stripping, and carbon adsorption. Precipitation would remove inorganic contaminants to pretreat the water prior to the air stripping step. The precipitation process involves adjusting the pH to encourage precipitation of inorganic compounds followed by flocculation/sedimentation and filtration. After the precipitation step, the groundwater would be conveyed to an air stripping unit, where the VOCs in

the groundwater at the Site would be effectively removed. An activated carbon adsorption step following the air stripping treatment would remove residual contaminants as a polishing step prior to discharge of the treated water to Scates Branch. Air emissions would be periodically monitored to prevent adverse impact on workers and the surrounding community, and to ensure the effectiveness of the emission control unit. The entire groundwater treatment train would be closed to prevent any escape of VOCs into the air. Any offgas escaping from the water during treatment would be captured and treated by carbon adsorption prior to discharge to the atmosphere.

Soil. The contaminated soils would be treated by in-situ soil vapor extraction technology. A soil vapor extraction (SVE) system would force air through the contaminated soils. The air passing through the soils would remove vaporized contaminants from the soil particles. The entire soil treatment train would be closed to prevent any escape of VOCs into the air. Any offgas escaping from the soil during treatment would be captured and treated by carbon adsorption prior to discharge to the atmosphere.

Institutional Controls. In addition to groundwater and soil remediation, Alternative 2a includes institutional controls, which consist of State regulations and/or County ordinances that prohibit use of water from the contaminated aquifer until the aquifer has been remediated to acceptable levels.

Capital Cost:	$ 1,344,000
Annual Cost:	$11,833,000
Present Worth:	$13,177,000
Time to Construct:	1 year

Alternative 2b - Groundwater Extraction and Treatment by Precipitation, Air Stripping, and Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Disposal. Institutional Controls.

Groundwater. Alternative 2b utilizes the same groundwater treatment components as Alternative 2a.

Soil. The contaminated soils would be excavated and transported offsite for incineration followed by offsite disposal in an approved RCRA landfill, instead of using in-situ vapor extraction as in Alternative 2a. It is assumed that approximately 750-1,000 cubic yards of contaminated soil would be excavated and transported to a permitted offsite incineration facility prior to disposal. The exact volume of soil requiring excavation will be determined in the remedial design. The excavated area(s) would be backfilled with clean soil and revegetated.

Institutional Controls. Alternative 2b includes institutional controls as described in Alternative 2a.

Capital Cost:	$ 5,815,000
Annual Cost:	$11,758,000
Present Worth:	$17,573,000
Time to Construct:	1 year

Alternative 3a - Groundwater Extraction and Treatment by Precipitation, Ultraviolet Oxidation, and Carbon Adsorption. Soil Treatment by In-situ Vapor Extraction. Institutional Controls.

Groundwater. Under this alternative, ultraviolet (UV) oxidation would be the major groundwater treatment process. The precipitation and carbon adsorption components are identical to Alternative 2a. The UV/oxidation process is an emerging groundwater treatment technology that uses a combination of ultraviolet light and a strong oxidizing agent(s) to convert the organics in the groundwater to carbon dioxide, chloride and water. Most commonly used oxidants include hydrogen peroxide (H_2O_2) and ozone (O_3).

Soil. To treat the contaminated soils, this alternative employs the soil vapor extraction technology as described in Alternative 2a.

Institutional Controls. Institutional controls for this alternative would be as described in Alternative 2a.

Capital Cost:	$ 1,578,000
Annual Cost:	$11,341,000
Present Worth:	$12,919,000
Time to Construct:	1 year

Alternative 3b - Groundwater Extraction and Treatment by Precipitation, Ultraviolet Oxidation, and Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Disposal. Institutional Controls

Groundwater. Alternative 3b uses the same groundwater treatment components as Alternative 3a.

Soil. The contaminated soils would be excavated and transported offsite for incineration followed by offsite disposal in an approved RCRA landfill, as described in Alternative 2b.

Institutional Controls. Alternative 3b includes institutional controls as described in Alternative 2a.

Capital Cost:	$ 6,049,000
Annual Cost:	$11,279,000
Present Worth:	$17,328,000
Time to Construct:	1 year

Alternative 4a - Groundwater Extraction and Treatment by Precipitation, Steam Stripping, and Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Disposal. Institutional Controls

Groundwater. Alternative 4a utilizes a high-efficiency steam stripper (HESS) unit as the major groundwater treatment component to remove the VOCs contaminants from the groundwater. A precipitation unit would pretreat the groundwater to remove inorganics as described in Alternative 2a. HESS uses steam to evaporate volatile organics from the groundwater. The decontaminated water coming out of the stream stripping tower is expected to meet the VPDES requirements. The vapor effluent of the stripping tower would subsequently pass through a condensing heat exchanger in which organics are recovered. An activated carbon bed would trap residual organics in the vapor effluent prior to discharge to the atmosphere. Air emissions would be periodically monitored to prevent adverse impact on workers and the surrounding community, and to ensure the effectiveness of the emission control unit.

Soil. This alternative would employ in-situ vapor extraction to treat contaminated soils at the Site as described in Alternative 2a.

Institutional Controls. Alternative 4a includes institutional controls as described in Alternative 2a.

Capital Cost:	$ 2,398,000
Annual Cost:	$12,617,000
Present Worth:	$15,015,000
Time to Construct:	1 year

Alternative 4b - Groundwater Extraction and Treatment by Precipitation, Steam Stripping, and Carbon Adsorption. Soil Excavation and Treatment by Offsite Incineration and Disposal. Institutional Controls

Groundwater. Alternative 4b utilizes the same groundwater treatment scheme as in Alternative 4a.

Soil. The contaminated soils would be excavated and transported offsite for incineration followed by offsite disposal in a RCRA landfill, as described in Alternative 2b.

Institutional Controls. This alternative includes institutional controls as described in Alternative 2a.

Capital Cost:	$ 6,869,000
Annual Cost:	$12,546,000
Present Worth:	$19,415,000
Time to Construct:	1 year

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the alternatives listed above in accordance with the nine criteria required by the NCP, 40 CFR Part 300.430(e)(9) for the evaluation of remedial alternatives (Appendix A). The nine criteria can be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria.

Threshold criteria:

1. Overall protection of human health and the environment; and

2. Compliance with applicable or relevant and appropriate requirements.

Primary balancing criteria:

3. Long-term effectiveness and permanence;
4. Reduction of toxicity, mobility, or volume through treatment;
5. Short-term effectiveness;
6. Implementability; and
7. Cost.

Modifying criteria:

8. State/Support agency acceptance; and
9. Community Acceptance.

Overall Protection of Human Health and the Environment

Because contaminant levels in the groundwater at the Site have exceeded health-based levels and contamination is likely to migrate further from the Site, Alternative 1 (No Action Alternative) would not be protective of human health. This alternative, therefore, cannot be selected and will not be evaluated further.

All alternatives, except Alternative 1, are expected to be protective of human health and the environment. The removal of groundwater contaminants is expected to significantly reduce risk associated with groundwater ingestion by future residents. Soil remediation by these alternatives is expected to reduce the migration of contaminants from soils into groundwater, thereby protecting the environment and reducing risk involving soil ingestion and dermal contact by future residents.

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

The NCP specifies that the remedial alternative selected must comply with Federal and State ARARs. All alternatives, except Alternative 1, are expected to comply with these requirements. In addition, all alternatives are potentially capable of achieving the cleanup levels for the groundwater at the Site. Compliance with the cleanup levels will be evaluated and monitored during the remediation period, and additional response actions will be implemented as necessary.

Long-term Effectiveness and Permanence

All alternatives, except Alternative 1, are expected to permanently remove the contaminants from the groundwater and remove volatile organics from the soils, thereby preventing the soils from acting as a continuing source of contamination to groundwater at the Site. Therefore, the risks to human health and the environment associated with groundwater contamination, which is the principle risk posed by the Site, would be significantly reduced.

All remedial technologies employed in these alternatives have been successfully used to treat similar contaminants at other hazardous waste sites. The UV/oxidation process, however, would require more testing to assure reliability. Both the UV/oxidation process and HESS require more process monitoring than the air stripping process to maintain reliability. Because all organic contaminants in the Site groundwater are volatile compounds, air stripping would be the most appropriate treatment process for the groundwater. Alternatives 2a and 2b, therefore, provide a higher degree of reliability over other alternatives with regard to treatment of contaminated groundwater at the Site.

Reduction of Toxicity, Mobility, or Volume through Treatment

All alternatives, except Alternative 1, are expected to produce similar and significant reduction of toxicity, mobility and volume of contamination associated with the groundwater and the soils at the Site. These alternatives use different methods of ultimate disposition of contaminants removed from the Site. In Alternatives 2a and 2b (involving air stripping), organics from the groundwater are collected by carbon, which would be sent offsite for destruction or regeneration. A small amount of organics not adsorbed by the carbon will be released into the air and to Scates Branch with the effluent water. Alternatives 3a and 3b destroy contaminants in groundwater by UV/oxidation treatment. In Alternatives that utilize HESS (4a and 4b), contaminants in groundwater are collected by an organic-water separator and sent offsite for destruction or reclamation.

In Alternatives involving the use of SVE (2a, 3a, and 4a), contaminants in soils are collected and treated prior to discharge to the atmosphere. The used carbon would be sent offsite for destruction or regeneration. In Alternatives 2b, 3b, and 4b, the contaminated soils are sent offsite for treatment and disposal.

Short-term Effectiveness

Risks to workers, the community and the environment during the implementation period are expected to be minimized by emission control measures.

All alternatives, except Alternative 1, would discharge treated water of acceptable quality to Scates Branch. In Alternatives 2a, 2b, 4a, and 4b, air emissions would be controlled by vapor phase carbon adsorption so that all adverse impacts to workers and the surrounding community would be eliminated. Monitoring of the performance of the emission adsorption unit will be required to assure its effectiveness and the protection of human health. In Alternatives 3a and 3b, no air emissions are expected if only hydrogen peroxide is used in the treatment process for groundwater.

In Alternatives 2a, 3a, and 4a, which utilize SVE, discharge of volatile organics to the atmosphere would be monitored closely for compliance with air emission regulations and to assure protection of human health. Gas collected from the SVE process would be treated by carbon adsorption to eliminate potential impacts to workers and the nearby community. Alternatives 2b, 3b, and 4b could result in a small release of volatile organics into the air during the excavation period, which could last a few weeks. It is unlikely that these emissions would produce an adverse impact on the workers or the community due to their short duration, low emission levels, and rapid dispersion. Excavation would be conducted during cooler temperatures, and air in the vicinity of the excavation area would be monitored to ensure compliance with applicable air emission regulations and the protection of human health. If unacceptable emissions occur, excavation activity would be stopped. Transportation of wastes and excavation of contaminated soils for offsite treatment and disposal would be in compliance with applicable laws and regulations, and a health and safety plan would be implemented to ensure protection of workers.

Implementability

All alternatives are technically implementable. Design and construction for all alternatives is anticipated to take eight months to one year. Air stripping, carbon adsorption, UV/oxidation, steam stripping, SVE, and offsite incineration have been successfully demonstrated at other sites under similar conditions.

However, UV/oxidation and HESS are emerging groundwater treatment technologies, and service for these technologies is available through only a limited number of vendors. Service for the air stripping technology, on the other hand, is widely available. Operational and process monitoring requirements for Alternatives 2a and 2b, which involve air stripping, are expected to be less intensive than for the other alternatives since the air stripping technology is simpler. Both SVE and offsite incineration/disposal are relatively available in the market. In summary, Alternatives 2a and 2b are the most implementable ones among the alternatives analyzed for the Site.

Cost

Treatment alternatives involving the use of either air stripping (Alternatives 2a and 2b) or UV/Oxidation (Alternatives 3a and 3b) cost relatively the same. Alternatives 4a and 4b, which utilize steam stripping, cost approximately two million dollars more.

The estimated total present worth for alternatives that utilize SVE (2a, 3a, and 4a) ranges from 12.9 million dollars to 15 million dollars. For alternatives involving offsite incineration and offsite disposal of soils, the estimated total present worth ranges from 17.6 million to 19.4 million. Alternatives with offsite incineration and offsite disposal (2b, 3b, and 4b) cost approximately 4.4 million dollars more than the corresponding alternatives (Alternatives 2a, 3a, and 4a), which employ the respective groundwater treatment scheme and SVE to treat soils.

State/Support Agency Acceptance

Both the Commonwealth of Virginia and EPA support the selected remedy as described in Section IX of this ROD, selected remedy and performance standards.

Community Acceptance

Community acceptance of the selected alternative is described in the responsiveness summary of the ROD (Part III).

IX. SELECTED REMEDY AND PERFORMANCE STANDARDS

Based on the evaluation of alternatives using the nine criteria and the public comments, both VDWM and EPA identify Alternative 2a as the selected remedy for cleaning up the Site and protecting human health and the environment. This alternative is believed to provide the best balance of tradeoffs with respect to the evaluation criteria. Among the balancing criteria, implementability and long-term effectiveness and permanence indicate that Alternative 2a is the most appropriate remedy for the Site.

Under the selected alternative, the contaminated groundwater will be extracted from the aquifer for treatment using a combination of air stripping and carbon adsorption, and the contaminated soils will be treated by soil vapor extraction. A monitoring scheme would be conducted to ensure the effectiveness of the remedy. Institutional control measures will also be developed and implemented. Treatability tests for the groundwater treatment system and soil treatment system are necessary to determine design parameters for the selected remedy. Some changes may be made to the selected remedy as a result of the remedial design and construction processes.

Work to be performed under this ROD shall be done in accordance with final remedial design documents and remedial action plans. In addition, the work shall comply with all ARARs and TBCs as set forth in the Statutory Determinations Section of this ROD, including but not limited to the specific standards discussed below in this section, which must be met with respect to the elimination of Site contamination.

Major components of the selected remedy and the corresponding performance standards for each component are detailed below.

Description of Groundwater Treatment Process

A groundwater extraction system would be installed to minimize migration of the contaminated groundwater and to remove groundwater from the aquifer for treatment. The initial estimate for the groundwater extraction network consists of approximately 8 to 10 extraction wells, resulting in a total pumping rate of 30 gallons per minute. Pumping tests will be necessary to determine the optimal design for a groundwater extraction system. Following extraction from the aquifer, the contaminated groundwater will be conveyed to a treatment system composing of precipitation, air stripping, and carbon adsorption units. The precipitation step would remove inorganic contaminants to pretreat the water prior to the air stripping step. The precipitation process involves adjusting the pH to encourage precipitation of inorganic compounds followed by flocculation/sedimentation and filtration. After the pretreatment step, the groundwater would be conveyed to an air stripping unit, which would effectively remove the VOCs. An activated carbon adsorption step following the air stripping treatment would remove residual contaminants as a polishing step prior to discharge of the treated water to Scates Branch. The entire groundwater treatment train would be closed to prevent any escape of VOCs into the air. Residuals generated by the treatment process will be disposed offsite, and carbon filters will be disposed or regenerated offsite. Any offgas escaping from the water during treatment would be captured and treated by carbon adsorption prior to discharge to the atmosphere. Air emissions would be periodically monitored to prevent adverse impact on workers and the surrounding community, and to ensure the effectiveness of the emission control unit. Figure 5 depicts the groundwater treatment scheme under the selected remedy.

Groundwater Treatment Performance Standards

1. Effluent Discharge Limits. Following the extraction and treatment of groundwater, the treated water must be discharged to the receiving stream (Scates Branch) in accordance with the effluent discharge limits established by the VSWCB as set forth below. These effluent discharge limitations require a toxics monitoring program to be conducted as part of the discharge permit requirements. These permit conditions may be modified as necessary if new information generated in the remedial design/remedial action (RD/RA) indicates significant changes in Site conditions.

Effluent Limitations

Parameter	Effluent Limitation (µg/l)
1,1,1-Trichloroethane	758928.6
Tetrachloroethene	40
Trichloroethene	360
1,1-Dichloroethene	NL
1,2-Dichloroethene (Total)	NL
1,1-Dichloroethane	NL
Acetone	NL
2-Butanone	NL
Methylene Chloride	NL
Carbon Disulfide	NL
Chloroform	2098
Chloroethane	NL
1,2-Dichloroethane	441.9
1,1,2-Trichloroethane	NL
Benzene	236.6
Ethylbenzene	1428.6
Vinyl Chloride	2343.8

4-Methyl 2-Pentanone	NL
Toluene	781
Xylene (Total)	169.6
Total Cadmium	32.6
Total Copper	25.7
Total Nickel	344.7
Total Zinc	231.5

NL = No Limit; however, monitoring and reporting are required.

These limits shall be modified to comply with any applicable effluent standard or limitation issued or approved under §§ 301(b)(2)(C),(D), and (E), 304(b)(2)(3)(4), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

(a) Contains different conditions or is otherwise more stringent than any effluent limitation specified above; or

(b) Controls any pollutant of concern not limited by the effluent limitations listed above.

Toxics Management Program

A. Biological monitoring:

(1) In accordance with the schedule in D. below and commencing within six months following the initial discharge of treated groundwater, the permittee shall conduct quarterly acute and chronic toxicity tests for a period of one year using 24-hour composite samples of final effluent from the discharge point. The acute tests shall be 48-hour static test using Ceriodaphnia and Pimephales

promelas, both conducted in such a manner and at sufficient dilutions for calculation of a valid LC50. The chronic tests shall be static renewal tests using Ceriodaphnia and Pimephales promelas. The Ceriodaphnia test shall be a 7-day reproduction test and the Pimephales test shall be a 7-day larval growth test. These chronic tests shall be conducted in such a manner and at sufficient dilutions to determine the "no Observed Effect Concentration" (NOEC) for survival and growth or reproduction. The permittee may provide additional samples to address data variability during the one year period of initial data generation. These data may be included in the evaluation of effluent toxicity. The results of all such additional analyses shall be reported. Technical assistance in developing the procedures for these tests shall be provided by VSWCB, if requested by the permittee. Test protocols and the use of alternative species shall be approved by the State Water Control Board staff prior to initiation of testing.

(2) If the LC50 is greater than or equal to 100% effluent in 6 or more of the total of 8 acute toxicity tests, or in at least 75% of the tests conducted if more than 8 tests are conducted, and if the NOEC is greater than or equal to the in-stream waste concentration (IWC) of 22.4% effluent in 6 or more of the total of 8 chronic toxicity tests, or in at least 75% of the tests conducted if more than 8 tests are conducted, the permittee shall continue acute and chronic toxicity testing of the effluent from the discharge point annually. The first annual tests shall be conducted within

three months of the last quarterly tests. The test organisms shall be those identified as the most sensitive species from the quarterly acute and chronic tests or alternative species approved by the VSWCB staff.

(3) If the LC50 is less than 100% effluent in 3 or more out of the total of 8 acute toxicity tests, or in more than 25% of the tests conducted if more than 8 tests are conducted, or if the NOEC is less than the IWC of 22.4% effluent in 3 or more out of the total of 8 chronic toxicity tests, or in more than 25% of the tests conducted if more than 8 tests are conducted, a toxicity reduction evaluation will be required.

(4) If, in the testing according to (2) above, any of the annual acute toxicity tests yields an LC50 of less than 100% effluent or any annual chronic toxicity test yields an NOEC of less than the IWC of 22.4% effluent, the test shall be repeated within 3 months. If the retest also indicates and LC50 of less than 100% effluent or an NOEC of less than the IWC, quarterly toxicity testing as in (1) above shall commence within three months. The results of these tests will be included in the evaluation of the need for toxicity reduction. If the retest does not confirm the results of the first test, then annual testing in accordance with the original annual compliance schedule shall resume.

B. Chemical monitoring:

(1) In accordance with the schedule in D, below and

commencing within six months following the initial discharge of treated groundwater, and continuing quarterly for a period of one year, the permittee shall collect 24-hour composite samples of the effluent from the discharge point. These samples shall be analyzed in the following manner:

(a) Priority pollutant and non-priority pollutant extractable organics using EPA's gas chromatography-mass spectrometry method 625, or other equivalent EPA approved methods. The permittee shall:

(i) report all priority pollutant organics present at the method detection limits established in method 625, and

(ii) tentatively identify and report a maximum of 20 substances which are detected but are not listed as priority pollutants including all of the non-priority substances of greatest apparent concentration for the combined base/neutral and acid extractable fractions to a maximum of 20.

(b) Organochlorine pesticides and PCBs using the EPA method 608. The permittee shall determine and report the concentrations of all compounds listed in this method at the detection limits specified in method 608.

(2) The above chemical analyses shall be conducted using EPA approved methods. The permittee shall obtain approval from VSWCB staff before using non-

EPA approved tests methods and/or detection and reporting limits other than those required in this special condition.

(3) The above chemical analyses shall be conducted in conjunction with the biological monitoring required in A. (1) whenever possible. When the results of biological testing indicate the necessity of resuming quarterly toxicity testing, the quarterly chemical analyses described in B. (1) shall also resume. The permittee may provide additional samples to address data variability during the one year period of initial data generation. These data may be included in the evaluation of effluent toxicity. The results of all such additional analyses shall be reported.

C. Toxicity Reduction Evaluation:

If the results of this Toxics Management program or other available information indicate that the wastewaters are actually or potentially toxic, the permittee shall submit: (1) a toxicity reduction evaluation plan, or (2) at the permittee's option, an in-stream impact study plan, and (3) an accompanying implementation schedule within 120 days of the notification of such a determination by VSWCB. The requirement of this plan, pursuant to the Virginia Toxics Management Regulation (VR 680-14-03), shall be to (1) assure the absence of actual or potential toxicity, or to (2) demonstrate that there is, or would be, no adverse impact from the discharge on all reasonable and beneficial uses of the state's waters. Upon completion of the review of the plan, the permit may be modified or alternatively revoked and reissued in order to reflect appropriate permit conditions and a compliance schedule.

D. Testing and Reporting Schedule:

The permittee shall conduct and report the results of the toxicity tests and chemical analyses specified in this Toxics Management Program in accordance with the following schedule:

(1)	Submit toxicity test protocols for approval	Within two months following the initial discharge of treated groundwater
(2)	Conduct first quarterly biological and chemical tests	Within six months following the initial discharge of treated groundwater
(3)	Submit results of D. (2)	With the Discharge Monitoring Report (DMR) for the seventh month following the initial discharge of treated groundwater
(4)	Conduct second quarterly biological and chemical tests	Within nine months following the initial discharge of treated groundwater
(5)	Submit results of D. (4)	With the DMR submitted for the tenth month following the initial discharge of treated groundwater.
(6)	Conduct third quarterly biological and chemical tests	Within twelve months following the initial discharge of treated groundwater
(7)	Submit results D. (6)	With the DMR submitted for the thirteenth month following the initial discharge of treated

		groundwater
(8)	Conduct fourth quarterly biological and chemical tests	Within fifteen months following the initial discharge of treated groundwater
(9)	Submit results D. (8)	With the DMR submitted for the sixteenth month following the permit effective date
(10)	Conduct first annual biological tests	Within eighteen months following the initial discharge of treated groundwater
(11)	Submit results first annual biological tests	With the DMR submitted for the nineteenth month following the initial discharge of treated groundwater
(12)	Conduct subsequent annual biological tests	Within subsequent 12 month periods from D. (10)
(13)	Submit results of subsequent annual biological tests	With the DMR submitted every 12 months from D. (11)

2. Cleanup Levels. Groundwater extraction will continue until the cleanup levels set forth in the following table are achieved or until a determination is made that the cleanup levels should be re-evaluated. Adjustment to these cleanup levels may be necessary if stream monitoring in Scates Branch indicates that fresh water criteria for the protection of aquatic life are being violated. The fresh water criteria for this evaluation are those values established by VSWCB as the effluent discharge limits for

the groundwater treatment system as set forth in Item #1 above.

A. ORGANICS ($\mu g/l$)

Compound	Cleanup Level[a,*]
1,1,1-Trichloroethane	200
Tetrachloroethene	5
Trichloroethene	5
1,1-Dichloroethene	7
1,2-Dichloroethene (total)	[b]70
Methylene chloride	[c]5
1,2-Dichloroethane	5
1,1,2-Trichloroethane	[c]5
Benzene	5
Vinyl chloride	[d]2

B. INORGANICS ($\mu g/l$)

Compound	Cleanup Level[*]	Fresh Water Criteria[e]	Drinking Water Standards
Cadmium	[g]TBD	0.66	[a]10
Copper	[g]TBD	5.7	[c]1,300
Nickel	[g]TBD	50	[c]100
Zinc	[g]TBD	47	[f]5,000

[a]*Federal maximum contaminant level (MCL) from 40 CFR, Part 141.*

[b]*MCL for cis-1,2-dichloroethene.*

[c]*Proposed Maximum Contaminant Level (PMCL).*

[d]*This MCL goal is below the SW 846 8240 detection limit. Therefore, either EPA method 524.1, 524.2, or 601 will be used to verify the concentration of vinyl chloride in the groundwater. These methods have a 1 ppb detection limit for vinyl chloride.*

[e]*Virginia Water Quality Criteria for Protection of Aquatic Life (VR 680-21-03.2).*

[f]*Secondary Maximum Contaminant Level (SMCL).*

[g]*TBD (to be determined) - Because the drinking water standards for these contaminants are significantly higher than the corresponding fresh water criteria for the protection of aquatic life, cleanup levels for these contaminants will be developed during the remedial design. The established cleanup levels will not exceed the drinking water criteria as promulgated under the Safe Drinking Water Act. In addition, the cleanup levels will be established to ensure that the natural discharge of groundwater from the Site to Scates Branch and its tributaries will not result in a violation of the fresh water criteria for the protection of aquatic life.*

[*]*Monitoring of Scates Branch at points adjacent to the Site will be conducted to verify that fresh water criteria for the protection of aquatic life are maintained. These criteria are identical to the effluent discharge limits established by the State Water Control Board for the groundwater treatment system at the Site, which are in-stream criteria based on zero-flow conditions for Scates Branch. If stream monitoring indicates that these criteria are being violated, the need for adjustment to the groundwater cleanup levels will be evaluated.*

3. Sludge/Residue Management. If sludge and/or residue generated as a result of the treatment of groundwater is stored on-site prior to off-site disposal, the storage must be in compliance with Virginia Hazardous Waste Management Regulations (VHWMR) § 10.8, Use and Management of Containers, or § 10.9, Tanks. Transportation off-site of the sludge and/or residue must be in compliance with VHWMR Part VII, Regulations Applicable to Transporters of Hazardous Waste, and 49 CFR Parts 107, 171.1-172.558 regarding off-site transportation of hazardous wastes.

Description of Soil Treatment Process

The extent of contamination in soils and the action levels for related contaminants would be determined during the remedial design. The contaminated soils would be treated by in-situ soil vapor extraction technology. A SVE system would force air through the contaminated soils. The air passing through the soils would remove vaporized contaminants from the soil particles. The entire soil treatment train would be closed to prevent any escape of VOCs into the air. Any offgas escaping from the soil during treatment would be captured and treated by carbon adsorption prior to discharge to the atmosphere.

Soil Treatment Performance Standards

1. Soil Cleanup Levels. The soil vapor extraction will continue until contamination from the soil is no longer a source of release of contamination to underlying groundwater which results in groundwater contamination above the established groundwater cleanup levels. The cleanup criteria for the soil will be determined during the remedial design by considering the characteristics of the soils and associated contaminants and then deriving specific levels of contaminants in soils that would not be expected to exert a significant impact on the underlying groundwater.

Description of Environmental Monitoring

An environmental monitoring plan will be developed and implemented to ensure the effectiveness of the remedy and to be protective of human health and the environment. Periodic review of the overall effectiveness of the remedy will be conducted at a minimum of every five (5) years after the initiation of the remedial action. The pump-and-treat system may be discontinued at some point after the achievement of the groundwater cleanup levels. However, if subsequent periodic reviews indicate that the groundwater is not fully remediated, re-starting of the pump-and-treat system may be necessary.

Monitoring Performance Standards

1. <u>Air Monitoring</u>. Off-gas from the groundwater treatment and soil vapor extraction units will be treated by carbon adsorption units so that air emissions comply with the Virginia Regulations for the Control and Abatement of Air Pollution (VRCAAP) (VR 120-01-01) and are not a potential threat to the surrounding community. Air emissions from the groundwater treatment unit and the soil vapor extraction unit will be monitored in accordance with protocol set forth below that has been established by the Virginia Department of Air Pollution Control to ensure that emissions do not in violate VRCAAP (VR 120-01-01) and are protective of human health and the environment. In the event that monitoring indicates that unacceptable emissions occur, appropriate control measures will be developed and implemented to prevent any potential threat to human health or the environment. In addition, the monitoring requirements may be modified as necessary if new information generated during the RD/RA indicates significant changes in Site conditions.

The following monitoring procedures should be adequate to confirm that the ambient concentrations of the volatile organic compounds to be released into the air are in agreement with the estimates that were calculated for the air stripper operations at this site. These calculations, based on data from the RI Report, were designed to provide for the worst case emissions from the air stripper. These estimated emissions do not exceed the threshold limits specified by VDAPC regulations.

Since none of the emissions from the air stripper are expected to exceed the exemption levels of the VDAPC's toxics regulations, monitoring at or beyond the fence line is not necessary.

To verify the calculations of the expected emissions from the air stripper, emissions sampling should be performed at the air stripper outlet only. Additional monitoring may be necessary if the monitored emissions exceed the calculated emission rate.

Based on available information, VDWM identified 16 compounds found at the site which will be emitted during the air stripping operations. All of these compounds are VOCs, specifically they are a mixture composed primarily of halogenated VOCs, two oxygenated VOCs, two aromatic VOCs and one sulphur containing VOC. For this mix of VOCs, EPA METHOD TO14 - "DETERMINATION OF VOLATILE ORGANIC COMPOUNDS (VOCS) IN AMBIENT AIR USING SUMMA PASSIVATED CANISTER SAMPLING AND GAS CHROMATOGRAPH ANALYSIS" is the recommended analytical procedure. EPA METHOD TO14 has the demonstrated capability to monitor and analyze for 13 of the 16 identified compounds. EPA METHOD TO14 does not appear to sample and analyze for acetone, 2-Butanone and carbon disulfide.

The use of EPA METHOD TO14 will provide for the sampling and analysis of the compounds in the mixture which are emitted in the greatest amounts or which are the most toxic (ie., lowest Threshold Limit Value - TLV). Because of the relatively low emission rates predicted for acetone, 2-Butanone and carbon disulfide (< 1% of the exemption rate), additional monitoring protocol to sample and analyze for these compounds should not be necessary.

In summary, use EPA METHOD TO14 to monitor emissions at the outlet of the air stripper to verify the engineering emissions estimates made for 13 of the 16 compounds. EPA METHOD TO14 describes the type of samplers, the analytical methods and related monitoring protocol.

With regard to monitoring frequency and duration, it is recommended that a one hour sample be taken and analyzed once a week during the first month of operation of the air stripper. The test should be performed when the stripper is running at its projected expected treatment rate of 30 gallons of water per minute. If the emissions results are consistent, and do not exceed the engineering estimates previously provided, then the sampling can be reduced to a one hour sample and analysis taken once every 30 days for the next 11 months under the same operating and control parameters. If these emission results are consistent and do not exceed the engineering estimates previously provided, then the analysis can be reduced to a one hour sample and analysis taken once every twelve months.

2. Environmental Monitoring. An environmental monitoring plan for the site will be developed to ensure the effectiveness of the Remedial Action and to ensure that the Remedial Action is protective of human health and the environment. This plan must address all potentially impacted environmental media. The monitoring plan shall include, but not be limited to, chemical monitoring of air emissions, chemical monitoring of groundwater including monitoring of the onsite deep drinking water well, and chemical/biological monitoring of surface water and sediment. A terrestrial monitoring program for wildlife (small mammals) and vegetation impacts shall also be conducted. The plan shall also include the air monitoring described in Item #1 above under **Monitoring Performance Standards**, stream monitoring as prescribed by VSWCB as part of the effluent discharge limits set forth in Item #1 above under **Groundwater Treatment Performance Standards**, and groundwater monitoring which meets the relevant and appropriate requirements of VHWMR § 10.5. Also, at a minimum, the influent of the treatment system will be sampled monthly and selected wells will be sampled quarterly for volatile organics, metals (target analyte list), and total cyanide.

Institutional Control

Appropriate institutional control measures will be developed and implemented as part of the remedial action. Institutional control measures would consist of State regulations and/or County ordinances that prohibit use of water from the contaminated aquifer until the aquifer has been remediated to acceptable levels.

Cost Estimate of the Selected Remedy

Capital Cost:	$ 1,344,000
Annual Cost:	$11,833,000
Present Worth:	$13,177,000

Remediation Goal

The goal of the response action is to reduce the risks associated with exposures to contaminated drinking water at the Site to less than the acceptable levels, i.e., 10^{-6} lifetime incremental carcinogenic risk and hazardous index of 1. The cleanup levels for contaminants in the groundwater at the Site are listed in Table 14. The action levels for contaminants in soils will be determined during the design phase.

The information collected in the RI/FS indicates that there is potential to achieve cleanup levels in the groundwater at the Site. However, the extent to which these cleanup levels can be achieved cannot be determined until the groundwater extraction and treatment system has been implemented and the aquifer response has been monitored over time. Periodic monitoring of the aquifer response during the implementation of the groundwater extraction system may reveal that groundwater contamination is especially persistent in the immediate vicinity of the contamination source(s). Monitoring data collected during the remedial action will be evaluated to determine the effectiveness of the pump-and-treat system and to

TABLE 14
CLEANUP LEVELS FOR GROUNDWATER AT THE ARROWHEAD PLATING SITE*

A. ORGANICS (μg/l)

Compound	Cleanup Level[a]	Detected Concentration Range
1,1,1-Trichloroethane	200	10-145,000
Tetrachloroethene	5	17-26,000
Trichloroethene	5	9-21,000
1,1-Dichloroethene	7	5-(9,850)/4,800
1,2-Dichloroethene (total)	[b]70	7-4,400
Methylene chloride	[c]5	5-(200)/9
1,2-Dichloroethane	5	9-22
1,1,2-Trichloroethane	[c]5	6-25
Benzene	5	7
Vinyl chloride	[d]2	10

B. INORGANICS (μg/l)

Compound	Cleanup Level	Fresh Water Criteria[e]	Drinking Water Standards	Detected Conc. Range (Total)
Cadmium	[g]TBD	0.66	[a]10	3.6-10.8
Copper	[g]TBD	5.7	[c]1,300	1.8-17,400
Nickel	[g]TBD	50	[c]100	7.5-667
Zinc	[g]TBD	47	[f]5,000	6.3-5,600

[a]*Federal maximum contaminant level (MCL) from 40 CFR, Part 141.*

[b]*MCL for cis-1,2-dichloroethene.*

[c]*Proposed Maximum Contaminant Level (PMCL).*

[d]*This MCL goal is below the SW 846 8240 detection limit. Therefore, either EPA method 524.1, 524.2, or 601 will be used to verify the concentration of vinyl chloride in the ground water. These methods have a 1 ppb detection limit for vinyl chloride.*

[e]*Virginia Water Quality Criteria for Potection of Aquatic Life (VR680-21-03.2).*

[f]*Secondary Maximum Contaminant Level (SMCL).*

[g]*TBD (to be determined) - Because the drinking water standards for these contaminants are significantly higher than the corresponding fresh water criteria for the protection of aquatic life, cleanup levels for these contaminants will be developed during the remedial design. The established cleanup levels will not exceed the drinking water criteria as promulgated under the Safe Drinking Water Act. In addition, the cleanup levels will be established to ensure that the natural discharge of groundwater from the Site to Scates Branch and its tributaries will not result in a violation of the fresh water criteria for the protection of aquatic life.*

()Concentrations in parentheses are assocaited with tentatively identified compounds.

**Monitoring of Scates Branch at points adjacent to the Site will be conducted to verify that fresh water criteria for the potection of aquatic life are maintained. These criteria are identical to the effluent discharge limits established by the State Water Control Board for the site groundwater treatment system, which are in-stream criteria based on zero-flow conditions for Scates Branch. If stream monitoring indicates that these criteria are being violated, the need for adjustment to the groundwater cleanup levels will be evaluated.*

identify necessary modifications for the treatment scheme. It may become apparent during the implementation or operation of the groundwater extraction and treatment that contaminant levels have ceased to decline. If, even after modifications are made, a determination is made that it will be impracticable to achieve and maintain the cleanup levels in the plume or a portion of the plume, the response action will be re-evaluated. In this event, groundwater extraction and treatment would continue as necessary to achieve cleanup levels throughout the rest of the area of contamination. All of the following measures, including long-term management, may occur as a response action to address those portions of the aquifer that are no longer responding to the existing system:

1) containment measures such as slurry wall or long-term gradient control by low level pumping;

2) waiver of chemical-specific ARARs for the cleanup of those portions of the aquifer based on the technical impracticability of achieving further contaminant reduction;

3) continued monitoring of specified wells; and

4) periodic re-evaluation of remedial technologies for aquifer restoration.

With respect to the soil treatment, if the vapor extraction can not achieve the desired cleanup levels, the effectiveness of the soil treatment remedy will be re-evaluated with respect to the levels of contaminants remaining in the soils and the continued impact of these contaminants to the groundwater. If that evaluation indicates that the contaminated soils have not been successfully remediated, then further response action will be determined and implemented. Options for the response action would include, but not be limited to, offsite incineration and offsite disposal of the contaminated soils as stipulated in the discussion for soil remediation for Alternative 2b.

X. <u>STATUTORY DETERMINATIONS</u>

It is EPA's primary responsibility at Superfund sites to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA (42 U.S.C § 9621) establishes several other statutory requirements and preferences. Under this Section, the selected remedy for the Site, when completed, must comply with ARARs established under Federal and State laws unless a statutory waiver is justified. The selected remedy must also be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technology to the maximum extent practicable. Finally, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of contamination as their principle element. This section discusses how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

Among the risks associated with the Site, the contaminated groundwater currently poses the most significant risk to human health and the environment. Through treatment of the contaminated groundwater, the selected remedy is expected to restore the contaminated aquifer to beneficial use. The groundwater remediation is also expected to eliminate discharge of contaminated groundwater to Scates Branch. In addition, treatment of contaminated soils at the Site is expected to eliminate secondary sources of contamination that may act as contributing factors to the groundwater contamination. These measures would protect human health and the environment.

All wastes generated as a result of implementation of the selected remedy will be required to be disposed or treated offsite and are not expected to pose any environmental or health hazard. By treating the offgas with carbon adsorption, short-term threats and cross-media impacts will be eliminated or minimized.

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

The selected remedy is expected to comply with all chemical-specific, location specific, and action-specific ARARs, and TBCs. Those ARARs and TBCs are presented below.

Chemical-specific ARARs

1. Relevant and appropriate Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act, 42 U.S.C. § 300, set forth in 40 CFR Part 141, and proposed MCLs set forth in the Federal Register dated July 25, 1990, May 22, 1989, and August 18, 1988, as set forth in Item #2 under **Groundwater Treatment Performance Standards**, Section IX of this ROD.

Location-Specific ARARs

1. Any activity to impact on wetlands in close proximity to the Site must comply with the Virginia Wetlands Act, Code of Virginia §§ 62.1-13.1 et seq.; Virginia Wetlands Regulations (VR 450-01-0051); Chesapeake Bay Preservation Act, Code of Virginia §§ 10.1-2100 et seq.; Chesapeake Bay Preservation Area Designation and Management Regulations; federal Water Pollution Control Act, 33 U.S.C. § 1344(f)(2) (commonly referred to as § 404 of the Clean Water Act); 33 CFR 323.2(c) and 33 CFR 323.2(e); and State Water Control Law, Virginia Code §§ 62.1-44.2 et seq.

Action-Specific ARARs

1. Discharge of treated groundwater to Scates Branch will comply with effluent discharge limits and monitoring requirements established by the VSWCB in accordance with the Virginia State Water Control Law, Code of Virginia §§ 62.1-44.2 et seq.; Virginia State Water Control Board Regulations entitled "Virginia Water Quality Standards" (VR 680-21-00); the federal Water Pollution Control Act, 33 U.S.C 1251; and the federal Safe Drinking Water Act, 42 U.S.C. 300(f).

2. Groundwater monitoring in accordance with § 10.5 of VHWMR (VR 672-10-1) will be conducted to monitor the effectiveness of the groundwater remedial action.

3. Hazardous wastes to be stored onsite will be stored in accordance with §§ 10.8 and/or 10.9 of the VHWMR (VR 672-10-1).

4. Transportation of hazardous waste offsite will be in accordance with VHWMR Part VII and the U.S Department of Transportation Rules for Transportation of Hazardous Materials, 49 CFR Parts 107, 171.1-172.558.

5. Air emissions from the groundwater treatment unit and the soil vapor extraction unit must 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); the federal Clean Air Act, 42 U.S.C. 7401; and 40 CFR Part 50.

6. Onsite worker safety provisions must be in compliance with OSHA, 29 U.S.C. 651, and 29 CFR Parts 1910 and 1926.

To-Be-Considered Materials

1. An air monitoring program will be conducted in compliance with protocol established by the Virginia Department of Air Pollution Control as set forth in Item #1 under **Monitoring Performance Standards**, Section IX of this ROD.

2. Federal Executive Order 11990 related to wetlands management (40 CFR 6.302).

3. Endangered species identified to be present onsite or to be potentially impacted by site activities must be given the protection afforded by the Virginia Board of Game and Inland Fisheries, Code of Virginia §§ 29.1-100 et seq.; Virginia Endangered Species Act, Code of Virginia §§ 29.1-563 et seq.; and the federal Endangered Species Act, 16 U.S.C. 1531.

Cost Effectiveness

The selected remedy is cost-effective because it would provide a similar degree of permanence and long-term effectiveness as Alternative 4a, which employs a high efficiency-steam stripping technique to treat the groundwater, and costs less (13.2 million as opposed to 15 million dollars). The No-Action Alternative can be implemented at a much lower cost, but it does not provide for permanent treatment, protect human health and the environment. Also, or meet ARARs.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The Commonwealth and EPA have determined that the selected remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be utilized in a cost-effective manner to control contamination at the Site. The selected remedy also provides the best balance of tradeoffs among the other evaluation criteria including long-term effectiveness and permanence; short-term effectiveness; reduction in toxicity, mobility and volume through treatment; implementability; State/support agency and community acceptance; and preference for treatment of contaminated water and soils as a principle element.

By extraction and treatment of the contaminated groundwater with air stripping and carbon adsorption, and by treatment of the contaminated soils with soil vapor extraction, the principle risk at the Site is expected to be significantly reduced, resulting in acceptable risk levels. The selected remedy, therefore, has been determined to be the most appropriate alternative for the Arrowhead Plating Site.

Preference for Treatment as Principal Element

By treating the contaminated groundwater and soils at the Site, the selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element to permanently reduce the toxicity, mobility and volume of the contamination.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan, released for public comment in July 1991, identified Alternative 2a as the preferred alternative. Although this ROD selects this alternative, review of the Proposed Plan and new information have resulted in the following significant changes.

- The Proposed Plan specified groundwater cleanup levels for cadmium, copper, nickel, and zinc as 0.4, 1000, 100, and 50 ppb respectively. Upon further evaluation by VDWM and consultation with VSWCB and EPA, it was determined that these proposed cleanup levels may not be appropriate, and cleanup levels for the above inorganic contaminants will be determined during the remedial design as noted in Table 14. This determination was made to allow for the establishment of cleanup levels that meet drinking water standards and ensure the protection of aquatic life from natural discharge of groundwater from the Site to Scates Branch and its tributaries.

o The Proposed Plan indicated that treatment of offgas generated by both the groundwater remedy and the SVE process would be collected and treated if necessary. It has been determined that the offgas will be collected and treated by carbon adsorption prior to discharge to the atmosphere to minimize media transfer of contamination.

PART III

RESPONSIVENESS SUMMARY

I. AN OVERVIEW

A public meeting was held in Montross, Virginia on August 6, 1991 to discuss the Proposed Plan for Cleanup at the Arrowhead Superfund Site. The public comment period began on July 26, 1991 and closed on August 26, 1991.

The Preferred Alternative specified by the VDWM and EPA is Alternative 2a which addresses the contamination in the groundwater and soil. The clean up entails: Groundwater extraction and treatment by precipitation, air stripping, and carbon adsorption. The soil would be treated by In-situ Vapor Extraction.

Questions addressed at the August 6, 1991 public meeting pertained to clarifications of processes and risks as opposed to disagreements with elements of the proposed plan. The turn out for the meeting was quite low, the majority of attendees being local, state or national officials. Public involvement in the meeting as well as the public comment period was minimal.

The following sections comprise this Responsiveness Summary:

* Overview
* Background on Community Involvement
* Summary of Comments Received During Public Comment Period and the Department's Responses
* Appendix B: Community Relations Activities Conducted at the Arrowhead Superfund Site community
* Appendix C: Additional Information
* Appendix D: Glossary of Superfund Terms

* Appendix E: Index of Documents for the Administrative Record File

II. BACKGROUND OF COMMUNITY INVOLVEMENT

A. Site Description

The Arrowhead Plating Site is located in Westmoreland County, Virginia, one mile east of Montross. The Site occupies about 30 acres along the north side of Virginia Route 3, and consists of a one-story brick manufacturing building with approximately 150,000 square feet of area. The manufacturing building is centered along the southern half of the property. The northern half of the property contains a surface impoundment system including an area of six former process waste lagoons (ponds) and two sanitary waste lagoons. Route 645 forms a semi-circle around the north and west perimeters of the Site. Route 645 is primarily residential, with residents relying on groundwater for their primary drinking water source. Drinking water for the site area is provided by a deep well completed in 1966 on the Northwest side of the property, and surface water flows to the Northeast towards Scates Branch.

Scates Branch is a stream located within fifty (50) feet of the Site. Surface water from the Site drains into Scates Branch, which flows 3400 feet to Weavers Millpond. Weavers Millpond drains to the Northeast through Pierce Creek to Nomini Creek. Pierce Creek becomes a tidal wetland, which is used for fishing and crabbing, about 1.2 miles from the Site. A school is located nearby on Route 3.

The primary newspapers in the Montross area are the Westmoreland News, the Fredericksburg Freelance Star, and the Northern Neck News. Citizens get information on current events from these media, as well as television, radio and word-of-mouth. WNNT out of Warsaw, and WRAR out of Tappahannock, are the major radio stations serving the Montross area.

The Westmoreland Environmental Council is also located in the area. The Environmental Council is made up primarily of Nomini Bay residents, and concerns itself primarily with Chesapeake Bay-related issues. Members are interested in the Arrowhead Site Superfund activities.

The primary issues of concern to most Montross-area residents include any issues that affect the Nomini Creek, Chesapeake Bay or local waters and wetlands; agriculture; maintaining the natural beauty of the area; and the recent influx of people from the Northern Virginia area who are buying land around Nomini Creek, and what impact this will have on the area.

B. History of Public Involvement

When Community Relations Plan interviews were conducted in 1990, interest levels in the area with regards to the Arrowhead Superfund Site seemed relatively low. Local officials indicated that since the removal action was completed, residents were not as interested in Site activities. This lull in public interest in the Site could have stemmed from any of the following:

* The plant, though with different operators, still employed a significant number of local residents (an estimated 200 people are still employed at the Site);

* Some people interviewed indicated that there was not much knowledge about the issues being investigated at the Site or the solutions being reviewed, and people would be interested in receiving information about the Site remedial activities if they were contacted.

* There were, and are, some groups of residents for whom other

issues are more immediate or important, such as employment, daily living, education of children, etc.

* Some people interviewed suggested that there may have been a general lack of understanding of the difference between the removal action and the remedial investigation/feasibility study. Many people, according to some individuals interviewed at that time, believed the Site had already been "cleaned up" during the removal action (December 1986 through November 1988), or were generally unaware that there was a problem at the Site.

* Those who live along the Nomini Creek at the furthest point of Route 645 may not have been aware that possible groundwater and surface water contamination was being investigated, and that a possible impact on the Creek and other shellfish beds was under study.

C. Key Community Concerns and Interests

According to those interviewed by the State, there are several areas of concern among the local citizens with regards to the Arrowhead Site and related activities:

* The primary concern among residents who have been concerned is the quality of the groundwater, since all residents rely on groundwater for drinking water supplies, and there is a very deep well located on the Site, with a water tower and many residential wells nearby. There has also been an interest in any impact the contamination had on the nearby wetlands, shellfish beds, or creeks.

* Many residents are currently employed by the tenants of the plant. One resident suggested during preliminary CRP interviews that there may have been concern about the health

effects on these employees from working, eating, and drinking on the Site. This resident said that, because older school children would learn about Site activities as part of their curriculum, this concern might have been prevalent among those students whose parents work at the Site.

* Residents who are members of the Environmental Council, and/or reside along one of the Potomac tributaries that receives runoff from the Site, have been and remain concerned about the contamination from the Site affecting the shellfish beds. One of the primary industries in Westmoreland County is seafood harvesting form the local waters, which provides a wide employment base during winter months in particular.

* There was concern voiced by some that information about the Site has not been made available, and the public should have access to information on the Site, remedial efforts, results of the removal action, and future test results. There was some fear among County officials that unnecessary concern would be stirred by the public participation program. There was the sentiment among some Town of Montross officials that the information would help allay unnecessary fears, concerns and suspicions about the Site.

* County officials were concerned that remedial investigation/ feasibility study work would interfere with the potential "industrial development" usage of the county-owned portion of the property.

D. Recent Community Interest Levels and Participation

A comprehensive community relations plan has been put into effect since those initial CRP community interviews were conducted, including quarterly Site updates mailed to residents on the mailing list, community workshops or meetings at project milestones, and periodic updates to local officials by letter or telephone. An Administrative Record File was set up in the community, and the Information Repository was relocated to the Assistant County Administrator Office on Peach Grove Lane, Montross, and the files updated.

Approximately 40 citizens attended a June 1990 community workshop on the RI/FS kickoff. The Westmoreland Environmental Council members remain the core of more interested residents, but one local official indicates that "the grapevine" continues to pass information on Site activities to interested but "shy" residents.

In May 1991, a community relations representative from EPA attended a meeting in the community to update a citizen's group on the status of Site activities.

A public meeting was held on August 6, 1991 to present the proposed plan for Site cleanup. The meeting was moderated by VDWM staff, and a handful of residents attended. The Westmoreland Environmental Council, the Town of Montross, and the County of Westmoreland had representatives in attendance. Several residents who are routinely active in following Site activities, but did not attend the public meeting, indicated in telephone follow-up that they are comfortable that they are receiving regular information on the Site by mail, so did not feel they needed to attend. A public notice and a quarterly update accompanied the meeting in August.

A list of community relations activities that have been sponsored at this Site may be reviewed in Appendix B.

III. SUMMARY OF PUBLIC COMMENTS AND RESPONSES

Question/Comment: The County Administrator, Eston Burge, commented that the original problem was cyanide, and the technical presentation at the public meeting indicated that there was no cyanide residue left at the Site. He was curious about the high cost when the cyanide problem had been eradicated during the removal action between 1986 and 1989.

VDWM Response: The project officer indicated that the cyanide contaminated soils were removed in 1986-87. The removal action was intended to address the most immediate threats from the Site. The purpose of the follow-up RI/FS is to deal with any potential long-term threats. The current focus of the proposed plan is for groundwater cleanup, since the groundwater underlying the Site has been contaminated.

Question/Comment: The president of the Westmoreland Environmental Council asked whether heavy metals were still a consideration at this point, or were they all removed.

VDWM Response: Soil containing heavy metals was removed during the removal action. We propose to treat the metals that were identified in groundwater. We did find some heavy metal residuals in soil samples, but the levels were very low. We are primarily addressing organic solvents, since the levels present in the groundwater pose a risk to human health and the environment.

Question/Comment: Is there current leaching of contaminants into the groundwater?

VDWM Response: Yes. This is why the proposed cleanup plan concentrates on groundwater treatment and SVE to address the remaining VOCs in the soils . The primary source of contamination, the tank contents and the drums, has been removed.

Question/Comment: What toxicological risk does the Site pose?

What was the risk assessment that lead the agencies to believe the proposed plan was necessary?

<u>VDWM Response:</u> The principal risks posed by the Site are associated with contaminated groundwater in the shallow aquifer underneath the Site. Groundwater is the sole source of drinking water for people in the area. In addition, residual contamination sources in the soils also releases contaminants into the groundwater and act as secondary sources. Although these soils pose minimal risks, they would also be treated to facilitate groundwater treatment.

<u>Question/Comment:</u> If the groundwater treatment scenario presented in the proposed cleanup plan is implemented, will one or several groundwater treatment facilities be used on the Site? How long will the treatment be in operation?

<u>VDWM Response:</u> The groundwater treatment system would include a groundwater extraction network that can be operated in different pumping modes to effectively extract the contaminated groundwater from the aquifer. Pulse pumping or changing the locations of extraction wells could occur. The extracted water would be conveyed to a groundwater treatment system. Monitoring would be implemented to evaluate the response of the aquifer. After groundwater has been remediated to acceptable levels, the treatment system would still be in operation for a period of time probably for a minimum of one year, for monitoring purposes.

<u>Question/Comment:</u> Since the area containing the most concentrated contamination is near the current plant buildings, will a well have to be located in the actual plant to get to the groundwater underlying the plan structures? Where would such a well be placed?

VDWM Response: During the RD phase of activity, the agencies and the Potentially Responsible Party(ies) (PRPs) will review various options when designing the pumping system. The exact locations of the wells will be determined during the RD, and citizens will be made aware of the design of the pumping system before it is built. More likely than not, a well will have to be located near or in the plant buildings.

Question/Comment: How deep underneath the Site can contamination be found?

VDWM Response: The depth of contamination varies from location to location. In some areas, contamination can be identified at 17 or 18 feet; in other areas, contamination can be located to 7 or 8 feet. The deepest areas of contamination are located under the original sources (tank and drum areas), where contamination can be found down to the groundwater.

Question/Comment: What are the chances that the contamination would not go anywhere if left in place?

VDWM Response: The contaminants would travel and ultimately reach the surface water sources like Scates Branch and Pierce Creek. It would not remain immobile.

Question/Comment: What happens to the gas during the groundwater treatment operation?

VDWM Response: The air stripping portion of the treatment facility would capture volatile organics from the groundwater via carbon adsorption units. The air released into the atmosphere would be clean. Monitoring will be done to ensure this, since we have to meet air quality regulations.

Question/Comment: How much more soil will be removed during the remedial action?

VDWM Response: An estimated 1500 tons. The exact amount will be determined during the RD phase of activity, when the engineering specifications are completed for the cleanup technology.

Question/Comment: The president of the Westmoreland Environmental Council expressed concern that the amount of money estimated for the proposed remedy is not a justified taxpayer expense given the risk posed by the Site in its current condition.

VDWM Response: The goal of the Superfund program is to encourage the PRPs, or those responsible for the Site, to pay for and undertake the cleanup of any contamination. The RI/FS for the Site was financed by a PRP, so the use of taxpayer money was minimized. For the upcoming portion of Superfund activities, the agencies will try to encourage the PRPs to finance the actual cleanup of the Site as well. Even when a PRP is not identified, the Superfund monies that fund the investigation and cleanup are from taxes on chemical and petroleum companies, not individual citizens. The estimated cost of the Arrowhead Site cleanup plan is $13.2 million.

Another goal of the Superfund program is to select a cleanup technology that permanently eliminates the contamination problem. While cost is one of the nine major criteria under Superfund, the primary consideration is protecting public health, welfare, and environment.

Question/Comment: A predominant concern of community members is the quality of the drinking water wells. Has the Site affected any private drinking water wells? Were residential wells sampled?

VDWM Response: A site sampling map is included in the RI Report, so interested citizens can see where sampling points were. The Remedial Investigation/Feasibility Study determined that the contamination was predominantly contained to the Arrowhead Site perimeters, with the exception of a small area to the Northeast of the Site, which moves downgradient in the direction of Scates Branch and Pierce Creek. Residential wells within the vicinity of the Site are not presently contaminated by the Arrowhead Site, since sampling showed that the contamination was confined to the Site. One of the primary reasons for choosing a permanent treatment technology is to prevent any future contamination of surface waters or drinking water wells.

IV. SUMMARY

This section ends the formal response to comments on the proposed plan received at the public meeting on August 6, 1991 in Montross, Virginia, or thereafter by telephone or mail. Copies of this Responsiveness Summary will be placed in the Information Repository and Administrative Record File located in the office of the Assistant Westmoreland County Administrator, Montross, Virginia.

Quarterly Community Updates will continue to be distributed to those on the mailing list. The Community Relations Plan will be updated prior to the RD. Once the RD work plan is completed and if there is local interest, a community briefing will be held in Montross to provide some of the details of the cleanup approach. A fact sheet will be mailed to residents and officials once the RD has been completed, and an engineering design is available. VDWM community relations staff will continue to be responsive to requests for additional community relations activities.

APPENDIX A

Description of Evaluation Criteria

DESCRIPTION OF EVALUATION CRITERIA

Overall Protection of Human Health and the Environment - addresses whether or not a remedy will: cleanup a site to within the risk range; result in any unacceptable impacts; control the inherent hazards (e.g., toxicity and mobility) associated with a site; and minimize the short-term impacts associated with cleaning up the site.

Compliance with ARARs - addresses whether or not a remedy is expected to meet all of the applicable or relevant and appropriate requirements of other environmental statutes and/or provide grounds for invoking a waiver.

Long-term Effectiveness and Permanence - refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

Reduction of Toxicity, Mobility, or Volume through Treatment - refers to the anticipated performance of the treatment technologies that may be employed in a remedy.

Short-term Effectiveness - refers to 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 until cleanup goals are achieved.

Implementability - describes the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.

Cost - includes the capital for materials, equipment, etc. and the operation and maintenance costs.

State/Support Agency Acceptance - indicates whether, based on its review of the RI/FS documents and the Proposed Plan, EPA or the State (as a support agency) concurs with, opposes, or has no comment on the preferred alternative.

Community Acceptance - is assessed here in the Record of Decision following a review of the public comments received on the RI/FS reports and the Proposed Plan.

APPENDIX B

Community Relations Activities Outline

ARROWHEAD ASSOCIATES SUPERFUND SITE
COMMUNITY RELATIONS PLAN ACTIVITY LIST

ACTIVITY	DATE
Community Interviews	09/20/89
Community Interview Follow-up	12/05/89
Administrative Record File Established	05/91
Community Relations Plan Drafted	01/03/90
RI/FS Workplan Approved	02/07/90
Public Notice RI/FS Start	02/15/90
Public Notice to Mailing List	02/15/90
Quarterly Site Updates	02/15/90- #1
Briefings With Local Representatives	As necessary
Telephone/Mail	As necessary
RI/FS Workshop	06/12/90
CRP Update Meetings	03/91
Quarterly Update to mailing list	05/01/91
Westmoreland Environmental Council Meeting	05/11/91
Public Notice of Proposed Plan	07/25/91
Public Notice to Mailing List	07/26/91
Quarterly Community Update to Mailing List	07/26/91
Public Comment Period Commences	07/26/91
Public Meeting Advertised	07/25/91
Public Meeting on Proposed Plan	08/06/91
Public Comment Period Ends	08/26/91
Responsiveness Summary Prepared (Preparation begins)	09/91
ROD "Community Relations Highlights" prepared	TBD
Public Notice of ROD Availability	TBD
Public Notice to Mailing List	TBD

Revise Community Relations Plan for RD/RA	TBD
RD/RA Activities Planning	TBD

APPENDIX C

Additional Information

COMMONWEALTH of VIRGINIA

DEPARTMENT OF WASTE MANAGEMENT
11th Floor, Monroe Building
101 N. 14th Street
Richmond, VA 23219
(804) 225-2667
TDD (804) 371-8737

August 14, 1991

Ms. Lillian Newton
Route 2 Box 120
Montross, Virginia 22520

Dear Ms. Newton:

Thank you for speaking with me this afternoon concerning the Arrowhead Superfund site. I understand your concern about your well and the surrounding community.

I have enclosed several materials that should answer your questions. You will find a packet that was distributed at the August 6, 1991 public meeting. This contains an update, a fact sheet on Remedial Design/Remedial Action, and the Proposed Plan for clean up. Two additional maps are included which illustrate where you are located in regard to the site. As I mentioned in our conversation, the contamination is concentrated in the site area. It would not flow into your well because you are located uphill of the Arrowhead site.

If you are concerned about your well in regard to possible non-site related contamination, I have enclosed a fact sheet about water that lists several organizations you may want to contact. The Water Resource Center has many materials that may assist you. The telephone number is listed on the fact sheet. I would recommend contacting the County Health office at 537-6100 or the Virginia Department of Health at 786-1760 if you need further assistance with non-site related problems. Please refer to the Facts about Water sheet for more details.

If you have any further questions please feel free to contact Jamie Walters at 225-2903 or me at 225-2909.

Sincerely,

Ann Troutman

Ann Troutman
Virginia Superfund Program

cc: JWT, ARR 67317-01

Commonwealth of Virginia
Department of Waste Management

June 1991

Where to get Facts About Water

Groundwater near Superfund sites is reviewed very carefully by the Commonwealth of Virginia and the U.S. Environmental Protection Agency, and residents are informed of sample results at meetings or through the mail. Sometimes at our Superfund site meetings, however, we are asked by residents whether they can get their well sampled through private efforts that the resident arranges and pays for. This, of course, is up to the individual resident, and laboratories do exist to analyze private samples.

Where Can Residents Get More Information on Groundwater?

The Virginia Water Resources Research Center located at Virginia Polytechnical Institute and State University (VPISU) in Blacksburg, Virginia, has numerous brochures and booklets available to citizens free of charge. The "Water Resource Center" also prints a list of state approved laboratories that conduct testing of privately sampled wells at the request of homeowners. Samples that must be analyzed for several or numerous contaminants can be costly, which deters many homeowners from choosing private sampling. Residents wishing to have their wells sampled only for coliform or other bacteria may look under "water testing" or "water analysis" in the Yellow Pages of the telephone directory for your area. The Water Resource Center list of laboratories approved by the State to take three or more samples can be found on the back of this sheet.

For copies of the Water Resource Center water booklets, call the Center at (703) 231-8036. Single copies of most publications are available to Virginia residents free of charge.

The VPISU Water Resource Center provides information to citizens on groundwater and threats to groundwater. A Water Resource Center representative said that updated lists of certified laboratories may be obtained from County Health offices (537-6100) or the Virginia Health Department (786-1760). The Water Resource Center suggests that citizens use certified laboratories, because some uncertified mail order laboratories are not as reliable. Also, citizens should mail samples on a Monday to ensure the most accurate sample results. The Water Resource Center representative also indicated that the Health Department will sample if they suspect a health threat stemming from bacteria or other contaminants.

WATER TESTING LABORATORIES

Blacksburg

Olver, Inc.
1116 South Main Street
Blacksburg, VA 24060
(703)552-5548

Charlottesville

Aqua-Air Laboratory, Inc.
627 Dice Street
P.O. Box 4006
Charlottesville, VA 22903
(804)295-1716

Chase City

B & B Consultants
316 East Third Street
Chase City, VA 23924
(804)372-3393

Culpeper

ESS Laboratories
218 North Main Street
Culpeper, VA 22701
(703)825-6660

Fairfax

American Medical Laboratories
11091 Main Street
Fairfax, VA 22030
(703)691-9120
(800)336-3718

Dewberry & Davis
2979 Prosperity Avenue
Fairfax, VA 22031
(703)-849-0258

Hampton

Bionetics Corp.-
Analytical Laboratories Division
18 Research Drive
Hampton, VA 23666
(804)865-0880
(800)476-5548

Lynchburg

Central VA Laboratory & Consultants
P.O. Box 10938
2418 Langhorne Road
Lynchburg, VA 24506
(804)847-2852

Newport News

Reed, James R. & Assoc., Inc.
813 Forrest Drive
Newport News, VA 23606
(804)599-6750

Norfolk

TC Analytics, Inc.
1200 Boissevain Avenue
Norfolk, VA 23507
(804)627-0400

Richmond

Analytics Laboratory
1415 Rhoadmiller Street
Richmond, VA 23260
(804)330-2950
(800)552-2838 (in VA)
(800)452-6543 (out of state)

Commonwealth Laboratory, Inc.
2209 East Broad Street
Richmond, VA 23223
(804)648-8358

Environmental Laboratories, Inc.
9211 Burge Avenue
Richmond, VA 23237
(804)271-3440

Froehling & Robertson, Inc.
3015 Dumbarton Road
Richmond, VA 23228
(804)264-2701

Virginia Beach

Jennings Laboratories, Inc.
1118 Cypress Avenue
Virginia Beach, VA 23451
(804)425-1498

The above private laboratories perform water testing, for a fee, for individuals and are certified by the Virginia Department of Health (VDH) to test for three or more contaminants. A variety of in-state labs are certified to test for coliform bacteria only; look for one near you in the yellow pages under "Water Analysis" or "Water Testing." (Check with the lab you call to find out what specific contaminants its certification is for.) More than 50 out-of-state labs also are approved by VDH. For a complete and up-to-date list of all VDH-approved labs and the specific tests for which they have been certified, contact your local health department or the Division of Consolidated Laboratory Services at (804)786-1155.

APPENDIX D

Glossary of Superfund Terms

Commonwealth of Virginia
Department of Waste Management

Fall/Winter 1989

Superfund Glossary

This glossary defines terms often used by the Department of Waste Management and the U.S. Environmental Protection Agency (EPA) staff when describing activities that take place under the Superfund law, CERCLA. The definitions apply specifically to the Superfund Program and may have other meanings when used for other types of programs. Italicized words included in various definitions are defined separately in the glossary. If you still have questions about Superfund Program terms, you can contact your Superfund Program Community Relations Liaison at the Department of Waste Management or the EPA.

Administrative Record File: A file containing all documents upon which the site cleanup decision is based; the file is usually located at a local library, town hall, or administrative office.

Administrative Order on Consent: A legal and enforceable agreement signed between EPA and *Potentially Responsible Parties (PRPs)* whereby PRPs agree to perform or pay the cost of a site cleanup. The agreement describes actions to be taken at a site and may be subject to a public *comment period*. Unlike a *consent decree*, an administrative order on consent does not have to be approved by a judge.

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

Aquifer: An underground rock formation made of materials like sand, soil, or gravel that can store and supply *groundwater* to wells and springs. Most aquifers used in the U.S. are within a thousand feet from the earth's surface.

Carcinogen: A substance that causes cancer.

Carbon Adsorption: A treatment system where contaminants are removed from groundwater 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 or the environment. "Cleanup" is often used broadly for various *response actions* or phases of the *remedial responses.*

Comment Period: A time period during which the public can review and comment on various documents and proposed *cleanup* plans. A comment period is provided when EPA proposes to add sites to the *National Priorities List (NPL).*
Also, a minimum 30-day comment period is held for community members to review and comment on a draft *feasibility study.*

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

CERCLA: (Comprehensive Environmental Response, Compensation and Liability Act) A Federal law passed in 1980 and modified in 1986 by *SARA*. 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:

- Pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work.

- Take legal action to force parties responsible for s contamination to clean up the site or pay back t Federal government for the cost of the cleanup.

Consent Decree: A legal document, approved and issued by a judge, that formalizes an agreement reached between EPA/State and *potentially responsible parties (PRPs)* where PRPs will perform all or part of a *Superfund* site cleanup. The consent decree describes actions that PRPs are required to perform and is subject to a public *comment period.*

Contract Lab Program: Laboratories under contract to EPA which analyze soil, water, and waste samples taken from *Superfund* Sites.

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

Cost Recovery: A legal process where *PRPs* can required to pay back the Federal government for money it spends on the *cleanup* program.

Enforcement: EPA's efforts, through legal action if necessary, to force *PRPs* to perform or pay for a *superfund cleanup.*

Enforcement Decision Document: A public document that explains the State's and EPA's selection of a cleanup alternative at a Superfund site through an *enforcement* action. Similar to a *Record of Decision (ROD).*

Environmental Response Team (ERT): EPA hazardous waste experts who provide 24-hour technical assistance to EPA regional offices and States during all types of emergencies involving releases at hazardous waste sites or toxic spills.

Feasibility Study (FS): A study done after the *remedial investigation* that reviews options for cleaning up the site.

Groundwater: Water found beneath the earth's surface that pores between materials like sand, soil, or gravel. In *aquifers*, groundwater occurs in sufficient quantities that it can be used for drinking water, irrigation and oth purposes.

Hazard Ranking System (HRS): A scoring system that is 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 groundwater to affect people or the environment. The HRS score determines whether a site will be added to the *National Priorities List (NPL)*.

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 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 - like a library, city hall, or public school.

Leachate: A contaminated liquid resulting when water 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 *groundwater.*

Monitoring Wells: Special wells drilled on or near a hazardous waste site where *groundwater* can be sampled to determine the direction in which groundwater flows, and the types and amounts of contaminants present.

National Oil and Hazardous Substances 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 that qualify for cleanup using Federal funds.

National Response Center: The center operated by the U.S. Coast Guard that receives and evaluates reports of oil and hazardous substance releases into the environment and notifies the appropriate agencies. The NRC can be contacted 24-hours a day, toll-free at (800) 424-8802.

National Response Team: Representatives of 12 Federal agencies that coordinate Federal responses to nationally significant pollution incidents and provide assistance to the responding agencies.

On-Scene Coordinator (OSC): The Federal official who coordinates and directs Superfund *removal actions.*

Operable Unit: An action taken as one part of an overall site cleanup.

Operations and Maintenance (O&M): Activities conducted at a site after a *response action* occurs, to ensure that the cleanup or con-tainment 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 a chemical in 1 million ounces of water is 1 ppm; 1 ounce of the chemical in 1 billion ounces of water is 1 ppb. If one drop of the chemical is mixed in a competition-size swimming pool, the water will contain about 1 ppb of the chemical.

Potentially Responsible Parties (PRPs): Any individual or company (such as owners, operators, transporters, or generators) poten-tially responsible for, or contributing to, the contamination problems at a site. Whenever possible, EPA and the State require PRPs to clean up hazardous waste sites they have contaminated.

Preliminary Assessment (PA): The process of collecting and reviewing available information about a known or suspected hazardous waste site. EPA and States use this information to determine if the site requires further study. If so, a *site inspection (SI)* is performed.

Quality Assurance/Quality Control (QA/QC): A system of procedures, checks, audits, and corrective actions used to ensure that field work and laboratory analysis during the investigation and cleanup of Superfund sites meet established standards.

Record of Decision (ROD): A public document that explains which cleanup alternative (s) will be used for a *National Priorities List (NPL)* site. The ROD is based on information generated during the *Remedial Investigation/Feasibility Study* and the *Community Relations Pro-gram* for the site.

Regional Response Team: Representa-tives of Federal, State, and local agencies who may assist in coordination of activities at the request of the *On-Scene Coordinator* or *Remedial Project Manager* before and during response actions.

Remedial Action (RA): The actual con-struction or implementation phase that follows the *remedial design* of the selected cleanup alternative at a site.

Remedial Design (RD): An engineering phase that follows the *Record of Deci-sion* when technical drawings and specifications are developed for the subsequent *remedial action* at a site.

Remedial Investigation/Feasibility Study (RI/FS): Two distinct but related studies. They are usually performed at the same time, and referred to as the RI/FS. The RI/FS is intended to:

- Gather the data necessary to determine the type and extent of contamination at a *Superfund* site.

- Establish criteria for cleaning up the site;
- Identify and screen *cleanup* alternatives for *remedial action; and* .

- 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 the public or the environment.

Removal Action: An immediate action taken over the short-term to address a release or threatened release of *hazardous substances.*

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:

- Removing hazardous materials from a site to an EPA-approved, licensed hazardous waste facility for treatment, containment, or destruction.

- Containing the waste safely on-site to eliminate further problems.

- Destroying or treating the waste on-site using *incineration* or other technologies.

- Identifying and removing the source of *groundwater* contamination and preventing further movement of the contaminants.

Responsiveness Summary: A summary of oral and/or written public comments received by the State or EPA during a *comment period* on key recommendations for site cleanup, and the State/EPA response to those comments. The Responsiveness Summary highlights key community concerns and public involvement.

Risk Assessment: An evaluation performed as part of the *remedial investigation* to assess conditions at the site and determine the risk posed to public health or the environment.

Site Inspection (SI): A technical phase that follows *preliminary assessment* designed to collect more extens[ive] information on a hazardous waste site. The information is used to score the site with the *Hazard Ranking System (HRS)* to see if a *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): Modifi-cations to CERCLA, enacted on October 17, 1986.

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

Treatment, Storage, and Disposal Facilities (TSDs): Any building, structure, or installation where a *hazardous substance* has been treated, stored, or disposed. TSD facilities are regulated by EPA and States under the *Resource Conser-vation and Recovery Act (RCRA).*

Trust Fund: A fund set up under the Superfund Law (*CERCLA*) to help pay for the cleanup of hazardous waste sites and to take legal action to force those who are responsible for the sites to clean them up.

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

Superfund Acronyms

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
CR: Community Relations
FS: Feasibility Study
HRS: Hazard Ranking System
NCP: National Oil and Hazardous Substances Contingency Plan
NPL: National Priorities List
OSC: On-Scene Coordinator
O&M: Operations & Maintenance
ppm/ppb: Parts per Million/Parts Per Billion
PRP: Potentially Responsible Party
PA: Preliminary Assessment
ROD: Record of Decision
RD/RA: Remedial Design/ Remedial Action
RI: Remedial Investigation
RPM: Remedial Project Manager
SARA: Superfund Amendments and Reauthorization A[ct] of 1986.

APPENDIX E

Index of Documents for The Administrative Record

ORGANIZATION OF AN ADMINISTRATIVE RECORD FILE

An Administrative Record File is the collection of key documents that EPA considered and relied on in forming the basis for the selection of the remedy for a Superfund response action. The documents in an administrative record file are organized into five different sections as follows:

I. SITE IDENTIFICATION
Documents concerning the background and identification of the site prior to its listing on the National Priorities List.

II. REMEDIAL ENFORCEMENT PLANNING
Documents pertaining to legal actions and potentially responsible parties.

III. REMEDIAL RESPONSE PLANNING
Documents pertaining to field activities, sampling, the Remedial Investigation/Feasibility Study (RI/FS), and the Record of Decision (ROD). The RI/FS are two related studies performed to gather the data necessary to determine the type, volume and location of contamination at the site; identify criteria for cleaning up the site; identify and screen cleanup alternatives for remedial action; and analyze in detail the technologies and costs of the alternatives. The ROD is a legal document that describes the final remedial actions selected for a Superfund site, why the remedial actions were chosen, costs involved, and public reaction.

IV. REMOVAL RESPONSE PROJECTS
Documents pertaining to any emergency removal actions performed at the site.

V. COMMUNITY INVOLVEMENT/CONGRESSIONAL CORRESPONDENCE/ IMAGERY
Documents pertaining to community participation and congressional involvement with the site. Maps and photographs are also included in this section.

Not all Administrative Record Files will contain all sections listed above. To see what is contained in the file, refer to the Administrative Record index located at the beginning of the Administrative Record File. This index follows the five section organization and details all documents. If no documents exist pertaining to a specific section of the Administrative Record File, then that section will not be included in the index of documents. Attached to the index is a listing of Site Specific Guidance Documents that the project manager relied upon when conducting activities. These documents, unless otherwise noted, are located in the U.S. EPA Region III Administrative Record Room.

ADMINISTRATIVE RECORD FILE FACT SHEET

Region III
May 1989

INTRODUCTION

The purpose of this Administrative Record File Fact Sheet is to assist site repository staff in managing Administrative Record Files associated with Superfund sites. The Administrative Record File Fact Sheet will also assist the site repository staff in answering questions posed by the public.

BACKGROUND

The United States Environmental Protection Agency (U.S. EPA) is responsible for implementing the Federal Laws designed to protect the environment. In recent years, the responsibilities of the U.S. EPA have grown due to the increasing concerns over hazardous substances endangering human health and the environment. These expanding responsibilities include implementing and overseeing the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as the Superfund Program.

Under the Superfund Program, EPA is responsible for managing the cleanup and enforcement activities for all Superfund sites. Every Superfund site is different, and cleanup actions, immediate or long-term, must be designed to address the specific needs of each site or release of hazardous substances. Immediate cleanup actions (removal actions) occur when a situation or site poses an imminent threat to human health or the environment. Long-term cleanup actions (remedial actions) follow extensive investigation into the extent of contamination at the site and a decision on the most feasible long-term cleanup remedy. These sites are identified on EPA's National Priorities List (NPL), which is a list of the sites that have met the criteria to be eligible for cleanup by the Superfund.

For each removal or remedial response action at a Superfund site, EPA is required to assemble and make available for public viewing a comprehensive record of relevant information pertaining to the site, which then becomes the Administrative Record File. The sole purpose of the Administrative Record File is to document EPA's decision-making process for a response action, addressing all relevant factual and policy factors. It must show that EPA followed proper procedures in making a decision and that the decision was not arbitrary and capricious.

Finally, EPA is required to make the Administrative Record File available to the public at a designated site repository at or near the site, and at the appropriate EPA regional office. This provides the public with the opportunity to review the documents and make comments on EPA's decision-making process.

The information presented in this section is based on the following sources: Your Guide To The United States Environmental Protection Agency (EPA Headquarters, Office of Public Affairs, May 1987); The New Superfund - What It Is, How It Works (EPA Headquarters, August 1987); and EPA Region I Waste Management Division Records Management Tools - Selected Example (EPA Region I and American Management Systems, Inc., May 18, 1988).

forcement Planning, Remedial Response Planning, Removal, Community Involvement/Congressional Correspondence/Imagery, and Site Deletion -- is stored in a separate three-ring binder(s). Each section is considered a volume and the six volumes are numbered consecutively, beginning with Volume I. Each volume is organized in chronological order and paginated, starting with page 1.

A document index for the entire Administrative Record File is included in the front of Volume I of the File. The index is organized to correspond directly with the actual Administrative Record File. The index lists every document in the Administrative Record File separately and provides the title and/or subject, the date, the page number and a list of any attachments.

Some documents cited in the index to the Administrative Record Files are located only at the EPA Region III office in Philadelphia, PA. How can members of the public review these documents?

A list of general guidance documents is attached to every index to facilitate the public understanding of the regulations for CERCLA-funded response actions. Because of the size and quantity of the general guidance documents, it would be extremely burdensome for EPA to include these documents in every Administrative Record File. Therefore, the general guidance documents are kept at the EPA Region III office in Philadelphia, PA. Members of the public may review these documents by contacting EPA Region III, Office of Public Affairs (at the address listed on Page 4) to arrange a visit to the regional office, or by submitting a written request for information.

What if a volume is damaged or a document is missing?

If an Administrative Record File volume is damaged or a document is missing from a volume, the site repository staff should contact EPA Region III, Office of Public Affairs for a replacement. The appropriate Public Affairs Officer for each site is listed on the last page of the Community Relations Plan located in the Community Involvement section of the Administrative Record File.

How will an Administrative Record File be updated?

Periodically, critical documents may be added to the existing Administrative Record File, located at the site repository and at the EPA Region III office, to ensure public awareness and comprehensive documentation of the remedy selection. These additional documents will be delivered to the site repository and placed at the back of the appropriate section in the existing Administrative Record File. An updated index will be placed in the first volume of the existing Administrative Record File citing all new documents.

What if an individual would like a copy of a document in the Administrative Record File?

An individual may photocopy any document contained in the Administrative Record File providing he/she abides by the site repository's photocopying procedures. Also, an individual may submit a Freedom of Information Act (FOIA) request, discussed

ARROWHEAD PLATING
ADMINISTRATIVE RECORD FILE *
INDEX OF DOCUMENTS

I. SITE IDENTIFICATION

1. U.S. EPA Potential Hazardous Waste Site Identification Report, 1/4/85. P. 100001-100001.

2. Report: Scovill Assessment Remediation Report, prepared by Law Environmental Services, 10/31/85. P. 100002-100041. A transmittal letter is attached.

3. Memorandum to Mr. Jay Rodstein, U.S. EPA, from Mr. Richard Brunker, U.S. EPA, re: Level of threat from conditions at the Arrowhead Associates Site, 2/12/86. P. 100042-100042.

4. Report: Preliminary Assessment of Arrowhead Associates Facility, prepared by Commonwealth of Virginia Bureau of Solid Waste Management, 3/28/86. P. 100043-100098.

5. Report: Site Inspection Report, prepared by the U.S. EPA, 6/15/89. P. 100099-100114.

* Administrative Record File available 5/17/91, updated 9/25/91.

II. REMEDIAL ENFORCEMENT PLANNING

1. Consent Agreement and Order In The Matter Of: Arrowhead Plating Site, Route 3, Montross, Virginia, Scovill Inc., Respondent, Docket No. III-86-12-DC, 7/3/86. P. 200001-200012.

2. Administrative Order on Consent In The Matter of Arrowhead Plating Site, 7/14/89. P. 200013-200042.

III. REMEDIAL RESPONSE PLANNING

1. Report: Remedial Investigation and Feasibility Study, Arrowhead Plating Site, Montross, Virginia, Work Plan, Volume II, prepared by ICF Technology Incorporated, 8/22/89. P. 300001-300292.

2. Letter to Mr. Gary Dietrich, ICF Technology, from Ms. Nora M. Okusu, Virginia Department of Waste Management, re: Approval of the Work Plan, 2/5/90. P. 300293-300294.

3. Report: Remedial Investigation and Feasibility Study, Arrowhead Plating Site, Montross, Virginia, Work Plan, Volume I, prepared by ICF Technology Incorporated, 3/12/90. P. 300295-300412.

3. Report: Remedial Investigation and Feasibility Study, Arrowhead Plating Site, Montross, Virginia, Work Plan, Volume III, prepared by ICF Technology Incorporated, 3/12/90. P. 300413-300803.

4. Letter to Mr. James Kuszjak [sic], Ogletree, Deakins, Nash, Smoak, and Stewart, from Ms. Sharon Skutle Wilcox, Commonwealth of Virginia Department of Waste Management, re: Round one and two sampling results, 12/5/90. P. 300804-300806.

5. Letter to Mr. Khoa Nguyen, Virginia Department of Waste Management, from Ms. Claudia A. Brand, ICF Kaiser Engineers, re: Description of data collected and proposal for additional field investigation activities, 1/18/91. P. 300807-300830. The following are attached:

    a) Figure 1 - (Location of Sewage Lagoon Sampling Locations;)
    b) Figure 2 - Proposed Location of Additional Monitoring Wells;
    c) Figure 3 - Revised Remedial Investigation Schedule;
    d) Table 1 - Summary of Inorganic Compounds in Surface Soils;
    e) Table 2 - Summary of Total Cyanide in Scates Branch Surface Water Samples;
    f) Table 3 - Inorganic Analyses of Sewage Lagoon Water;
    g) Table 4 - Inorganic Analyses of Sewage Lagoon Sediments;

h) Table 5 - Analytical Procedures and QA/QC Protocol;
i) Attachment 1 - Procedures for Additional Field Work;
j) Attachment 2 - Aerial Photographs of Site with Proposed Boring/Well Locations.

6. Letter to Mr. Khoa Nguyen, Virginia Department of Waste Management, from Ms. Claudia A. Brand, ICF Kaiser Engineers, re: Modified soil boring/monitoring well locations and sampling for additional work, 2/1/91. P. 300831-300837. A map of proposed locations for additional monitoring wells, summary of additional borings/wells for the remedial investigation and procedures for additional field work are attached.

7. Field Trip Reports for the Commonwealth of Virginia, 4/12/90, 4/12/90, 4/19/90, 4/24/90, 4/26/90, 5/2/90, 5/8/90, 5/9/90, 5/10/90, 5/30/90. P. 300838-300865.

8. Field Trip Reports for U.S. EPA Oversight Contractors, 4/25/90, 6/11/90, 6/27/90, 7/6/90, 8/14/90. P. 300866-300894.

9. Monthly Progress Reports prepared by ICF Kaiser Engineers for the RI/FS, 1/90-3/91. P. 300895-301285.

10. Report: Draft Remedial Investigation Report, Arrowhead Plating Site, Montross, VA, Volume I, prepared by ICF Kaiser Engineers, Inc., 5/1/91. P. 301286-301554.

11. Report: Draft Remedial Investigation Report, Arrowhead Plating Site, Montross, VA, Volume II, Appendices B-L, prepared by ICF Kaiser Engineers, Inc., 5/1/91. P. 301555-302112.

12. Letter to Ms. Claudia Brand, ICF Kaiser Engineers, Inc., from Mr. Khoa Nguyen, Commonwealth of Virginia Department of Waste Management, re: Comments from the state and EPA on the draft RI, 6/25/91. P. 302113-302132.

13. Report: Final Draft Feasibility Study, Arrowhead Plating Site, Montross, VA, prepared by ICF Kaiser Engineers, 7/23/91. P. 302133-302234.

14. Letter to Ms. Claudia A. Brand, ICF Kaiser Engineers, Inc., from Mr. Khoa Nguyen, Commonwealth of Virginia Department of Waste Management, re: Comments from the state and EPA on the draft FS, 8/15/91. P. 302235-302243.

15. Letter to Mr. Paul Spaulding, Commonwealth of Virginia Department of Waste Management, from Mr. Gordon Kerby, Commonwealth of Virginia Department of Air Pollution Control, re: Information concerning type of samplers, recommended monitoring protocol, analytical methods and monitoring frequency for the air emissions, 9/16/91. P. 302244-302246.

16. Letter to Mr. Paul Spaulding, Commonwealth of Virginia Department of Waste Management, from Mr. Burton R. Tuxford, II, Commonwealth of Virginia State Water Control Board, re: Transmittal of effluent limitations and the Toxic Monitoring Program, 9/20/91. P. 302247-302260. Tables of effluent limitations, the Toxic Monitoring Program, and a facsimile cover sheet are attached.

IV. REMOVAL RESPONSE PROJECTS

1. Reports: Draft Remedial Action Plan, Former Plating Site, Montross, Virginia, prepared by Law Environmental Services, 3/86. P. 400001-400027. A letter regarding the report is attached.

2. Report: Report of Waste Characterization, prepared by Law Environmental Services, 6/86. P. 400028-400276.

3. Memorandum to Dr. J. Winston Porter, U.S. EPA, from Mr. James M. Seif, U.S. EPA, re: Immediate removal action for the Arrowhead Plating Company, 7/3/86. P. 400277-400282. A CERCLA funding action memorandum is attached.

4. Letter to Mr. Mohammad Habibi, Virginia Department of Waste Management, from Ms. Kathleen A. McNelis and Mr. L. David Wheeless, Law Environmental Services, re: Procedural information regarding the burning of hydrazine solution at the site, 7/31/86. P. 400283-400284.

5. Letter to Mr. Robin Aitken, U.S. EPA, from Mr. L. David Wheeless, Law Environmental Services, re: Status and abatement activities contained in the consent order for the site, 8/28/86. P. 400285-400287.

6. Report: Phase II Plan, Former Plating Site, Route 3, Montross, Virginia, prepared by Law Environmental Services, 8/29/86. P. 400288-400306. A transmittal letter is attached.

7. Report: Phase I Abatement Plan, Former Plating Site, Route 3, Montross, Virginia, prepared by Law Environmental Services, 9/12/86. P. 400307-400344. A transmittal letter is attached.

8. Letter to Mr. Charles Perry, Ogletree, Deakins, Nash, Smoak and Stewart, from Mr. Robin Aitken, U.S. EPA, re: EPA's comments on the proposed work plan, 10/17/86. P. 400345-400345.

9. Letter to Mr. Charles A. Perry, Ogletree, Deakins, Nash, Smoak and Stewart, from Mr. Bruce P. Smith, U.S. EPA, re: Approval of the Phase I Plan, 12/4/86. P. 400346-400348. The proposed schedule and concurrences are attached.

10. U.S. EPA Fact Sheet, Arrowhead Plating Company Site, 12/8/86. P. 400349-400350.

11. Letter to Dr. Wladimir Gulevich, U.S. EPA, from Mr. Robin Aitken, U.S. EPA, re: Schedule of cleanup activities, 12/12/86. P. 400351-400351.

12. Letter to Mr. Robin Aitken, U.S. EPA, from Mr. Charles A. Perry, Ogletree, Deakins, Nash, Smoak and Stewart, re: Procedure for handling the material in the anodizing pit, 1/14/87. P. 400352-400352.

13. Memorandum to file from Mr. Robin Aitken, U.S. EPA, re: Onsight meeting, 2/16/87. P. 400353-400353.

14. Report: Draft January Monthly Report, CERCLA Removal Oversight, prepared by Versar Inc., 2/17/87. P. 400354-400359.

15. Letter to Mr. Keith Fowler, Commonwealth of Virginia State Water Control Board, from Ms. Kathleen A. McNelis and Mr. L. David Wheeless, Law Environmental Services, re: Permitting process, 2/20/87. P. 400360-400361.

16. Report: Draft February Monthly Report, CERCLA Removal Oversight, prepared by Versar Inc., 3/10/87. P. 400362-400365.

17. Report: Report of Building Surface Sampling, prepared by Law Environmental Services, 4/87. P. 400366-400586.

18. Letter to Mr. Vincent Carpano, State Water Control Board, from Mr. Walter F. Lee, U.S. EPA, re: Use of the National Pollutant Discharge Elimination System (NPDES) waiver authority, 4/9/87. P. 400587-400587.

19. Report: March Monthly Report, CERCLA Removal Oversight, prepared by Versar Inc., 4/14/87. P. 400588-400678. A transmittal letter is attached.

20. Report: Report of Phase II Characterization, prepared by Law Environmental, Inc., 5/87. P. 400679-401027.

21. Report: April Monthly Report, CERCLA Removal Oversight, prepared by Versar Inc., 5/15/87. P. 401027A-401027C.

22. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Vince A. Carpano, Commonwealth of Virginia State Water Control Board, re: Effluent limitation for proposed discharge from noted treatment ponds, 5/27/87. P. 401028-401031. A memorandum regarding limitations and a table on ammonia are attached.

23. Letter to Ms. Ellen Teplitzky, U.S. EPA, from Mr. Charles A. Perry, Ogletree, Deakins, Nash, Smoak and Stewart, re: Phase IB Abatement Plan, 8/7/87. P. 401032-401045. The plan is attached.

24. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Charles A. Perry, Ogletree, Deakins, Nash, Smoak, and Stewart, re; Approval and amendment to Phase IB workplan, 9/4/87. P. 401046-401047.

25. Report: Phase II Abatement Plan, prepared by ICF Technology Inc., 10/9/87. P. 401048-401081.

26. Letter to Mr. Charles A. Perry, Ogletree, Deakins, Nash, Smoak and Stewart, from Mr. Walter F. Lee, U.S. EPA, re: Approval of the abatement plan, 10/18/87. P. 401082-401082.

27. Report: Draft Interim Final Report, Arrowhead Plating Site, CERCLA Removal Oversight, prepared by Versar, Inc., 12/23/87. P. 401083-401090. A transmittal letter is attached.

28. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Charles A. Perry, Ogletree, Deakins, Nash, Smoak & Stewart, re: Change in the Phase II Abatement Plan, 6/6/88. P. 401091-401092.

29. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Discharge criteria set by the State Water Control Board, 7/15/88. P. 401093-401099. A memorandum regarding effluent limitations and two pages of the abatement plan are attached.

30. Report: Draft July Monthly Report, CERCLA Removal Oversight, prepared by Versar, Inc., 8/16/88. P. 401100-401118. A transmittal letter is attached.

31. Report: Draft August Monthly Report, CERCLA Removal Oversight, prepared by Versar, Inc., 9/16/88. P. 401119-401141. A transmittal letter is attached.

32. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Transmittal of soil sample results and request for approval of proposed additional removal actions, 9/19/88. P. 401142-401282. The soil sampling results are attached.

33. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Water samples, 9/19/88. P. 401283-401326. The water sampling results are attached.

34. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Soil data, 10/19/88. P. 401327-401348. A memorandum transmitting the soil data and the soil data are attached.

35. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Assessment of soil sampling results, 12/12/88. P. 401349-401403. The soil sampling results are attached.

36. Report: Draft Final Report, Oversight at the Arrowhead Plating Facility, prepared by Versar, Inc., 1/3/89. P. 401404-401455. A transmittal letter is attached.

37. Letter to Mr. Walter Lee, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Transmittal of additional soil sample results and the assessment of the results, 1/11/89. P. 401456-401464.

38. Letter to Mr. William Steuteville, U.S. EPA, from Mr. Gary N. Dietrich, ICF Technology Incorporated, re: Samples taken from pond bottoms, 5/1/89. P. 401465-401535. Sampling data and an analysis narrative are attached.

39. Letter to Mr. Gary N. Dietrich, ICF Technology Incorporated, from Mr. William Steuteville, U.S. EPA, re: Review of the proposal to backfill the excavation areas, 9/8/89. P. 401536-401537.

40. Letter to Mr. Gary N. Dietrich, ICF Technology Incorporated, from Ms. Nora M. Okusu, Commonwealth of Virginia, Department of Waste Management, re: Permission granted to backfill lagoons, 10/25/89. P. 401538-401539.

41. Letter to Mr. Gary N. Dietrich, Ferric, and Mr. Jeffrey Goodman, ICF Kaiser Engineers, Inc., from Ms. Nora M. Okusu, Commonwealth of Department of Waste Management re: Modification of the October 25, 1989 letter, 3/30/90. P. 401540-401541.

42. Letter to Mr. James Kuszaj, Ogletree, Deakins, Nash, Smoak, and Stewart, from Ms. Kimberly A. Hummel, U.S. EPA, re: Information on additional work that is needed to stabilize and vegetate the recently back filled lagoon area, 6/29/90. P. 401542-401641. A memorandum regarding a site visit, a letter regarding a site inspection, and a report entitled Virginia Erosion and Sediment Control Law and General Criteria are attached.

43. Letter to Mr. Howard Woodhead, Land Use Administrator, from Mr. Chuck Moore, Weston Services, Inc., re: Submittal of Erosion-Sediment Control Plan, 8/15/90. P. 401642-401643. The Erosion-Sediment Control Plan is attached.

44. Letter to Mr. James Kuszaj, Ogletree, Deakins, Nash, Smoak, and Stewart, from Mr. Timothy Longe, Commonwealth of Virginia Department of Waste Management, re: Approval of the Erosion-Sediment Control Plan, 9/14/90. P. 401644-401644.

45. Memorandum to Ms. Denise M. Mosca, State Water Control Board, from Mr. Gerald A. Duff, State Water Control Board, re: Inspection of area behind A.R. Winarick, Inc., 3/5/91. P. 401645-401645.

46. Letter to Mr. Gary Dietrich, ICF Technology Inc. from Mr. William Steuteville, U.S. EPA, re: Closure of the Consent Agreement and Order, 3/12/91. P. 401646-401646.

V. <u>COMMUNITY INVOLVEMENT/CONGRESSIONAL CORRESPONDENCE/IMAGERY</u>

1. Report: <u>Aerial Photographic Analysis of Arrowhead Associates</u>, prepared by U.S. EPA, 4/88. P.500001-500027.

2. Report: <u>Community Relations Plan, Arrowhead Superfund Site</u>, prepared by Virginia Department of Waste Management, 1990/1991. P. 500028-500064.

3. Commonwealth of Virginia Department of Waste Management, Arrowhead Superfund Site, Community Relations Update, 2/91. P. 500065-500072.

4. Community Relations Update, Arrowhead Associates Superfund Site, 7/91. P. 500073-500074.

BIBLIOGRAPHY OF SITE SPECIFIC GUIDANCE DOCUMENTS

1. Emergency Response Procedures for Control of Hazardous Substance Releases, prepared by R.W. Melvold, Rockwell International and L.T. McCarthy, MERL, January 1, 1983. EPA-600/D-84-023

2. Superfund Removal Procedures, Revision #3, prepared by OSWER/OERR, February 1, 1988. OSWER #9360.0-03B

3. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, prepared by OSWER/OERR, October 1, 1988. OSWER #9355.3-01

4. A Compendium of Superfund Field Operations Methods, prepared by OERR and OWPE, December 1, 1987. OSWER #9355.0-14

5. Data Quality Objectives for Remedial Response Activities: Development Process, prepared by CDM Federal Programs Corp. and OERR/OWPE, March 1, 1987. OSWER #9355.0-7B

6. Data Quality Objectives for Remedial Response Activities: Example Scenario: Remedial Investigation/Feasibility Study Activities at a Site with Contaminated Soils and Groundwater, prepared by CDM Federal Programs Corp. and OERR/OWPE, March 6, 1987. OSWER #9355.0-7B

7. Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, prepared by EPA Data Review Work Group, R. Bleyler, Viar and Co./Sample Mgmt. Office, and HSED, July 1, 1988.

8. Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, prepared by R. Bleyler Viar and Co. Sample Management Office, EPA Data Review Workgroup, and HSED, February 1, 1988.

9. CERCLA Compliance with Other Environmental Statutes, prepared by J.S. Porter, OSWER, October 2, 1985. OSWER #9234.0-2
Attachments: Potentially Applicable or Relevant and Appropriate Requirements

10. CERCLA Compliance with Other Laws Manual Draft Guidance, prepared by OERR, August 8, 1988.
OSWER #9234.1-01

11. Quality Criteria for Water 1986, prepared by Office of Water Regulations and Standards, May 1, 1987.
EPA-440/5-86-001

12. Guidelines for Carcinogen Risk Assessment (Federal Register, September 24, 1986, P. 33992), prepared by EPA, September 24, 1986.

13. Guidelines for Exposure Assessment (Federal Register, September 24, 1986, P. 34042), prepared by EPA, September 24, 1986.

14. Guidelines for the Health Risk Assessment of Chemical Mixtures (Federal Register, September 24, 1986, P. 34014) prepared by EPA, September 24, 1986.

15. Integrated Risk Information Systems (IRIS) (A Computer-Based Health Risk Information System Available Through E-Mail--Brochure on Access is Included), prepared by OHEA, (undated).

16. Superfund Exposure Assessment Manual, prepared by OERR, April 1, 1988.
OSWER #9285.5-1

17. Superfund Public Health Evaluation Manual, prepared by OERR and OSWER, October 1, 1986.
OSWER #9285.4-1

18. Community Relations in Superfund: A Handbook (Interim Version), prepared by OERR, June 1, 1988.
OSWER #9230.0-03B
Attachment: Chapter 6 of the Community Relations Handbook, 11/3/88

19. Interim Guidance on Potentially Responsible Party Participation in Remedial Investigations and Feasibility Studies, prepared by J.W. Porter, OSWER, May 16, 1988.
OSWER #9835.1a