AMERICAN CREOSOTE SITE
JACKSON, TENNESSEE

RECORD OF DECISION

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

SEPTEMBER 1996

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

American Creosote Works, Inc.
Jackson, Madison County, Tennessee

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Operable Unit #2 at the American Creosote Works site in Jackson, Tennessee. The decision was made in accordance with the requirements of 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 remedial action selected is based on the information contained in the Administrative Record for the site.

Actual or threatened releases of hazardous substances from this site will be addressed by the response action selected. Implementing the response action in this Record of Decision (ROD) will mitigate the imminent and substantial endangerment of public health, welfare or the environment associated with the site.

The Tennessee Department of Environment and Conservation (TDEC) has provided input as the support agency throughout the remedy selection process. Officials of TDEC are in agreement with the selected remedy.

DESCRIPTION OF THE REMEDY

The remedy selected is a combination of free liquid removal and disposal, immobilization, deed restriction, and monitoring. Free creosote, water, emulsion, and associated contaminants will be recovered from site soils and treated before disposal at approved locations. Remaining contaminants in the target area will be immobilized by mixing the contaminated soils and sludge with an appropriately formulated binding reagent. The resulting mass will be buried within the area and the area will be properly landscaped to control erosion. Institutional controls will be imposed to limit the property to industrial and similar uses only. Leach tests will be conducted periodically on the immobilized material to evaluate performance of the remedy. In addition, surface waters, sediments, and aquifers affected by the site will be monitored to ensure that they are protected effectively by the remedy.

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. The remedy is cost-effective and utilizes permanent solutions. It employs treatments that reduce toxicity, mobility or volume as principal elements of remedy.

This remedy will result in hazardous substances remaining on site above health-based levels. Therefore, a review will be conducted every five years after commencement of remedial action to evaluate remedy effectiveness and to ensure that the remedy continues to provide adequate protection of human health and the environment.

Richard D. Green
Richard D. Green, Acting Director
Waste Management Division

30 SEP 96
Date

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1.0 SITE LOCATION AND DESCRIPTION

1.1 SITE LOCATION

The ACW site is located in central Madison County, Tennessee. The site covers approximately 60 acres immediately southwest of downtown Jackson, Tennessee (Figure 1). Land use in the area is predominantly industrial/commercial with a few residential buildings to the north and undeveloped areas to the south. The site is bounded on the south by the Seaboard Railroad, the southwest by the South Fork Forked Deer River, to the west and north by Central Creek, a tributary to the South Fork Forked Deer River, and to the east by industrial buildings.

1.2 SITE DESCRIPTION

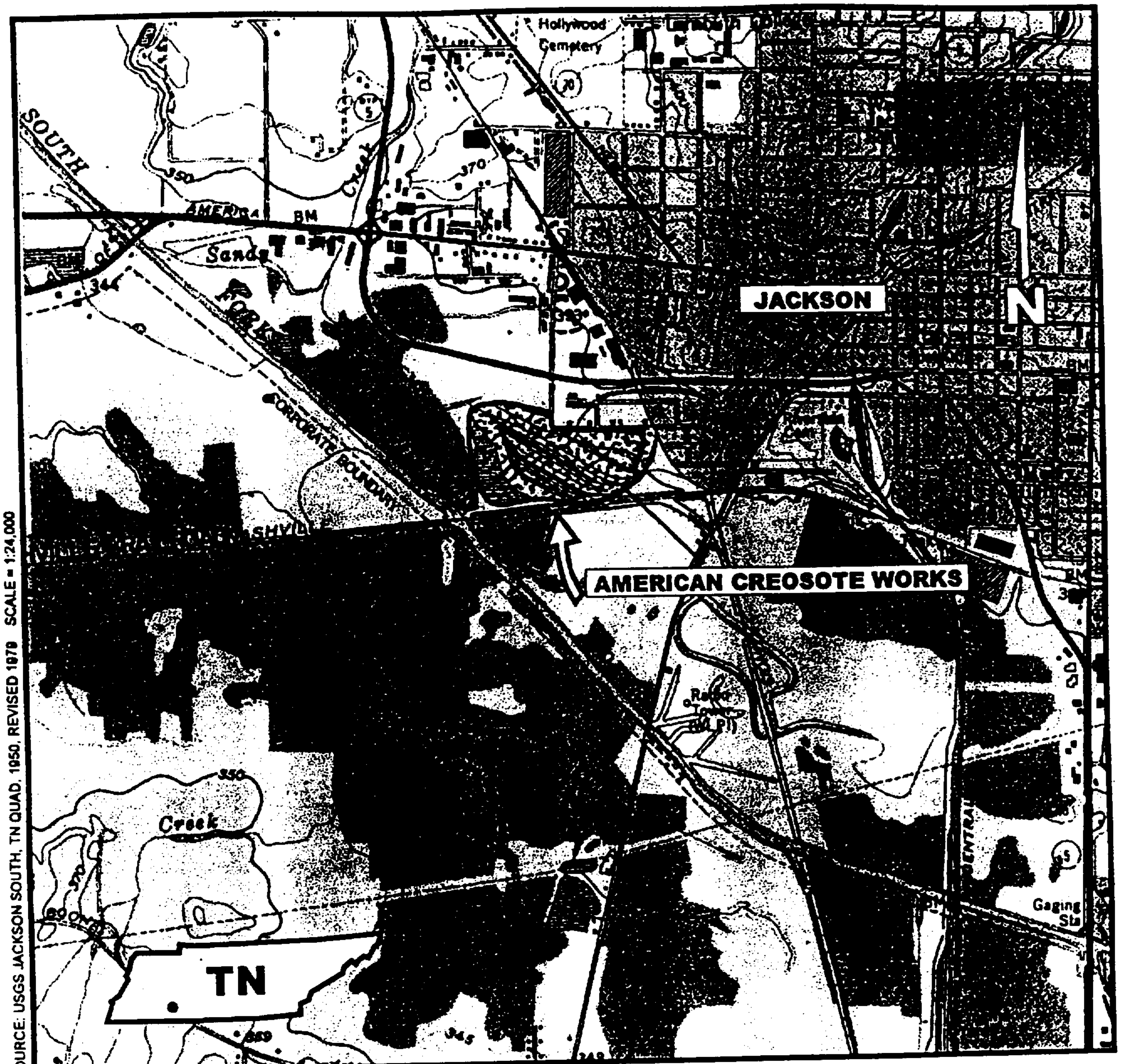
The general area is characterized by a gently rolling topography with wide, marshy floodplain. Maximum relief is on the order of 100 feet (350 ft MSL to 450 ft MSL), with relief at the site being about 20 feet. Within the boundary of the site, there are numerous small swales and several low lying areas. As Figure 2 indicates, there were five (5) lagoons on the site. The low lying areas and the lagoons have historically accumulated contaminated surface water and sediments.

1.3 SITE HISTORY

The American Creosote Works, Inc., began operations as a wood preserving facility in the early 1930s. The operations continued until December 1981. The wood preserving work used both creosote and pentachlorophenol (PCP). Wastewater sludge from the creosote and PCP treatment of wood products are listed as K001 waste under RCRA. Untreated process wastewater and potentially contaminated storm water run-off was discharged directly into Central Creek, a tributary of the South Fork Forked Deer River, until 1973. The major sources of contaminated water were the treatment cylinder condensate and surface water run-off over contaminated soils.

A levee was constructed in 1973 to retain surface water run-off from the site and to reduce the potential for site flooding by the South Fork Forked Deer River. The soil borrow pits used for the levee construction subsequently became sludge storage lagoons. Figure 2 shows the general site features, the process area and the lagoon locations.

During 1974 and 1975, a wastewater treatment system was



SOURCE: USGS JACKSON SOUTH, TN QUAD, 1950, REVISED 1979 SCALE = 1:24,000

FIGURE 1
SITE LOCATION
AND TOPOGRAPHIC MAP
AMERICAN CREOSOTE WORKS
JACKSON, MADISON COUNTY, TENNESSEE
NOVEMBER, 1993

EPA

DG3E470 CDR REV040395

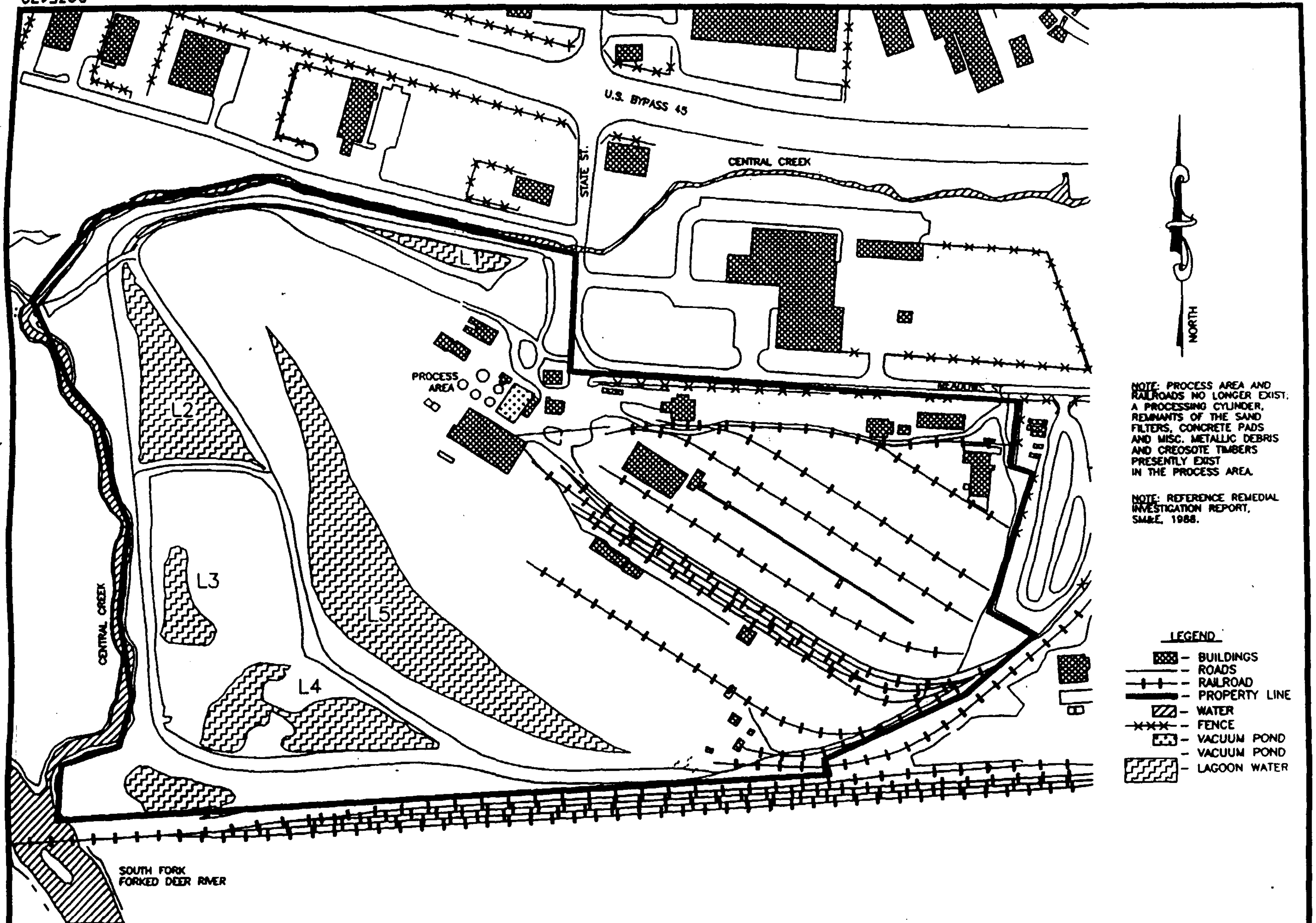


FIGURE 2
SITE MAP
AMERICAN CREOSOTE WORKS
JACKSON, TENNESSEE
NOVEMBER, 1993

installed. The system operated through 1981. The engineering report for the treatment system states that 25,000 gallons of groundwater per day entered the sump under the pressure treatment cylinders. The report also states that there was an accumulation of five tons of sludge per year in the sand filters and that a few loads of sand filter sludge were spread on the back road at the east end of the property.

The American Creosote Works, Inc. ceased operations in December 1981. In May 1982, the company filed for bankruptcy under Chapter 11 of the U.S. Bankruptcy Code. Response actions at the ACW site began immediately prior to the closing of the facility and continue to the present. The response actions taken to date include the following.

1.3.1 Response Actions

November 1981. The Tennessee Department of Health and Environment (TDHE), presently the Tennessee Department of Environment and Conservation (TDEC), installed four shallow monitoring wells around the property line. The monitoring wells ranged in depth from 24 to 35 feet approximately.

December 1981. A National Pollution Discharge Elimination System (NPDES) Permit Number TN0001904 was issued December 12, 1981. The permit allowed the discharge of storm water run-off from a site lagoon into the Central Creek. Operations at ACW ceased at this time as well.

June 1982. TDHE sampled the site. High concentrations of PCP and creosote were present in the storage tank sludge, soils, and wastewater.

May 1983. Sampling at the ACW site by United States Environmental Protection Agency (EPA), Region IV, Environmental Services Division (ESD), personnel indicated the sludge, surface soils, lagoon waters and shallow groundwater south and southwest of the lagoons were contaminated with organic compounds associated with wood preserving by creosote and pentachlorophenol (PCP). Based on the investigation by ESD, EPA was authorized to remove hazardous waste at the site under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The United States Coast Guard Gulf Strike Team was called in to remove impounded water at the site.

June 1983. Approximately 30,000,000 gallons of water with PCP less than 100 parts per billion (ppb) were pumped into the South Fork Forked Deer River. The water exceeding the discharge criteria set by the Tennessee Division of Water Quality (TDWQ) was treated prior to release. Hazardous Waste Technology Service (HAZTECH) was the EPA contractor on site. The untreatable portions of the highly emulsified oil/water mixture were placed in the empty tanks on site for storage until subsequent removal was possible. Due to the quantity of contaminated material, plans were approved for the on-site containment of the contaminated materials by stabilization with lime kiln dust. The sludge was removed from the bottom of the pond areas and from the product storage areas and placed in a pit excavated in Lagoon 3. The sludge in Lagoon 1 was solidified in-place and capped with clay. The sludge in the basins and tanks was solidified and taken, along with the soil surrounding the tanks, to Lagoon 3. The pit containing the sludge was closed and capped with clay. Diversion ditches were cut through the old bottom of Lagoon 3 to divert water away from the pit containing the sludge. A pump and gravity drain pipe were installed in conjunction with the altered drainage pattern to remove subsequently impounded water. The work at the site was completed on August 8, 1983.

<u>February 1985.</u> Repair work to mitigate the effects of a leaking storage tank containing 10,000 to 15,000 gallons of PCP-contaminated water was undertaken by the EPA contractor, O.H. Materials.

<u>June 1985.</u> O.H. Materials, under the guidance of EPA, issued a Remedial Action Plan, which included site assessment, analytical data summaries, remedial action alternatives, and cost estimation.

<u>January 1987.</u> The U.S. Army Corps of Engineers (USACE) and the EPA began field work for the Remedial Investigation/Feasibility Study (RI/FS). Soil and Material Engineers (S&ME) was the contractor for the USACE.

<u>October 1988.</u> The RI/FS Report was completed.

<u>January 5, 1989.</u> The Record-of-Decision was signed for Operable Unit 1 (OU1).

<u>January-February 1989</u>. USEPA sampled all the tanks and pits within the process area for a dewatering treatability study.

<u>July 1989.</u> USEPA began the field work for OU1 Remedial Design and Remedial Action at the site.

<u>November 1989.</u> USEPA finished demolition, disposal, and regrading of most of the plant facility and awaited a time slot for use of an incinerator for contaminated soils and sludge. Construction of new drainage pipe and ditch at the southwest

corner of the site was completed.

January 1990. Remedial Action work started in July 1989 was completed.

December 1990. At the request of the state, EPA initiated design and installation of a replacement drainage control system which included a submersible pump and a recontouring of the landfill cap.

June 1991. EPA began Site Stabilization field work.

June - July 1991. EPA oversaw the salvaging of scrap metal from the old process area.

August 1991. EPA installed a security fence around the entire site to restrict public access.

Currently, TDEC performs Site Stabilization activities at ACW under a 1993 Support Agency Cooperative Agreement (SACA). These activities include operation and up-keep of the drainage control system, maintenance of all site facilities, and periodic sampling of lagoon water before discharge to the river.

1.3.2 Enforcement Activities

In December 1981, ACW received its **National Pollution Discharge Elimination Systems** (NPDES) permit #TN0001904. However, the facility ceased operation shortly thereafter. On May 21, 1982, ACW filed for Chapter 11 bankruptcy.

In June 1983, EPA used CERCLA emergency response funds to remove and treat water from the site, remove and bury sludge, and cap certain areas with clay. On June 1, 1983, the Technical Assistance Team (TAT) took samples at the site. On June 3, 1983, the EPA arranged for water from the site to be pumped to the South Fork of the Forked Deer River. EPA consolidated the sludge into a control area (former lagoon 3) and capped the area with clay. All on-site operations were completed by August 31, 1983. Costs for the above-described activities were approximately $750,000. In October 1984, the site was placed on the National Priorities List (NPL). On September 19, 1985, EPA began a Remedial Investigation and Feasibility Study of the site which cost approximately $800,000 to complete.

On July 25, 1983, EPA filed a proof of claim for $3,500,000 in the Chapter 11 bankruptcy proceeding. Due to ACW's lack of adherence to the court's procedures, on April 20, 1988, the U.S. Bankruptcy Court for the Northern District of Florida, Pensacola

Division, dismissed ACW's case. Based upon accumulated evidence and the fact that the Tennessee Secretary of State revoked ACW's charter of incorporation on April 9, 1985, ACW is a defunct organization and is not a viable potentially responsible party (PRP) for cost recovery purposes. Therefore, the Federal Superfund and Tennessee State funds are being used for investigations and remedial actions at the site.

2.0 COMMUNITY RELATIONS HISTORY

Community relations activities for the American Creosote Works Site have been conducted jointly by the USEPA and the TDHE/TDEC. The initial contact with the public took place in Jackson, Tennessee, in 1982. This was in the form of interviews with representatives of the City of Jackson regarding the upcoming Superfund removal action of June 1983. Two public meetings were organized for the Jackson community. The first meeting was held in December 1986, prior to initiating RI/FS field activities. The second meeting was held on August 29, 1988, to discuss the results of the RI/FS and USEPA's Proposed Plan for addressing site contamination. These meetings preceded the OU1 ROD which was signed in December 1988.

For the purpose of the current ROD, a Proposed Plan Fact Sheet was published in May 1996. It summarized the findings of additional studies on the site, discussed the objectives and proposed methods of site cleanup, requested comments on the Proposed Plan, and invited the public to discuss the site at the Availability Session held on June 25, 1996, in Jackson, Tennessee. Only one comment, requesting monitoring of a private well, was received from the public in relation to the Proposed Plan. No member of the public attended the Availability Session. Overall, active involvement and participation by the general public regarding the site have been minimal.

In 1988, the water and sewer authority formally expressed concern about the potential impact of the site on the Jackson wellfield located 1.5 miles northeast of the site, and on the sewer interceptor line located near the southern edge of the site. To date, there has been no report of any site related impact on the wellfield or the sewer lines.

There has been discernible interest from the City and the local business community in facilitating the commercial development of the site and the surrounding area. In 1995, USEPA was informed by TDEC that the site was being considered as a possible location for a penitentiary. Apparently the site did not meet the necessary requirements as current information indicates that the idea has been dropped.

3.0 SUMMARY OF SITE CHARACTERISTICS

3.1 Surface Features

The terrain at the ACW site is flat to gently rolling with a moderate relief which is provided by the area stream channels. Land surface altitudes range from about 340 feet above mean sea level along the South Fork Forked Deer River to about 350 feet near the northeastern corner of the site. The site is partially protected from flooding by levees on the west and the south.

The main processing area was located in the north central portion of the site and several remnants of the previous operations still remain. These include sand filters, one steel treatment cylinder, small sheds, several concrete pads which housed the above-ground storage tanks, and miscellaneous piles of concrete, steel, and timber cross ties. Vegetation in the processing area mainly consists of scattered, tall grasses and wild flowers.

The physical demarcation of the site can be described as follows (Figure 2):

- the northern boundary consisting of the small, intermittent stream identified as Central Creek immediately north of the ACW dike and the right-of-way limits of Meadow Street

- the eastern boundary consisting of the back road up to the constructed fence line with the adjacent lumber company yard

- the southern boundary consisting of the right-of-way limits of the Seaboard Railroad

- the western boundary consisting of Central Creek immediately west of ACW dikes and a small portion of the South Fork Forked Deer River

Physical features initially identified as part of the wood preserving facility include:

- plant process area and tanks

- drip yards
- surface water lagoons
- road and railroad beds
- administration building
- chemistry laboratory
- numerous shops and work sheds
- surface water drainage ways

The ACW site is within the floodplain of the South Fork Forked Deer River. The boundaries of the site include dikes on the northwest, west, and southwest. Two small drainage ways are within the immediate areas including the Central Creek, and an unnamed tributary. Central Creek flows along the northern and western border of the site. The dikes on the ACW site form one of the Creek's channel banks. Surface flow is to the south and into the South Fork Forked Deer River which is approximately 300 feet downstream of the site. The drainage area of Central Creek is approximately 1.1 square miles and it includes industrial property, commercial property and several residences.

3.2 Soils

Three different soils are identified at the site as mapped by the Soil Conservation Service (SCS, 1978). These soil members are the Lexington, Falaya, and the Collins Association. They are described as follows:

Lexington Association. The Lexington soil covers approximately 80 percent of the site and are generally those soils which are east of Lagoons 2, 3, and 4. The Lexington soil is described as an urban land complex with 1 to 12 percent slope. Within the site, the Lexington's slope is generally less than 1 percent. The soil material is predominantly loamy and very acidic.

Falaya Association. The Falaya soil covers 10 percent of the site, generally the area of Lagoon 4 and extending in a thin strip along the southern boundary parallel to the Seaboard Railroad. It is described as a silt loam with 0 to 2 percent slopes. This soil is generally formed on the low areas of first bottoms along streams and is somewhat poorly drained. The Falaya soil is excessively wet during the winter and spring with most areas frequently flooded after periods of heavy rainfall; groundwater is often at a depth of 1 to 2 feet. The soil has a high available water capacity and is strongly acidic.

Collins Association. The Collins soil is primarily loamy silt with 0 to 2 percent slopes. It forms on the floodplain of streams and is moderately well drained. This soil is generally found along the northwestern boundary adjacent to Central Creek and extends to Lagoons 2 and 3. The Collins soil is frequently flooded for a brief duration, mainly in winter and spring. The soil has a high available water capacity and is very strongly acidic.

3.3 Land Use

The land use in the general area of the ACW site includes industrial, residential, commercial, pastures, and forest lands. Based on the data compiled from the aerial photographs of the surrounding area of the site, over one-half of the land within a one-quarter mile radius of the site is used for commercial and industrial purposes. The remaining portion of the one-quarter mile radius is mostly forest land, or cultivated cropland and pasture. The only residential area within the quarter mile radius is contiguous with the northwestern boundary of the site.

3.4 Climatology

The ACW site is within a mid-continent temperate region characterized by moderately cold winters and warm, humid summers. The predominant southerly winds bring warm, moist air, and the occasional winds from the northwest bring dry air. The most common severe weather conditions are in the form of mild droughts or thunderstorms. Damaging hail and tornadoes associated with thunderstorms can occur. Local flooding from high intensity, isolated storms is generally the most severe problem in small watersheds.

The Jackson weather station is the nearest facility to the ACW site for which long-term climatological data are available. The station is approximately two miles northeast of the site. The coldest days occur in January when the monthly average temperature is 34°F (1°C). During May through September, an average of 25 days will have a maximum temperature of 90°F (30°C) or greater. Precipitation is mostly in the form of rain and averages 50 inches annually. The amount of precipitation, in general, is evenly distributed throughout the year.

4.0 SCOPE AND ROLE OF OPERABLE UNITS

As a result of various studies on the site, particularly the 1988 RI/FS, USEPA concluded that it was prudent to commence mitigating certain site hazards while addressing the issues of data gaps regarding groundwater and soil contamination. Therefore, the cleanup of the site was proposed to be organized into three operable units. Operable Unit 1 Remedial Action (RA) consisted of surface clean-up activities and site stabilization. It was implemented to eliminate visible hazardous conditions at the site, protect the River, and control access to the site. The OU1 ROD was signed in 1988, and the RA was completed in 1990. OU2 was planned to address additional investigations and protection of groundwater, while soil contamination issues and other site clean-up needs were deferred to OU3.

The current decision document is the second ROD on the site, and it addresses the cleanup of the surface soils, the surface waters, sediments and the aquifers affected by the site. The selected clean-up measures are planned to maintain the site as a safe property for industrial use by treating the contaminated soils, sludge, sediments, free creosote, emulsion, debris and impounded water at the site. In addition, a Monitoring Plan, which will include the treated soil area, Central Creek, South Fork Forked Deer River, the Alluvial and Fort Pillow aquifers, will be designed and implemented as part of the remedial action. When completed, the selected remedy will be protective of the surface soils, the surface waters, and the groundwater impacted by the site.

This Operable Unit may be implemented in phases if government budgetary constraints so dictate. Funding of the remedy must be provided by the Federal and the State governments because there are no viable responsible parties. The remedy is readily applied in phases without reduction in effectiveness. Implementing the phased approach will allow the highest human health or environmental risk at the site to be addressed first with available funds, using proven technologies and a permanent remedy.

5.0 SITE STUDIES

5.1 PREVIOUS INVESTIGATIONS

5.1.1 Site Assessment, 1981

Evaluation of the site for necessary actions began in November 1981, when various monitoring and sampling activities were initiated by the Tennessee Department of Environment and Conservation. Results of these activities revealed that high concentrations of creosote and PCP were present in shallow groundwater, soils, sludge, and wastewater stored at the site.

5.1.2 Field Investigation, 1983

EPA's Environmental Services Division (ESD) conducted various sampling activities at ACW in 1982 to determine the extent of contamination at the site. PCP was detected in all surface water samples collected with the highest concentration being 640 micrograms per liter (μg/L). Sediment samples from ponds at the site were contaminated with organic compounds associated with the wood preserving process. Most of the compounds were polyaromatic hydrocarbons (PAHs). The group of sediment samples with the highest concentrations recorded between 40,000 to 2,800,000 micrograms per kilogram (μg/kg). PCP was detected at concentrations of 500,000 and 17,000 μg/kg for sediment samples collected from two on-site lagoons. Two soil samples were collected in the processing area. These samples indicated PAHs at concentrations of 10,400,000 and 61,700,000 μg/kg, and PCP was detected at concentrations of 2,000,000 to 5,000,000 μg/kg.

5.1.3 Site Analysis, 1984

The USEPA Environmental Photographic Interpretation Center obtained historical photographs representing the period from 1950 to 1979. Color missions were flown on June 1, June 22, and August 4, 1983. A land use analysis was performed on these series of photographs. Throughout the study period, portions of the main processing and wood storage areas appeared to have had a very dark-toned coloration, indicating possible ground staining and/or the deposition of dark-toned materials.

5.1.4 Remedial Investigation, 1988

USEPA conducted a major study of the problems at the site using the services of the US Army Corps of Engineers as the primary contractor. The aim of the study was to determine the extent and severity of contamination at the site, evaluate the physical setting and hazardous materials migrational pathways, and to assess the potential public health and environmental impacts. Details of this study are in the "Final Remedial Investigation Report", July 1988, by S&ME, Inc. Environmental Services. The findings are summarized as follows:

1. Three contaminant source areas were identified including (i) plant process facility (treatment building, pressure cylinders, boiler room tanks, oil storage tanks, tank cars, vacuum pond, sand filters, pits), (ii) sub-surface free product (creosote, PCP and emulsion), (iii) site soils, surface water and sediments.

2. Approximately 90 percent of the soil at the site was found to be contaminated. However, the vertical extent of contamination appeared to be less than 5 feet for most

of the site.

3. Creosote and PCP were detected in groundwater samples from the monitoring wells installed at the site indicating on-site groundwater contamination.

4. The compounds of major health and environmental concern were volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), dioxins and furans.

5. Contaminants could migrate offsite through groundwater, movement, site flooding, surface water overflow, and discharge of contaminated sediments from the site.

6. Neither the groundwater nor the surface water was identified as being used for potable water within one mile of the site. Two well fields, located east and north of the site, supply the local drinking water.

7. Direct contact with waste sources, and contact with contaminated surface water and/or sediments, were determined to be the most probable human and environmental exposure routes.

5.1.5 Feasibility Study, 1988

This study was conducted by USACE for USEPA to develop and evaluate methods of addressing the contamination problems identified during the Remedial Investigation discussed above. The study included an evaluation of potential cancer and non-cancer risk associated with the chemicals of concern at the site. It concluded that the site posed an unacceptable level of human health and environmental risk which required remediation. Although the study evaluated several cleanup technologies for the site, it did not recommend choosing a permanent remedy at that time, due to the data gaps which it identified. These gaps included the extent of groundwater contamination outside the site boundary and the maximum depth of soil contamination. In addition, the study stated that pilot studies of the treatment technologies evaluated for the site were needed before a permanent remedy could be chosen. Due to the need for additional data gathering and evaluation, remedial work at the site was planned to be conducted under three operable units. Therefore, the 1988 Feasibility Study formed the basis for the OU1 ROD, and established the reasons for the new studies which are summarized below.

5.2 RESULTS OF ADDITIONAL INVESTIGATIONS

5.2.1 Groundwater Studies

Under contract with USEPA, the United States Geological Survey (USGS) conducted a comprehensive groundwater study at the site between 1990 and 1993. The study evaluated the extent of off-site groundwater contamination and the potential for contamination of local water-supply wells. In addition, on-site groundwater quality was assessed. Water samples were taken from the two aquifers in the area, the alluvial aquifer at the depth of about 40 feet and the Fort Pillow aquifer which is as deep as 150 feet. Details of this study are in the USGS Investigations Report No. 93-4170, entitled "Hydrogeology, Ground-Water Quality, and Potential for Water-Supply Contamination near an Abandoned Wood-Preserving Plant Site at Jackson, Tennessee". The conclusions of the study are summarized as follows:

1. Contaminants from the wood preserving facility were detected in on-site samples taken from the Alluvial and Fort Pillow aquifers. Concentrations of organic compounds, particularly naphthalene, PCP, and benzene exceeded drinking water standards in many samples from the Alluvial aquifer. Few organic compounds were detected in water samples from the Fort Pillow aquifer.

2. Concentrations of organic compounds were low in water samples from off-site wells.

3. Wells sampled to assess the potential for pollution of water-supply sources by the site did not reveal site-related contaminants.

5.2.2 Environmental Impact Assessment

In 1990, the USGS conducted environmental sampling and analyses in and around the site. Results of the study are as follows:

1. Surface waters and sediments near the site contained detectable levels of creosote and PCP compounds apparently transported from the site, primarily by surface runoff. Central Creek which bounds the site to the north and west reflected the most pronounced contamination impact. Naphthalene (creosote constituent) and PCP were detected at concentrations above maximum acceptable levels for fish and aquatic life.

2. In laboratory tests, sediments from Central Creek reflected significant toxic effects on some aquatic organisms. Similarly, sediment samples from South Fork Forked Deer River adversely affected aquatic communities.

3. Species composition and diversity of phyton, benthos, and fish at the Central Creek indicated pollution by the site.

4. Fish tissue samples from Central Creek contained organic compounds indicative of creosote contamination.

5. Analyses of the soil and sediment samples from the site indicated the presence of toxic substances.

A detailed description of the samples and results of the laboratory analyses can be found in the USGS report of 1993, "Water Quality, Organic Chemistry of Sediment, and Biological Conditions of Streams Near an Abandoned Wood Preserving Plant Site at Jackson, Tennessee".

5.2.3 Focused Remedial Investigation

In 1993, after evaluating the results of the USGS studies and reviewing the reports of previous investigations, USEPA and TDEC engaged in several discussions to consider issues related to the site. The purpose of the discussions was to determine an optimum strategy for effectively remediating the site in view of the new data. The main issues discussed included the current and future use of the property, and availability of clean-up funds. As a result of the discussions, the following conclusions were reached:

1. Sources of drinking water in the area do not appear to be threatened significantly by contaminants at the site. Nevertheless, contaminated soils, sediment, and surface water

remain on the site. In addition, liquid waste remains underground as sources of multi-media contamination. Therefore, a plan to mitigate the threat posed by the site to human health and the environment was needed.

2. The property is in an industrial area. No new residential developments have been observed near the site. The current zoning for the site, according to the Jackson City Planning Commission, is "General Industrial" which prohibits all residential, school, and church uses. Therefore, its future use, which would most likely remain industrial, must be considered in establishing the clean-up standards for the site.

3. There is no viable Potentially Responsible Party for the site. The cost of cleanup must be paid, in accordance with the Superfund Law, by the State and USEPA on the basis of 10 and 90 percent share respectively. The clean-up plan developed for the site must be implementable in phases to allow for State and Federal budgetary constraints.

Based on these conclusions, it was decided that the clean-up objective for the site would be: to ensure that persons who enter the property are protected from potential health risks related to the site. Therefore, a new study, which focused on the surface soil, surface water, and sediments was conducted to delineate the current extent of contamination and to collect data for evaluating associated human health risk. Details of the study are reported in the "U.S. EPA Region IV Remedial Investigation, American Creosote Works, Jackson, Madison County, Tennessee, November, 1993". The study is summarized as follows.

Soil samples taken from approximately 135 locations at the site were analyzed in the laboratory to determine the current nature and concentrations of site contaminants. Results of the analyses indicated a widespread presence of creosote and PCP compounds at varying concentrations. Four specific locations of the site were identified as exhibiting unacceptable levels of creosote constituents, PCP, and dioxin. The locations include: (1) the former process area, (2) areas along the railroad tracks near the eastern half of the site, (3) areas between the on-site lagoons, and (4) areas along the southeastern boundary of the site. These locations represent the "hot spots" which, potentialy, pose the most significant human health and environmental risk at the site.

Three surface water samples were taken from the lagoons at the site. Analyses of the samples indicated the presence of PCP and several metals.

Four sediment samples from the lagoons were analyzed. Dioxin was the only contaminant of concern detected at an elevated average concentration of 0.0075 ppm. The lagoons and the contamination are included in the remediation plan for the site.

6.0 SUMMARY OF SITE RISKS

A comprehensive study of the data collected during the November 1993 RI was conducted by Roy F. Weston, Inc. for USEPA to assess potential human health risk associated with the contaminants at ACW. In line with the current remedial objectives, the Focused Risk Assessment (FRA) addressed contaminated soils which constitute the primary source of human health threat based on the analyses of sampling data and exposure pathways. The FRA which was conducted according to USEPA protocol and guidelines included the following:

1. Identification of chemicals of potential concern
2. Exposure assessment
3. Toxicity assessment and
4. Risk characterization.

Details of the study can be found in the "Focused Risk Assessment- American Creosote Works, Jackson, Tennessee" which was finalized in April 1996. The following is a summary of the study.

6.1 Chemicals of Potential Concern

The Chemicals of Potential Concern associated with contaminated soil at the ACW Site are listed in Table 1. These are the compounds identified by the FRA as likely to pose human health risks. They were identified by using USEPA methods to screen the chemicals detected in the samples from the site.

6.2 Exposure Assessment

The purpose of Exposure Assessment is to quantify the likelihood for human exposure to the Chemicals of Potential Concern at the Site. The likelihood of exposure to a Chemical of Potential Concern is expressed as Chronic Daily Intake (CDI), and is estimated based on the route of exposure, concentration, frequency, and duration of exposure to the chemical. As discussed previously, the primary carrier of the contaminants at

Table 1

American Creosote Works Site
Chemicals of Potential Concern

	Surface Soil Range of Concentrations mg/kg
INORGANICS	
Aluminum	6,800-19,000
Arsenic	4.5
Barium	103-210
Beryllium	0.47-0.97
Chromium (Total)	16.5-54.0
Cobalt	5.0-8.7
Copper	11.5-63.0
Lead	29.5-43.0
Manganese	430-880
Mercury	0.14-0.38
Nickel	9.3 - 16.0
Selenium	2.8
Vanadium	26.0-36.0
PESTICIDES/PCBs	
4,4'-DDT	0.024 - 0.03
2,3,7,8 - TCDD (TEQ)	0.0002 - 0.018
Endosulfan II (beta)	0.076
Endrin Ketone	0.008 - 0.24

Table 1 (Continued)

American Creosote Works Site
Contaminants of Potential Concern

	Surface Soil Range of Concentrations mg/kg
SEMI-VOLATILE ORGANICS	
Acenaphthene	0.063-35
Anthracene	0.087 - 210
Benzo(a)anthracene	0.82 - 71.0
Benzo(a)pyrene	1.2 - 99.0
Benzo(b and/or k)fluoranthene	1.6 - 97.0
Benzo(ghi)perylene	1.3 - 120
Carbazole	0.051 - 59.0
Chrysene	1.2 - 73.0
Dibenzo(a,h)anthracene	0.13 - 1.1
Dibenzofuran	0.039 - 19.0
Fluoranthene	0.29 - 200
Fluorene	0.14 - 45.0
Indeno(1,2,3-cd)pyrene	0.19 - 93.0
3-Nitroanaline	19.0
Pentachlorophenol	0.11 - 120
Phenanthrene	0.11 - 68.0
Pyrene	0.35 - 150
VOLATILES	
Benzene	0.002
Trichloroethene	0.003 - 0.014

the site is the surface soil. In addition, the FRA indicates that dust emanating from the contaminated soil potentially could transport certain Chemicals of Potential Concern. Therefore, possible pathways of exposure to ACW contaminants include incidental soil ingestion, dermal contact, and inhalation of dust by trespassers and workers at the site. For these conditions, CDI was calculated for each Chemical of Potential Concern at the site. Results of the calculations are shown in Table 2. Details of the procedure, equations, and other assumptions for the calculations are in the FRA report and in Tables 3 through 7.

6.3 Toxicity Assessment

Toxicity Assessment is the process by which possible harmful effects of the Chemicals of Potential concern are evaluated. The process provides an estimate of the relationship between the extent of exposure to a contaminant and the occurrence of adverse effects.

Several of the chemicals found at the ACW site for example benzene, PCP, and dioxin, have the potential to cause cancer (carcinogenic). Other Chemicals of Potential concern, such as dibenzofuran, may cause human health problems which are not related to cancer. Toxicity values, which numerically express the dose-response relationships for chemicals, are derived differently for carcinogens and noncarcinogens. These values are referred to as Cancer Slope Factors for carcinogens and Chronic Reference Doses for noncarcinogens. The Cancer Slope Factors and Chronic Reference Doses in Tables 8 and 9 respectively are the results of the Toxicity Assessment for the chemicals of potential concern found at the site. The FRA report details the procedure.

2

Surface Soil Ingestion, Inhalation, and Dermal Contact
Estimated Daily Intakes for Current Trespassers and Future Workers
Based on the Exposure Point Concentrations

American Creosote Works Surface Soil Contaminants of Potential Concern	Ingestion Chronic Daily Intake Trespasser Youth 7-16 (mg/kg-day)	Dermal Contact Chronic Daily Intake Trespasser Youth 7-16 (mg/kg-day)	Inhalation Chronic Daily Intake Trespasser Youth 7-16 (mg/kg-day)	Ingestion Chronic Daily Intake Worker Adult (mg/kg-day)	Dermal Contact Chronic Daily Intake Worker Adult (mg/kg-day)	Inhalation Chronic Daily Intake Worker Adult (mg/kg-day)	Ingestion Lifetime Daily Intake Trespasser Youth 7-16 (mg/kg-day)	Dermal Contact Lifetime Daily Intake Trespasser Youth 7-16 (mg/kg-day)	Inhalation Lifetime Daily Intake Trespasser Youth 7-16 (mg/kg-day)	Ingestion Lifetime Daily Intake Worker Adult (mg/kg-day)	Dermal Contact Lifetime Daily Intake Worker Adult (mg/kg-day)	Inhalation Lifetime Daily Intake Worker Adult (mg/kg-day)
Aluminum	5.7E-03	1.3E-04	2.9E-04	7.6E-03	5.6E-04	8.9E-04	8.6E-04	1.7E-05	4.1E-05	1.9E-03	2.0E-04	3.2E-04
Arsenic	1.4E-06	3.1E-08	6.8E-08	1.8E-06	1.3E-07	2.1E-07	2.0E-07	4.1E-09	9.8E-09	4.5E-07	4.7E-08	7.5E-08
Barium	6.3E-05	1.4E-06	3.2E-06	8.4E-05	6.2E-06	9.9E-06	9.5E-06	1.9E-07	4.6E-07	2.1E-05	2.2E-06	3.5E-06
Beryllium	2.9E-07	6.7E-09	1.5E-08	3.9E-07	2.8E-08	4.6E-08	4.4E-08	8.7E-10	2.1E-09	9.7E-08	1.0E-08	1.6E-08
Cobalt	2.6E-06	6.0E-08	1.3E-07	3.5E-06	2.5E-07	4.1E-07	3.9E-07	7.8E-09	1.9E-08	8.7E-07	9.0E-08	1.5E-07
Chromium	1.6E-05	3.7E-07	8.2E-07	2.2E-05	1.6E-06	2.5E-06	2.4E-06	4.9E-08	1.2E-07	5.4E-06	5.6E-07	9.1E-07
Copper	1.9E-05	4.3E-07	9.6E-07	2.5E-05	1.8E-06	3.0E-06	2.8E-06	5.7E-08	1.4E-07	6.3E-06	6.6E-07	1.1E-06
Lead	1.3E-05	3.0E-07	6.5E-07	1.7E-05	1.3E-06	2.0E-06	1.9E-06	3.9E-08	9.3E-08	4.3E-06	4.5E-07	7.2E-07
Manganese	2.6E-04	6.1E-06	1.3E-05	3.5E-04	2.6E-05	4.1E-05	4.0E-05	7.9E-07	1.9E-06	8.8E-05	9.2E-06	1.5E-05
Mercury	1.1E-07	2.6E-09	5.8E-09	1.5E-07	1.1E-08	1.8E-08	1.7E-08	3.4E-10	8.2E-10	3.8E-08	4.0E-09	6.4E-09
Nickel	4.8E-06	1.1E-07	2.4E-07	6.4E-06	4.7E-07	7.5E-07	7.2E-07	1.4E-08	3.5E-08	1.6E-06	1.7E-07	2.7E-07
Selenium	8.4E-07	1.9E-08	4.3E-08	1.1E-06	8.2E-08	1.3E-07	1.3E-07	2.5E-09	6.1E-09	2.8E-07	2.9E-08	4.7E-08
Vanadium	1.1E-05	2.5E-07	5.5E-07	1.4E-05	1.1E-06	1.7E-06	1.6E-06	3.2E-08	7.8E-08	3.6E-06	3.7E-07	6.0E-07
Acenaphthene	4.5E-06	1.0E-06	2.3E-07	5.9E-06	4.4E-06	7.0E-07	6.7E-07	1.3E-07	3.2E-08	1.5E-06	1.5E-06	2.5E-07
Anthracene	3.3E-06	7.5E-07	1.7E-07	4.4E-06	3.2E-06	5.1E-07	4.9E-07	9.8E-08	2.4E-08	1.1E-06	1.1E-06	1.8E-07
Benzene	6.0E-10	1.4E-10	3.0E-11	8.0E-10	5.9E-10	9.4E-11	9.0E-11	1.8E-11	4.3E-12	2.0E-10	2.1E-10	3.4E-11
Benzo(a)anthracene	1.0E-06	2.3E-07	5.1E-08	1.4E-06	9.9E-07	1.6E-07	1.5E-07	3.0E-08	7.4E-09	3.4E-07	3.5E-07	5.7E-08
Benzo(a)pyrene	8.7E-06	2.0E-06	4.4E-07	1.2E-05	8.5E-06	1.4E-06	1.3E-06	2.6E-07	6.3E-08	2.9E-06	3.0E-06	4.9E-07
Benzo(b)fluoranthene	9.6E-07	2.2E-07	4.9E-08	1.3E-06	9.4E-07	1.5E-07	1.4E-07	2.9E-08	7.0E-09	3.2E-07	3.3E-07	5.4E-08
Benzo(k)fluoranthene	9.6E-07	2.2E-07	4.9E-08	1.3E-06	9.4E-07	1.5E-07	1.4E-07	2.9E-08	7.0E-09	3.2E-07	3.3E-07	5.4E-08
Benzo(GHI)perylene	1.1E-05	2.5E-06	5.4E-07	1.4E-05	1.1E-05	1.7E-06	1.6E-06	3.2E-07	7.8E-08	3.6E-06	3.7E-06	6.0E-07
Carbazole	1.6E-06	3.6E-07	8.0E-08	2.1E-06	1.5E-06	2.5E-07	2.4E-07	4.7E-08	1.1E-08	5.3E-07	5.5E-07	8.8E-08
Chrysene	1.1E-07	2.4E-08	5.4E-09	1.4E-07	1.0E-07	1.7E-08	1.6E-08	3.2E-09	7.7E-10	3.5E-08	3.7E-08	5.9E-09
Dibenzo(a,h)anthracene	3.3E-07	7.6E-08	1.7E-08	4.4E-07	3.2E-07	5.2E-08	5.0E-08	9.9E-09	2.4E-09	1.1E-07	1.1E-07	1.8E-08
Fluoranthene	3.2E-05	7.3E-06	1.6E-06	4.2E-05	3.1E-05	5.0E-06	4.8E-06	9.6E-07	2.3E-07	1.1E-05	1.1E-05	1.8E-06
Fluorene	3.4E-06	7.7E-07	1.7E-07	4.5E-06	3.3E-06	5.3E-07	5.1E-07	1.0E-07	2.4E-08	1.1E-06	1.2E-06	1.9E-07
Indeno(1,2,3-CD)pyrene	1.1E-06	2.6E-07	5.7E-08	1.5E-06	1.1E-06	1.8E-07	1.7E-07	3.4E-08	8.2E-09	3.8E-07	3.9E-07	6.3E-08
3-Nitroaniline	5.7E-06	1.3E-06	2.9E-07	7.6E-06	5.6E-06	8.9E-07	8.6E-07	1.7E-07	4.1E-08	1.9E-06	2.0E-06	3.2E-07
Pentachlorophenol	3.6E-05	8.3E-06	1.8E-06	4.8E-05	3.5E-05	5.6E-06	5.4E-06	1.1E-06	2.6E-07	1.2E-05	1.2E-05	2.0E-06
Phenanthrene	7.1E-06	1.6E-06	3.6E-07	9.5E-06	7.0E-06	1.1E-06	1.1E-06	2.1E-07	5.2E-08	2.4E-06	2.5E-06	4.0E-07
Pyrene	2.9E-05	6.7E-06	1.5E-06	3.9E-05	2.8E-05	4.6E-06	4.4E-06	8.7E-07	2.1E-07	9.7E-06	1.0E-05	1.6E-06
Trichloroethene	4.2E-09	9.7E-10	2.1E-10	5.6E-09	4.1E-09	6.6E-10	6.3E-10	1.3E-10	3.0E-11	1.4E-09	1.5E-09	2.3E-10
4,4-DDT	9.0E-09	2.1E-09	4.6E-10	1.2E-08	8.8E-09	1.4E-09	1.4E-09	2.7E-10	6.5E-11	3.0E-09	3.1E-09	5.0E-10
Dibenzofuran	1.1E-06	2.6E-07	5.7E-08	1.5E-06	1.1E-06	1.8E-07	1.7E-07	3.4E-08	8.2E-09	3.8E-07	3.9E-07	6.3E-08
Dioxins (TEQ)	5.4E-09	1.2E-09	2.7E-10	7.2E-09	5.3E-09	8.5E-10	8.1E-10	1.6E-10	3.9E-11	1.8E-09	1.9E-09	3.0E-10
Endosulfan II (beta)	2.3E-08	5.2E-09	1.2E-09	3.0E-08	2.2E-08	3.6E-09	3.4E-09	6.8E-10	1.6E-10	7.6E-09	7.9E-09	1.3E-09
Endrin Ketone	6.3E-08	1.4E-08	3.2E-09	8.4E-08	6.2E-08	9.9E-09	9.5E-09	1.9E-09	4.6E-10	2.1E-08	2.2E-08	3.5E-09

Table 3

American Creosote Works Site
Exposure Point Concentration of
Contaminants Detected in Soil

Surface Soil Analyte	Site-Related Samples		
	95% UCL of Mean Concentration (mg/kg)	Maximum Concentration (mg/k)	Exposure Point Concentrations (mg/kg)
INORGANICS			
Aluminum	152,645	19,000	19,000
Arsenic	--	4.5	4.5
Barium	766	210	210
Beryllium	2.96	0.97	0.97
Chromium (total)	926	54.0	54.0
Cobalt	15.2	8.7	8.7
Copper	55,501	63.0	63.0
Lead	62.9	43.0	43.0
Manganese	2,506	880	880
Mercury	2.6	0.38	0.38
Nickel	28.7	16.0	16.0
Selenium	--	2.8	2.8
Vanadium	45.8	36.0	36.0
VOLATILE ORGANICS			
Benzene	--	0.002	0.002
Trichloroethene	0.03	0.014	0.014
SEMI-VOLATILES			
Acenaphthene	19.9	35	14.9
Anthracene	10.9	210	10.9
Benzo(a)anthracene	33.9	71.0	33.9
Benzo(a)pyrene	29.1	99.0	29.1
Benzo(b,k)fluoranthene	32.04	97.0	32.04

Table 3 (Continued)

American Creosote Works Site
Exposure Points Concentration of
Contaminants Detected in Soil

Surface Soil Analyte	Site-Related Samples		
	95% UCL of Mean Concentration (mg/kg)	Maximum Concentration (mg/k)	Exposure Point Concentrations (mg/kg)
Benzo(ghi)perylene	35.9	120	35.9
Carbazole	5.25	59.0	5.25
Chrysene	35.3	73.0	35.3
Dibenzo(a,h)anthracene	1.2	1.1	1.1
Dibenzofuran	3.8	19.0	3.8
Fluoranthene	106	200	106
Fluorene	11.2	45.0	11.2
Indeno(1,2,3-cd)pyrene	37.7	93.0	37.7
3-Nitroaniline	--	19.0	19.0
Pentachlorophenol	453	120	120
Phenanthrene	23.8	68.0	23.8
Pyrene	97.0	150	97.0
PESTICIDES/PCBs			
4,4-DDT	0.05	0.03	0.03
2,3,7,8 - TCDD (TEQ)	0.06	0.018	0.018
Endosulfan II (beta)	--	0.076	0.076
Endrin Ketone	0.21	0.24	0.021

Table 4
Upper Confidence Limit
Algorithm

The following formula was used to determine the 95 percent UCL on the arithmetic mean assuming the data are lognormally distributed (EPA, 1991b):

$$UCL = e^{\left(\bar{x}_i + 0.5s^2 + \frac{sH}{\sqrt{n-1}}\right)}$$

Where:

e = constant (natural log)

$\bar{x}_i$ = mean of the log-transformed data for contaminant i.

s = standard deviation of the log-transformed data

$$\left(s = \sqrt{\frac{\sum_{i=1}^{n} (x_1 - \bar{x}_1)^2}{n-1}}\right)$$

H = statistic determined by the standard deviation and sample size.

n = sample size for contaminant in the particular media set

Table 5

Model for Calculating Doses from Incidental Ingestion of Soil

Soil Ingestion Dose (mg/kg-day)	=	$\frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$
Where:		
CS	=	Upper 95% confidence limit of the mean concentration or the maximum concentration in surface soil (mg/kg)
IR	=	Ingestion rate (mg/day)
CF	=	Conversion factor (1E-6 kg/mg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)
Assumptions :		
CS	=	Chemical concentration in soil.
IR	=	100 mg/day for the current trespasser.
	=	50 mg/day for the future adult worker (EPA, 1991a).
EF	=	52 days/year for the current trespasser, based on 1 day/week exposure for 52 weeks/year (estimated).
	=	250 days/year for the future adult workers (EPA, 1991a).
ED	=	10 years for the current trespasser (EPA, 1991a).
	=	25 years for the future adult worker (EPA, 1991a).
BW	=	45 kg for a youth (7-16 yrs. old) scenario (EPA, 1991a).
	=	70 kg for an adult scenario (EPA, 1991a).
AT	=	Exposure duration (years) x 365 days/year for evaluating noncancer risk
	=	70 years x 365 days/year for evaluating cancer risk

Table 6

Model for Calculating Doses from Dermal Contact with Soil

Soil Dermal Absorption Dose (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Where:

CS	=	Upper 95% confidence limit of the mean concentration or the maximum concentration in surface soil (mg/kg)
CF	=	Conversion factor (1E-6 kg/mg)
SA	=	Skin surface area available for contact (cm^2/day)
AF	=	Soil to skin adherence factor (mg/cm^2)
ABS	=	Dermal absorption factor (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Assumptions:

CS	=	Chemical concentration in soil.
SA	=	3,200 cm^2/day for the current youth trespasser. It represents 25% of the mean total surface area of a youth 7-16 years old (EPA, 1992a).
	=	5,000 cm^2/day for the future adult worker. It represents 25% of the mean total surface area of an adult (EPA, 1992a).
AF	=	0.6 mg/cm^2, soil adherence factor (EPA, 1991b).
ABS	=	0.01 - Organic compounds (EPA, 1991b)
	=	0.001 - Inorganic compounds (EPA, 1991b).
EF	=	52 days/year for the youth trespasser (estimated).
	=	250 days/year for the future adult worker (EPA, 1991a).
ED	=	10 years for a youth trespasser scenario (EPA, 1991a).
	=	25 years for an adult worker (EPA, 1991a).
BW	=	45 kg for a youth trespasser scenario (EPA, 1991a).
	=	70 kg for an adult worker scenario (EPA, 1991a).
AT	=	Exposure duration (years) x 365 days/year for evaluating noncancer risk.
	=	70 years x 365 days/year for evaluating cancer risk.

Table 7

Model for Calculating Doses from Inhalation of Soil Particulate Matter

$$\text{Soil Inhalation Dose (mg/kg-day)} = \frac{CS \times PM_{10} \times IR \times CF \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Upper 95% confidence limit of the mean concentration or the maximum concentration in surface soil (mg/kg)
PM_{10}	=	Small particulate matter concentration in air ($\mu g/m^3$)
IR	=	Inhalation rate (m^3/day)
CF	=	Conversion factor (10^{-9} kg/μg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Assumptions:

CS	=	Chemical concentration in soil.
PM_{10}	=	Area specific — 24 $\mu g/m^3$ (TDEC, 1995).
IR	=	20 m^3/day for the adult worker and trespasser (EPA, 1991a).
EF	=	52 days/year for the youth trespasser based on 1 day/week exposure for 52 weeks/year (estimated).
	=	250 days/year for the future on-site adult workers (EPA, 1991a).
ED	=	10 years for the youth trespasser (EPA, 1991a).
	=	25 years for the future on-site adult worker (EPA, 1991a).
BW	=	45 kg for the youth trespasser (EPA, 1991a).
	=	70 kg for the future on-site adult worker (EPA, 1991a).
AT	=	Exposure duration (years) x 365 days/year for evaluating noncancer risk.
	=	70 years x 365 days/year for evaluating cancer risk.

macroinvertebrates and small fish. Adequate feeding habitat for endangered species of bats and the bald eagle were determined to be absent within Brushy Fork Creek and the tributaries which are affected by the site.

The site is not located in a 100-year floodplain. According to the U.S. Fish and Wildlife Service (FWS), the Brushy Fork Creek is not a habitat for endangered species and the site is not on a wetland, nor does it affect a wetland.

Table 8

Cancer Slope Factors (CSFs)
$(mg/kg\text{-}day)^{-1}$

Chemical	Oral	Reference	Inhalation	Reference	Dermal[1]
ORGANICS					
Benzene	2.9E-2	EPA, 1995	2.9E-2[2]	EPA, 1995	3.6E-2
Benzo(a)anthracene	7.3E-1	ECAO	NTV	--	1.46
Benzo(a)pyrene	7.3	ECAO	NTV	--	14.6
Benzo(b)fluoranthene	7.3E-1	ECAO	NTV	--	1.46
Benzo(k)fluoranthene	7.3E-2	ECAO	NTV	--	0.146
Carbazole	2E-2	HEAST, 1994	NTV	--	4E-2
Chrysene	7.3E-3	ECAO	NTV	--	0.0146
4,4-DDT	3.4E-1	EPA, 1995	3.4E-1[2]	EPA, 1995	6.8E-1
Dibenzo(a,h)anthracene	7.3	ECAO	NTV	--	14.6
2,3,7,8 - TCDD	1.5E+5	HEAST, 1994	1.2E-1[2]	EPA, 1995	3E+5
Indeno(1,2,3-cd)pyrene	7.3E-1	ECAO	NTV	--	1.46
Methylene chloride	7.5E-3	EPA, 1995	1.6E-3[2]	--	9.38E-3
Pentachlorophenol	1.2E-1	EPA, 1995	NTV	--	2.4E-1
Trichloroethene	1.1E-2	ECAO	6E-3[2]	EPA, 1995	1.4E-2
INORGANICS					
Arsenic	1.5	EPA, 1995	1.5E+1[2]	HEAST, 1994	8.75
Beryllium	4.3	EPA, 1995	8.4[2]	EPA, 1995	2.15E+1
Chromium (VI)	NTV	--	4.1E+1[2]	HEAST, 1994	NTV
Lead	NTV	--	NTV	--	NTV
Nickel	NTV	--	8.4E-1[2]	EPA, 1995	NTV

[1] The dermal CSF was derived by dividing the oral CSF by the appropriate absorption factor: 0.8 - volatile organics, 0.5 - semi-volatile organics, and 0.2 - inorganics (Personal Communications, 1993b)

[2] Derived from a unit risk by dividing by 20 m^3/day, and multiplying by a body weight of 70 kg and a conversion factor of 1,000 (EPA, 1992a).

NTV = No toxicity data were available.
NC = Not of concern for this route of exposure.

Table 9

Chronic Reference Doses (RfD)
(mg/kg-day)

Chemical	Oral RfD	Reference	Inhalation RfD	Reference	Dermal[1] RfD
ORGANICS					
Acenaphthene					
Anthracene	3E-1	EPA, 1995	NTV	--	1.5E-1
Benzene	NTV	--	NTV	--	NTV
Benzo(a)anthracene	NTV	--	NTV	--	NTV
Benzo(a)pyrene	NTV	--	NTV	--	NTV
Benzo(b and/or k)fluoranthene	NTV	--	NTV	--	NTV
Benzo(ghi)perylene	NTV	--	NTV	--	NTV
Carbazole	NTV	--	NTV	--	NTV
Chrysene	NTV	--	NTV	--	NTV
4,4'-DDT	5E-4	EPA, 1995	NTV	--	2.5E-4
Dibenzo(a,h)anthracene	NTV	--	NTV	--	NTV
Dibenzofuran	NTV	--	NTV	--	NTV
2,3,7,8-TCDD (TEQ)	NTV	--	NTV	--	NTV
Endosulfan II	NTV	--	NTV	--	NTV
Endrin ketone	NTV	--	NTV	--	NTV
Fluoranthene	4E-2	EPA, 1995	NTV	--	2E-2
Fluorene	4E-2	EPA, 1995	NTV	--	2E-2
Indeno(1,2,3-CD)pyrene	NTV	--	NTV	--	NTV
3-Nitroanaline	NTV	--	NTV	--	NTV
Pentachlorophenol	3E-2	EPA, 1995	NTV	--	1.5E-2
Phenanthrene	3E-2	--	NTV	--	1.5E-2
Pyrene	3E-2	EPA, 1995	NTV	--	1.5E-2
Trichloroethene	6E-3	--	6E-3	EPA, 1995	4.8E-3
INORGANICS					

Table 9 (Continued)

Chronic Reference Doses (RfD)
(mg/kg-day)

Chemical	Oral RfD	Reference	Inhalation RfD	Reference	Dermal[1] RfD
Aluminum	NTV	--	NTV	--	NTV
Arsenic	3E-4	EPA, 1995	NTV	--	6E-5
Barium	7E-2	EPA, 1995	NTV	--	1.4E-2
Beryllium	5E-3	EPA, 1995	NTV	--	1E-3
Chromium	5E-3	EPA, 1995	NTV	--	1E-3
Cobalt	NTV	--	NTV	--	NTV
Copper	3.7E-2	EPA, 1992	NTV	--	7.4E-3
Lead	NTV	--	NTV	--	NTV
Manganese	1.4E-1 (food) 5E-3 (water)	EPA, 1995	1.4E-5	--	2.8E-2
Mercury	3E-4	HEAST, 1994	8.75E-5	HEAST, 1994	6E-5
Nickel	2E-2	EPA, 1995	NTV	--	4E-3
Selenium					
Vanadium	7E-3	HEAST, 1994	NTV	--	1.4E-3

[1] The dermal RfD was derived by multiplying the oral RfD by the appropriate absorption factor: 0.8 - volatile organics, 0.5 - semi-volatile organics, and 0.2 - inorganics (Personal Communication, EPA, 1993b).

[2] Calculated from the drinking water MCL assuming the consumption of two liters of water per day and a body weight of 70 kg (EPA, 1989).

NTV = No toxicity data were available.
NC = Not of concern through this route of exposure.

6.4 **Risk Characterization**

Risk characterization combines the results of toxicity and exposure assessments to yield numerical expressions of probable site related health effects. The process estimates individual and overall risk of health hazard from site contaminants using different methodologies for carcinogens and noncarcinogens. The output of the process is a major factor in deciding if a site requires cleanup.

Carcinogenic risks are expressed as probabilities of occurrence of cancer due to exposure to a certain level of contaminant over a period of time. USEPA generally considers a cancer risk acceptable if the probability of its occurrence is not more than 1 in 10,000 (1E-4). In other words, a site may not require a remedial action if no more than 1 person out of 10,000 people would develop cancer due to exposure to the chemicals at the site, provided no other conditions necessitate a clean-up action.

Carcinogenic risks were evaluated for the Chemicals of Potential concern at the site using methodologies approved by USEPA. Total cancer risks were 2 in 10,000 for the current youth trespasser and 9 in 10,000 for the future adult worker. These results indicate levels of cancer risk which are unacceptable to USEPA. See Table 10 for detailed results.

Toxic effects from contaminants which do not cause cancer are expressed numerically by the ratios of specific exposure levels to the reference doses for the Chemicals of Potential Concern. The ratio representing potential concern for the effects of a single noncarcinogen in a single medium (e.g., soil) is termed

TABLE 10

Surface Soil I[illegible]on, Inhalation, and Dermal Contact
Cancer Risk for Current Trespasser and Future Worker
Based on the Exposure Point Concentrations

American Creosote Works **Surface Soil Contaminants of Potential Concern**	**Ingestion** Lifetime Risk Trespasser Youth 7-16	**Dermal Contact** Lifetime Risk Trespasser Youth 7-16	**Inhalation** Lifetime Risk Trespasser Youth 7-16	**Ingestion** Lifetime Risk Worker Adult	**Dermal Contact** Lifetime Risk Worker Adult	**Inhalation** Lifetime Risk Worker Adult	Total Lifetime Risk for Trespasser Youth 7-16	Total Lifetime Risk for Worker Adult
Aluminum	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Arsenic	3E-07	3E-08	1E-07	7E-07	4E-07	1E-06	5E-07	2E-06
Barium	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Beryllium	2E-07	2E-08	2E-08	4E-07	2E-07	1E-07	2E-07	8E-07
Cobalt	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Chromium	NO SF	NO SF	5E-06	NO SF	NO SF	4E-05	NA	NA
Copper	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Lead	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Manganese	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Mercury	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Nickel	NO SF	NO SF	3E-08	NO SF	NO SF	2E-07	NA	NA
Selenium	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Vanadium	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Acenaphthene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Anthracene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Benzene	3E-12	7E-13	1E-13	6E-12	8E-12	1E-12	3E-12	1E-11
Benzo(a)anthracene	1E-07	4E-08	NO SF	2E-07	5E-07	NO SF	2E-07	8E-07
Benzo(a)pyrene	1E-05	4E-06	NO SF	2E-05	4E-05	NO SF	1E-05	7E-05
Benzo(b)fluoranthene	1E-07	4E-08	NO SF	2E-07	5E-07	NO SF	1E-07	7E-07
Benzo(k)fluoranthene	1E-08	4E-09	NO SF	2E-08	5E-08	NO SF	1E-08	7E-08
Benzo(GHI)perylene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Carbazole	5E-09	2E-09	NO SF	1E-08	2E-08	NO SF	7E-09	3E-08
Chrysene	1E-10	5E-11	NO SF	3E-10	5E-10	NO SF	2E-10	8E-10
Dibenzo(a,h)anthracene	4E-07	1E-07	NO SF	8E-07	2E-06	NO SF	5E-07	2E-06
Fluoranthene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Fluorene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Indeno(1,2,3-CD)pyrene	1E-07	5E-08	NO SF	3E-07	6E-07	NO SF	2E-07	8E-07
3-Nitroaniline	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Pentachlorophenol	7E-07	3E-07	NO SF	1E-06	3E-06	NO SF	9E-07	4E-06
Phenanthrene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Pyrene	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Trichloroethene	7E-12	2E-12	2E-13	2E-11	2E-11	1E-12	9E-12	4E-11
4,4-DDT	5E-10	2E-10	2E-11	1E-09	2E-09	2E-10	7E-10	3E-09
Dibenzofuran	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Dioxins (TEQ)	1E-04	5E-05	5E-12	3E-04	6E-04	4E-11	2E-04	8E-04
Endosulfan II (beta)	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Endrin Ketone	NO SF	NO SF	NO SF	NO SF	NO SF	NO SF	NA	NA
Total	1E-04	5E-05	5E-06	3E-04	6E-04	4E-05	2E-04	9E-04

NO SF=No Slope Factor available
NA=Not Applicable
NC=Not of Concern due to the non-volatile properties of metals

Hazard Quotient (HQ). The sum of all HQs for the noncarcinogens in a medium at a site represents the overall effect of one or more chemicals and is termed Hazard Index (HI). Generally, a value of HI which exceeds 1.0 is indicative of potential health concerns from exposure to one or more of the chemicals evaluated. Values of the total HI estimated for ACW are 0.02 and 0.04, for the youth trespasser and the adult worker respectively. See Table 11 for detailed results. These values indicate that health risks for noncarcinogens at the site are negligible.

6.5 CLEAN-UP CRITERIA

The human health risk assessment concluded that site remediation is warranted due to an unacceptable level of carcinogenic risk. Nevertheless, the Contaminants of Concern (PCP, PAHs, dioxin, and arsenic) were detected at unacceptable concentrations only at certain areas of the site. Based on the Iso-concentration maps developed during the Focused Remedial Investigation, a total area of approximately 28 acres of the 60 acre site requires remediation. See Figures 3 and 4.

The clean-up goals developed for ACW are presented in Table 12. Remediation of the site will be designed to achieve or exceed the cancer risk protection level of 1E-4 for the Future Adult Worker. This remedial goal is also protective of the Youth Tresspasser.

7.0 REMEDIAL ALTERNATIVES

The main objectives of remediating the ACW site are: (1) to mitigate the potential health hazards due to incidental soil ingestion, dermal contact, and dust inhalation by current

TABLE 11

Surface Soil [illegible]stion, Inhalation, and Dermal Contact
Hazard Quotients for Current Trespassers and Future Workers
Based on the Exposure Point Concentrations

American Creosote Works Surface Soil Contaminants of Potential Concern	Ingestion Chronic HQ Trespasser Youth 7-16	Dermal Contact Chronic HQ Trespasser Youth 7-16	Inhalation Chronic HQ Trespasser Youth 7-16	Ingestion Chronic HQ Worker Adult	Dermal Contact Chronic HQ Worker Adult	Inhalation Chronic HQ Worker Adult	Total HI for Trespasser Youth 7-16	Total HI for Worker Adult
Aluminum	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Arsenic	0.005	0.0005	NO RfD	0.006	0.002	NO RfD	0.005	0.008
Barium	0.0009	0.0001	NO RfD	0.001	0.0004	NO RfD	0.001	0.002
Beryllium	0.00006	0.000007	NO RfD	0.00008	0.00003	NO RfD	0.00006	0.0001
Cobalt	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Chromium	0.003	0.0004	NO RfD	0.004	0.002	NO RfD	0.004	0.006
Copper	0.0005	0.00006	NO RfD	0.0007	0.0002	NO RfD	0.0006	0.0009
Lead	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Manganese	0.002	0.0002	NO RfD	0.003	0.0009	NO RfD	0.002	0.003
Mercury	0.0004	0.00004	NC	0.0005	0.0002	NC	0.0004	0.0007
Nickel	0.0002	0.00003	NO RfD	0.0003	0.0001	NO RfD	0.0003	0.0004
Selenium	0.0002	0.00002	NO RfD	0.0002	0.0001	NO RfD	0.0002	0.0003
Vanadium	0.002	0.0002	NO RfD	0.002	0.0008	NO RfD	0.002	0.003
Acenaphthene	0.0001	0.0001	NO RfD	0.0001	0.0004	NO RfD	0.0002	0.0005
Anthracene	0.00001	0.000005	NO RfD	0.00001	0.00002	NO RfD	0.00002	0.00004
Benzene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Benzo(a)anthracene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Benzo(a)pyrene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Benzo(b)fluoranthene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Benzo(k)fluoranthene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Benzo(GHI)perylene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Carbazole	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Chrysene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Dibenzo(a,h)anthracene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Fluoranthene	0.0008	0.0004	NO RfD	0.001	0.002	NO RfD	0.001	0.003
Fluorene	0.00008	0.00004	NO RfD	0.0001	0.0002	NO RfD	0.0001	0.0003
Indeno(1,2,3-CD)pyrene	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
3-Nitroaniline	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Pentachlorophenol	0.001	0.0006	NO RfD	0.002	0.002	NO RfD	0.002	0.004
Phenanthrene	0.0002	0.0001	NO RfD	0.0003	0.0005	NO RfD	0.0003	0.0008
Pyrene	0.001	0.0004	NO RfD	0.001	0.002	NO RfD	0.001	0.003
Trichloroethene	0.0000007	0.0000002	0.00000004	0.0000009	0.0000009	0.0000001	0.0000009	0.000002
4,4-DDT	0.00002	0.000008	NO RfD	0.00002	0.00004	NO RfD	0.00003	0.00006
Dibenzofuran	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Dioxins (TEQ)	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Endosulfan II (beta)	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Endrin Ketone	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NO RfD	NA	NA
Total	0.02	0.003	0.00000004	0.02	0.01	0.0000001	0.02	0.04

NO RfD=No Reference Dose available
NA=Not Applicable
NC=Not of Concern due to the non-volatile properties of metals

59 0045

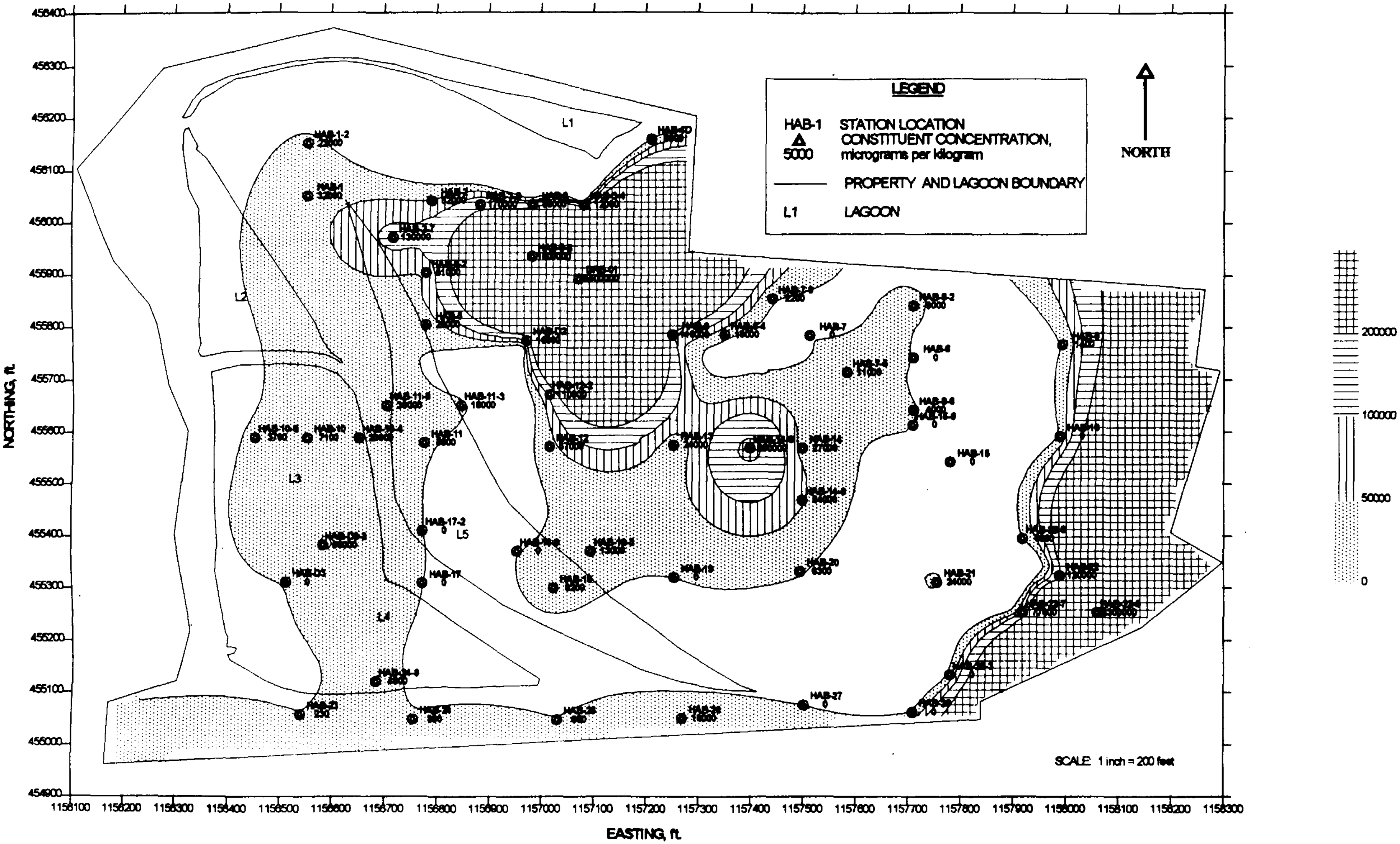


FIGURE 3
PENTACHLOROPHENOL CONCENTRATIONS
SURFICIAL SOILS, 0 to 6 inches
AMERICAN CREOSOTE WORKS SUPERFUND SITE
JACKSON, TENNESSEE

NOTE: "0" represents the quantitation limit of the chemical analysis, i.e., the non-detect value. The results of the contouring do not reflect the lagoon sediment samples.

5 9 0046

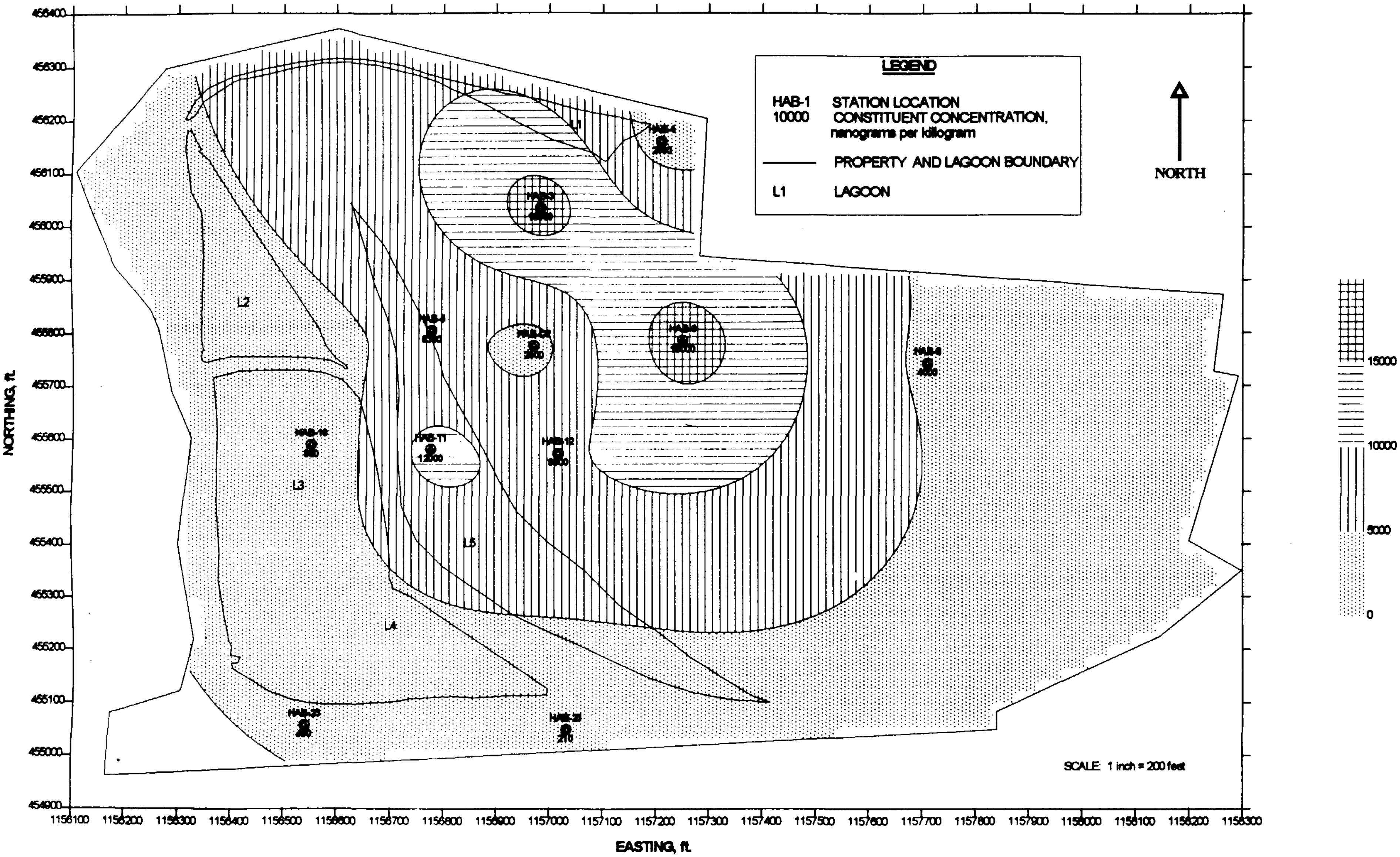


FIGURE 4
DIOXIN TOXICITY EQUIVALENT VALUE (TEQ)
SURFICIAL SOILS, 0 to 6 inches
AMERICAN CREOSOTE WORKS SUPERFUND SITE
JACKSON, TENNESSEE

NOTE: "0" represents the quantitation limit of the chemical analysis, i.e., the non-detect value. The results of the contouring do not reflect the lagoon sediment samples.

59 0047

TABLE 12

PRELIMINARY REMEDIAL GOALS

Risk Based RGs – Based on Lifetime Cancer Risk
Current Youth, ages 7–16, Trespasser
Soil (Units: mg/kg)

CHEMICALS	Based on Cancer Risk 1E–6	Based on Cancer Risk 1E–5	Based on Cancer Risk 1E–4
Organics			
Benzo(a)pyrene	2.91	29.1	291
Dioxins (TEQ) – 2,3,7,8 TCDD	0.00009	0.0009	0.009

Risk Based RGs – Based on Lifetime Cancer Risk
Future Adult Worker
Soil (Units: mg/kg)

CHEMICALS	Based on Cancer Risk 1E–6	Based on Cancer Risk 1E–5	Based on Cancer Risk 1E–4
Inorganics			
Arsenic	2.25	22.5	225
Organics			
Benzo(a)pyrene	0.415	4.15	41.5
Dibenzo(a,h)anthracene	0.55	5.5	55
Pentachlorophenol	30	300	3000
Dioxins (TEQ) – 2,3,7,8 TCDD	0.0000225	0.000225	0.00225

trespassers and future workers at the site. (2) to protect the Alluvial and the Fort Pillow aquifers, the Central Creek, the South Fork Forked Deer River, and the sediments which were found to be impacted by the site. (3) to maintain the site as an industrial property which will not pose a significant threat to human health or the environment. The following is a discussion of the remedial alternatives evaluated for meeting these objectives. Although several pertinent options were screened for the site, only two are deemed necessary for discussion in this ROD.

Option #1 is "No Further Action". This option is considered, as required by Superfund Law, for comparison with other clean-up alternatives. Option #2 is a combination of Liquid Recovery, Immobilization and Monitoring. It is considered because it is well suited for addressing the conditions at ACW, based on USEPA's research and field experience with similar sites. In addition, the preliminary results of site-specific treatability studies indicate that the train of remedies in Option #2 can be successfully applied at the site. The choice of the option for consideration conforms with USEPA's newly developed Presumptive Remedy Policy and the recent initiative to streamline clean-up processes. The presumptive remedy policy allows USEPA to consider an optimum clean-up method from several suitable technology alternatives previously evaluated for sites with similar problems. Detailed information on the background and application of presumptive remedies may be obtained from Appendix A, "Presumptive Remedies for Soils, Sediments, and Sludge at Wood Treater Sites".

7.1 Option #1--No Further Action

Under this option, no new clean-up activities would occur at the site. However, the on-going USEPA site management and stabilization tasks, which the State currently performs under a Support Agency Cooperative Agreement, would continue indefinitely. These tasks include upkeep of the perimeter fence, the levee, the equipment for draining the lagoon, and sampling of the lagoon water before it is discharged into the River. In addition, the existing deed restriction which limits the site to industrial and similar uses only will be maintained. This option requires no additional capital cost to USEPA or the State. However, certain contaminants found at the site would remain at the current unacceptable levels.

7.2 Option #2--Liquid Recovery/Immobilization/Monitoring

Under this remedial option, the liquid recovery process would remove free creosote, emulsion, water and associated contaminants from the soils. Through the process of immobilization, migration of the soil contaminants would be reduced considerably. Option #2 includes excavating trenches to drain liquids trapped between the surface of the soil and the underlying clay, separating creosote and water for proper disposal, excavating and solidifying contaminated soils, backfilling and capping treated soils, and installing a containment berm around the capped area. The existing deed restriction will be maintained in order to continue limiting the property to industrial and similar uses only, and the site will be monitored for a minimum of five years to ensure remedy effectiveness.

The monitoring program will include:

1. Leach tests to ensure the integrity of the immobilization remedy.

2. Sampling and analyses of the Alluvial and Fort Pillow aquifers in selected on-site and off-site wells to ensure that the aquifers are protected by the remedy.

3. Sampling and analyses of sediments and water from the Central Creek and the South Fork Forked Deer River to ensure protection of fish and aquatic life.

8.0 COMPARATIVE ANALYSIS OF REMEDIAL OPTIONS

The two remedial options discussed above were evaluated with respect to the current conditions of the site and USEPA's mandate to prevent the release of hazardous chemicals into the environment. Option #1 does not comply with USEPA's mandate because the option would result in an unacceptable level of risk for the soil pathway at the site. Option #2 will remove free products and treat the soils which constitute the sources of contamination at the site. In addition, Option #2 will protect the surface waters, the sediments and the aquifers affected by the site. Based on current information, this option provides the best balance of trade-offs relative to the nine criteria which USEPA uses to evaluate clean-up alternatives. The following is an evaluation of the options.

8.1 **Threshold Criteria**

1. Overall Protection

Option #1, the "No Action" alternative, does not provide adequate protection of human health and the environment because it does not prevent migration of contaminants in the soils. In addition, persons entering the site are potentially at risk of exposure to the contaminants through dermal contact, accidental ingestion and/or inhalation. Therefore, this alternative was eliminated from further consideration.

Option #2, Immobilization/Liquid Recovery/Monitoring, provides both short and long-term protection by removing the source of release of contamination into the environment, and by containing residual contaminants in a fixed mass. It reduces the potential for further surface water and groundwater contamination, and migration of contaminants offsite. In addition, it eliminates potential risks associated with dermal contact, inhalation and accidental ingestion of contaminated soils, sediments, and/or sludge.

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

Remedial action operations for Option #2 will be conducted in compliance with all federal and state ARARs. Removal, treatment, transportation and land disposal regulations or CERCLA off-site rules will be adhered to. Appropriate emission controls will be provided, if needed, to ensure compliance with air quality standards during excavation and treatment. Recovery, processing, and disposal of the free products will be designed and implemented to comply with all federal and state ARARs.

8.2 Primary Balancing Criteria

1. Long-Term Effectiveness and Permanence

Option #2 provides long-term and permanent solutions by the processes of contaminant source removal and immobilization.

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

Significant reduction in mobility of contaminants is provided by Option #2 through the process of solidification, and removal of free products reduces toxicity and volume of contaminants.

3. Short-Term Effectiveness

Option #2 treatment can be accomplished within 6 to 9 months for the entire target area of the site. The remedy immediately becomes effective after the treatment is applied. In addition, because the technology is flexible, the site may be segmented for treatment. Each segment can be treated and rendered protective of human health and the environment in a relatively short time.

4. Implementability

Immobilization is a frequently used remedial technology which has been applied at many wood treater sites similar to ACW. In a recent USEPA publication, (Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites, December 1995), which ranked ten technologies, immobilization was used at 13 out of 50 sites evaluated by the report. Required equipment is relatively simple and readily obtainable. Similarly, the other components of the remedy (liquid recovery and monitoring) are used frequently in hazardous waste site remediations. This option is flexible and can be adapted to remediating the site in phases if necessary, due to government budgetary constraints.

5. Cost

The cost of this option depends on the area, depth, and volume of the soil to be treated. Based on field sampling data, the area and depth of the contaminated soil which requires treatment are approximately 28 acres and 2 feet respectively. These equate to approximately 90,000 cubic yards or 120,000 tons of soil. The total cost (Present Value) of Option #2 is $18,448,638 as summarized below. The Monitoring component of the cost is estimated at $100,000 per year for five years, discounted at 7%.

ESTIMATED COST FOR THE SELECTED REMEDY

Liquid Recovery and Immobilization	$14,321,933
Monitoring	$436,977
SUBTOTAL COST	$14,758,910
Contingency (25%)	$3,689,728
TOTAL COSTS	**$18,448,638**

8.3 Modifying Criteria

1. State Acceptance

Officials of the Tennessee Department of Environment and Conservation are in agreement with Option #2 clean-up plan, and have concurred with the treatment technology to be applied.

2. Community acceptance

Selection of Option #2 was proposed publicly in and around the community where the site is located. No comments for or against the alternative specifically were received during the public comment period which lasted 30 days. However, three general site-related comments (one from the public and two from state officials), were received during the period. These are addressed in the Responsiveness Summary section of this document.

9.0 THE SELECTED REMEDY

The selected remedy (Option #2) for ACW site is a combination of (1) Liquid Recovery, (2) Immobilization, and (3) Monitoring. This combination is necessary because much of the soil to be remediated is saturated with spilled creosote, water and emulsion. Liquid recovery is planned to remove most of the organic load in the waste in order to enhance the application and effectiveness of Immobilization on the residual contaminants in the soils. The Monitoring component of the remedy will evaluate the immobilized waste for integrity, and assess the effectiveness of natural attenuation of the remaining contaminants in the groundwater, the surface waters and sediments.

9.1 Liquid Recovery

The Liquid Recovery stage of the clean-up will remove the free product by gravity drainage using a series of trenches constructed between the soil surface and the clay below. The free product will be processed on-site to separate the various liquids using a system of oil/water separators. The recovered creosote will be stored temporarily on-site in a tank and ultimately hauled to an authorized off-site creosote recycling facility. The remaining liquid will be treated on-site to meet effluent discharge standards before being discharged into the South Fork Forked Deer River.

9.2 Immobilization

The primary goals of the immobilization process are to limit the solubility of the chemicals of concern at the site and to change the chemical forms of the contaminants to minimize their leachability. The process will be designed to stabilize the contaminants, thereby limiting their mobility, and to solidify the contaminated soil into a monolithic block of treated waste which will not disintegrate. These conditions will be achieved by mixing the contaminated soil in batches with properly formulated binding reagents composed of Portland cement, fly ash and lime or kiln dust. The resultant mass of waste will be buried in the excavated area, covered with clay and top soil which, in turn, will be graded. Finally, the area will be seeded with grass. The cross-section of the anticipated final landscape for the treated area is depicted in Figure 5.

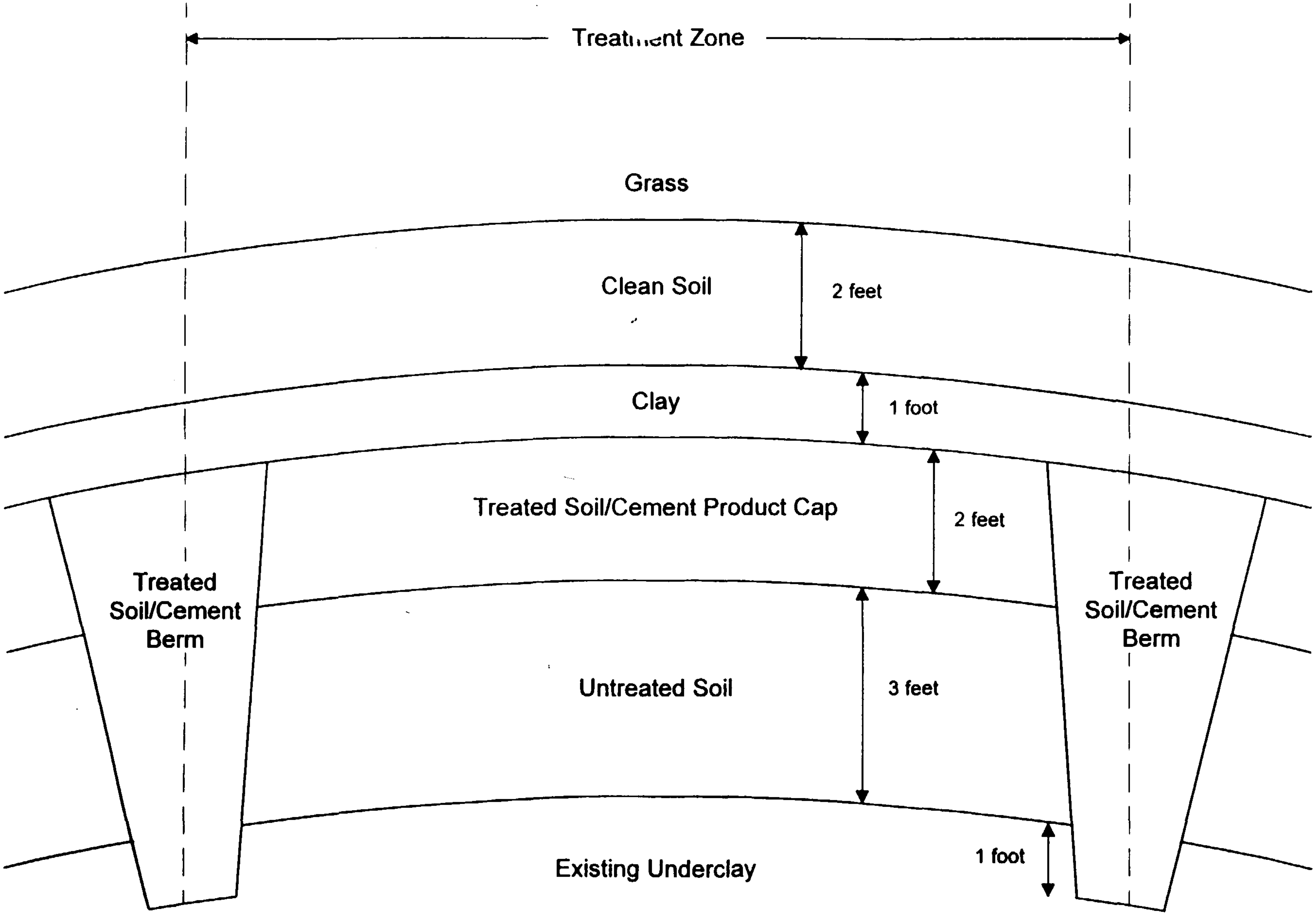


Figure 5. Cross-Section of Final Treatment Area: 2-Foot Treatment Depth (not to scale)

5 9 0057

The success of an immobilization project depends on using the right mix and quantity of the binding reagent and ensuring appropriate curing conditions. These, in turn, depend on the chemical and physical characteristics of the waste. Therefore, USEPA recently initiated site-specific treatability studies on the waste at ACW. Preliminary results of leach tests indicate that immobilization can be applied successfuly at the site. As part of the Remedial Design (RD), bench-scale treatability studies will be conducted to formulate the appropriate reagent and leach tests will be run on the site contaminants prior to treatment. After the treatment, the leach tests will be performed periodically for five years in addition to tests for unconfined compressive strength to monitor the durability of the treated soil.

9.3 Monitoring

Monitoring is the third aspect of the selected remedy. It will be initiated immediately after the two other RA components are completed for the following three purposes.

1. **To provide a systematic procedure for collecting data on the performances of the preceding remedial activities**: during the Liquid Recovery stage of the RA, the volume and rate of liquid recovery will be recorded. In addition, the physical and chemical characteristics of the liquids will be analyzed. These data will enhance the design of any necessary future phases of the RA. As previously discussed, leach and other tests will be run periodically on the immobilized waste to evaluate its integrity.

2. To evaluate and report regularly the effects of the remedial activities on the Alluvial and Fort Pillow aquifers, the Central creek, the South Fork Forked Deer River, and sediments: based on the USGS studies summarized in Section 5.2, the only significant groundwater contamination associated with the site is within the site boundaries. Apparently, the masses of clay in the subsurface effectively inhibit fluid flow from the site. Nevertheless, surface runoff, erosion, and floodwater from the site have transported toxic substances from the site which have contaminated the nearby surface waters, sediments, fish and aquatic life. This limited adverse environmental impact will be addressed by the selected RA. The liquid recovery process will remove the source of further on-site groundwater contamination, and the residual waste immobilization will restrain further effect of surface runoff, erosion, and floodwater from the site. These, in addition to the inevitable process of natural attenuation will clean up the affected media, habitats, and receptors. An appropriate sampling and analyses program will be designed and implemented as part of this RA to ensure that the desired results are obtained.

3. To develop a data base for USEPA's Five-Year Review: the first of these reviews is due five years after the initiation of the RA construction activities. The Five-Year Reviews will document progress and indicate if any modification of the RA or other additional work is warranted.

In summary, the remedy will include the following activities:

1. Delineating the area to be treated.

2. Constructing trenches within the area to drain and collect liquids including creosote, emulsion, and water.

3. Installing collection and treatment tanks and other equipment to treat collected liquid for proper disposal.

4. Excavating and screening contaminated soils to be treated.

5. Mixing contaminated soils with properly formulated cement, kiln dust, and fly ash to bind and harden contaminants to soil, and to reduce soil permeability.

6. Placing treatment product into the excavation and compacting.

7. Installing a berm of clean soil around the treated soil areas to control water runoff.

8. Capping the bed of treated soil with clay, top soil, and then reseeding to control erosion.

9. Maintaining deed restrictions to limit the property to industrial use only.

10. Designing and Implementing a comprehensive monitoring program.

9.4 Remedy Implementation

Despite current government funding limitations, it is prudent to begin implementing the selected remedy in order to reduce the risks at the site. Therefore, a segment of the site is recommended for immediate remediation. An area of about 8.4 acres, with an estimated 27,000 cubic yards of contaminated soil, has been delineated for the initial phase of the remedy implementation. The area extends from the central to the western part of the site, and poses the site's highest human health and enviromental risk. Currently, additional sampling is being conducted in this area of the site for the treatability study and remedial design. Cost of remediating the area is estimated at $5,900,000, including monitoring expenses and a 25% contingency.

10.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, USEPA must select remedies that protect human health and the environment. The remedies must comply with applicable or relevant and appropriate requirements unless a statutory waiver is justified. Furthermore, they must be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that permanently and significantly reduce the volume, toxicity,or mobility of hazardous substances as their principal element. A discussion of how the selected remedy meets these requirements follows.

10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through treatment of contaminated soil, sludge, and sediment by solidification and stabilization, extraction and recycling of creosote, extraction and treatment of contaminated sub-surface water and emulsion, drainage and treatment of impounded water and implementation of institutional controls to restrict future use of the site. In addition, all visible debris at the site, including tanks, railroad ties, lumber, and building/foundation materials will be removed and disposed of at approved locations. Finally, a significant reduction in erosion and transportation of contaminated soil from the site will result from the solidification/stabilization process, thereby reducing surface water pollution potential.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The selected remedy will comply with all federal and state ARARs. The Land Disposal Restrictions will not be violated because "placement" will not occur as a result of the RA. The contaminated soil will be processed in a single area of contamination. The ARARs that are pertinent to the selected remedy are presented below.

Federal ARARs

* Clean Water Act Discharge Limitations, NPDES Permit 40 CFR 122, 125, 129, 136; pretreatment Standards 40 CFR 403.5. Prohibits unpermitted discharge of any pollutant or combination of pollutants into waters of the U.S. from any point source, including storm water runoff from industrial areas. Applicable.

* Clean Water Act Wetlands Regulations, Part 404, CFR 230. Controls the discharge of dredged or fill materials into waters of the U. S. Applicable.

* Fish and Wildlife Coordination Act, 16 U.S.C. 661, 742a, 2901. Requires action to protect fish and wildlife from actions modifying streams or areas affecting streams. No impact expected, but applicable.

* Resource Conservation and Recovery Act (RCRA):

-- 40 CFR 262 and 263. RCRA generator and transporter requirements are applicable to the off-site transport and recycling of recovered creosote.

-- 40 CFR 264.553. RCRA requirements for temporary units are applicable to any tank used for temporary storage of recovered creosote before transported for recycling offsite.

* Clean Air Act (CAA), National Ambient Air Quality Standards (NAAQS), 40 CFR, Part 50.6. Sets primary and secondary standards for protection of public health from exposure to criteria pollutants. Applicable to particulate matter emissions from the soil excavation process.

* USEPA Regulations on Ambient Air Monitoring, 40 CFR 53.22, 40 CFR 53.34. Applicable to discharge of air contaminants, gaseous and particulate emissions from the soil excavation process.

State ARARs

* Rule Chapter 1200-1-7 Solid Waste Regulations, State of TN.

* Tennessee Hazardous Waste Management Act of 1977, TCA 68-212-101 to 121.

* Tennessee Hazardous Waste Management Act of 1982, TCA 68-212-201 to 224.

* Tennessee Water Quality Act, TCA 69-3-101 to 131.

* Tennessee Air Quality Control Act, TCA 68-201-101 to 118.

10.3 <u>Cost Effectiveness</u>

Excluding the monitoring expenses, the selected remedy is expected to cost between $145 and $155 per ton of treated waste material. The industry average ranges between $75 and $400 per ton of waste for similar treatment. Therefore, the projected cost of the process to be used at the site is competitive. Recovery of free product, which is a part of the remedy, will remove a significant amount of the primary source of environmental pollution. Immobilization process will virtually eliminate the effects of the residual waste on the environment. Therefore, the remedy is believed to be cost-effective.

10.4 <u>Utilization of Permanent Solutions to the Maximum Extent Practicable</u>

The free product recovery component of the selected remedy is a permanent solution designed to eliminate the source of site contamination to the maximum extent possible. Immobilization of the residual contamination will provide a long lasting environmental and human health protection. In addition, the deed restriction to be maintained on the site will limit the use of the property and permanently control the effect of the site on human health.

10.5 Preference for Treatment As a Principal Remedy Element

The major components of the selected clean-up plan constitute preference for treatment as a principal remedy element. The free product to be recovered from the site will be treated appropriately before disposal at approved off-site locations. As previously discussed, the soils, sediments, and sludge with their associated contaminants will be immobilized by treatment with properly designed binding reagents.

11.0 SIGNIFICANT CHANGES TO THE PROPOSED PLAN

In May 1996, the Superfund Proposed Plan Fact Sheet regarding the selected remedy stated the following: "The area of the Site to be treated is estimated at 365,100 square feet or 8.4 acres. Contaminated soils to depths of 2 to 5 feet from the surface would be excavated and treated. These would result in the treatment of between 35,000 and 88,000 tons of contaminated soil. Depending on the amount of soil treated, cost of the project is expected to be between $5 million and $12 million." According to this Record of Decision, the total area of the site to be remediated is 28 acres at an estimated cost of $18,448,638. However, remediation of the 28 acres is to be conducted in phases. During the initial phase, 8.4 acres of the site would be remediated at an estimated cost of $5.9 million. The reasons for the apparent differences are as follows:

1. Due to RA funding constraints, the cleanup of contaminated soils will need to be conducted in phases. In the Proposed Plan, an area of 8.4 acres was discussed as the area to be remediated. This area represents the portion of the site with the highest

contamination, and therefore, the focus of the first phase of remediation. However, site studies have esimated the total area which may require remediation at 28 acres. Therefore, the area addressed by the clean-up levels set in this ROD is more properly stated as 28 acres, with the the first phase of cleanup to focus on the most contaminated area of approximately 8.4 acres.

2. The calculation of contaminated soils has been refined further by studies conducted after the Proposed Plan which indicates that the average depth of soils requiring remediation is 2 feet.

3. The combination of increasing the total area addressed by the ROD (28 acres versus 8.4 acres), and refining the depth of soil treatment (2 feet versus a range of 2 to 5 feet) has resulted in a change to the estimated cost of the RA.

4. The Proposed Plan did not discuss or provide funding for Monitoring activities. This ROD has outlined the reasons for monitoring and has included its estimated cost of $100,000 per year for 5 years in the RA cost estimate.

12.0 <u>Responsiveness Summary</u>

Pursuant to Superfund policy, this section of the ROD is intended to addresses the comments, issues and questions raised by citizens during the Proposed Plan public comment period. Three letters were received regarding the Proposed Plan during the public comment period held between June 3 and July 3, 1996. A summary of the letters, and USEPA's responses to the issues raised are presented below.

1. A letter was received from the Tennessee Wildlife Resources Agency which recommends the establishment of good base-line information by sampling fish on the South Fork Forked Deer River before implementing the RA plan.

Response: This recomendation will be considered during the Remedial Design which includes establishing appropriate base-line data for the RA.

2. A letter was written by a citizen to the Division of Superfund, Tennesse Dept. of Environment regarding his concern about "lack of testing of private wells for contamination." The letter was a followup to a phone discussion by the writer and a Tennessee State official. It was sent by the official to USEPA with comments that the writer lives approximately four miles, directly south of the site. The official believes that the writer's fear can be allayed by the fact that groundwater flows southwest in the vicinity of the site. In addition, wells screened at six different levels on the southern boundary of the site did not indicate contamination.

Response: USEPA personnel discussed the issue with Tennessee State officials and agreed with their conclusions.

3. An official of the Tennessee Division of Water Pollution Control, in a letter to the Tennessee Division of Superfund expressed concern about the waste previously consolidated and capped at the site, and the impounded water on top of the cap. In the same letter, the writer felt that USEPA did not propose a plan to address the impact of the site on the Alluvial and Fort Pillow aquifers, the Central Creek, the South Fork Forked Deer

River, sediments, and aquatic organisms.

Response: USEPA personnel discussed the concerns with the officials of the Tennessee Division of Superfund. The officials indicated that the impounded water issue would be addressed by the repair work being conducted under the State Superfund Cooperative Agreement for Site Stabilization. USEPA indicated that the remedy plan for the affected aquifers, creek, river, sediments, and aquatic organisms would be detailed in this Record of Decision.

APPENDIX A

PRESUMPTIVE REMEDIES FOR SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES

5 9 0070

United States
Environmental Protection
Agency

Office of
Solid Waste and
Emergency Response
Washington, DC 20460

Directive: 9200.5-162
EPA/540/R-95/128
PB 95-963410
December 1995

Superfund

EPA

Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites

5 9 0071

EPA/540/R-95/128
December 1995

Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites

Office of Emergency and Remedial Response, 5202G
Washington, DC 20460

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INTRODUCTION

Since the enactment of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund), the Superfund remedial and removal programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, disposal practices performed, or environmental media affected. Based on information acquired from evaluating and cleaning up these sites, the Superfund program is undertaking an initiative to develop presumptive remedies to accelerate future cleanups at these types of sites. The presumptive remedy approach is one tool for speeding up cleanups within the ***Superfund Accelerated Cleanup Model (SACM)***. This approach can also be used to streamline remedial decisionmaking for corrective actions conducted under the Resource Conservation and Recovery Act (RCRA).

Presumptive remedies are preferred technologies for common categories of sites, based on EPA's experience and its scientific and engineering evaluation of alternative technologies. The objective of the presumptive remedies initiative is to use the Superfund program's experience to streamline site characterization and speed up the selection of cleanup actions. Over time, presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

This directive identifies the presumptive remedies for wood treater sites with contaminated soils, sediments, and sludges. EPA has developed guidance on presumptive remedies for municipal landfill sites [33] and sites with volatile organic compounds (VOCs) in soils [32]. EPA is also in the process of developing guidance on presumptive remedies for polychlorinated biphenyl (PCB), grain storage, manufactured gas plant, and contaminated ground-water sites. In addition, EPA has developed a directive entitled Presumptive Remedies: Policy and Procedures [31], which outlines and addresses the issues common to all presumptive remedies (e.g., the role of ***innovative treatment technologies***).

Bold and italicized ***terms*** are defined in the Glossary at the end of this document. The References section at the end of this document provides a list of supporting guidance documents that may be consulted for additional information on relevant topics. Bracketed numbers [#] appear throughout the text to indicate specific references in the References section.

PURPOSE

The purpose of this directive is to provide guidance on selecting a presumptive remedy or combination of presumptive remedies for wood treater sites with contaminated soils, sediments, and sludges. Specifically, this guidance:

- Describes the contaminants generally found at wood treater sites;
- Presents the presumptive remedies for contaminated soils, sediments, and sludges at wood treater sites;
- Describes the presumptive remedy process concerning the site characterization and technology screening steps; and
- Outlines the data that should be used to select a presumptive remedy.

The presumptive remedies for wood treater sites with soils, sediments, and sludges contaminated with organic contaminants are bioremediation, thermal desorption, and incineration. The presumptive remedy for wood treater sites with soils, sediments, and sludges contaminated with inorganic contaminants is immobilization. The section of this document entitled "Presumptive Remedies for Wood Treater Sites" provides a brief description of each of these technologies.

The decision to establish these technologies as presumptive remedies for this site type is based on EPA's accumulated knowledge about site characterization and remedy selection for wood treater sites with contaminated soils, sediments, and sludges, including actual performance at Superfund and RCRA sites. This decision is also based on an analysis conducted by EPA on ***Feasibility Studies (FSs)*** and ***Records of Decision (RODs)*** for sites where wood treating contaminants in soils, sediments, and sludges drove remedy selection. The results of this analysis, which are summarized in Appendix A (Technical Basis for Presumptive Remedies), demonstrate that these four technologies represent approximately 84% of the remedies selected in the FSs and RODs analyzed. The FS/ROD analysis also provides information on why other, non-presumptive technologies generally are not effective and/or appropriate for cleaning up wood treater sites with contaminated soils, sediments, or sludges.

USE OF THIS DOCUMENT

This directive is designed to assist Superfund site managers (i.e., ***Remedial Project Managers (RPMs)*** and ***On-Scene Coordinators (OSCs)***) and other personnel in selecting remedies for cleaning up soils, sediments, and sludges at wood treater sites that are contaminated primarily with creosote, pentachlorophenol, and/or chromated copper arsenate. Site managers in other programs, such as the RCRA corrective action program or the private sector, may also find this document useful. For example, the information contained in this document could be used to eliminate the need for an alternatives screening step and streamline the detailed analysis of alternatives in the RCRA Corrective Measures Study, which is analogous to the FS under CERCLA.

Wood treater sites that have contaminated soils, sediments, and sludges often have contaminated ground water as well. At some of these sites, the contaminated soils, sediments, or sludges may not require treatment or may only need to be contained, depending on the degree of human health and environmental risk posed by the contaminated soils, sediments, or sludges as determined in the ***removal site evaluation*** and/or ***remedial site evaluation*** (i.e., the preliminary assessment/site inspection (PA/SI)). At some sites, a combination of treatment options may need to be implemented to address the contamination of ground water as well as soils, sediments, and sludges. When addressing contamination at wood treater sites, site managers should consider the impact of contamination across all environmental media. In particular, site managers at wood treater sites should consider the impacts of ground-water contamination. EPA is currently developing guidance on a presumptive remedy approach for responding to contaminated ground-water sites. When available, this guidance should be used to address ground-water contamination at wood treater sites. Site managers should also consult existing guidance on the remediation of contaminated ground water [6, 7, 17, 20, 38]. Box A provides a brief discussion of ground-water considerations for wood treater sites that is consistent with existing guidance and the forthcoming presumptive remedy ground-water approach. In addition, Box D provides background information on non-aqueous phase liquid (NAPL) contaminants, including dense NAPLs (DNAPLs or sinkers) and light NAPLs (LNAPLs or floaters).

The presumptive remedy evaluation and selection process described in this document is consistent w and fits into the more detailed conventional remedy selection process outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300). The Agency believes that the presumptive remedies set out in this document represent appropriate response action alternatives for sites meeting certain criteria and, therefore, generally should be used. However, remedy selection for an individual site may vary because of specific site characteristics or community or state concerns. Although it may still be possible to accelerate remedy selection for non-presumptive technologies, such selection will not be able to take advantage of the generic justification provided by this document. Under these circumstances, a conventional ***Remedial Investigation/Feasibility Study (RI/FS)*** or ***Engineering Evaluation/Cost Analysis (EE/CA)*** should be performed. Guidance on circumstances in which a presumptive remedy might not be appropriate is found in Presumptive Remedies: Policy and Procedures [31]. When determining whether a remedial or removal action is the appropriate method for cleaning up a wood treater site, site managers should consult the NCP and Superfund program guidance. Also, the Agency is currently developing a fact sheet to assist RPMs and OSCs in identifying the factors affecting the site-specific determination of whether a Superfund early action is best accomplished as a non-time-critical removal action or an early remedial action.

This directive is not a stand-alone document. To ensure a full understanding of wood treater site characterization and remedy selection, site managers should refer to the FS/ROD analysis, which is summarized in Appendix A of this document, and the documents cited as references at the end of this document. Site managers unfamiliar with certain complex site conditions at wood treater sites should consult with experienced site managers, the contacts listed in Box B of this document, the Superfund Technical Assistance Response Team (START), or the Environmental Response Team (ERT). EPA is continuing to gather and develop more information on the remedies selected and implemented at wood treater sites.

ANTICIPATED BENEFITS OF PRESUMPTIVE REMEDIES

The use of this document is expected to reduce the costs and time required for remedy selection at wood treater sites. This directive should be used to:

BOX A
Ground-Water Considerations

Wood treater sites typically involve subsurface DNAPL and/or LNAPL contaminants (see Boxes C and D) in addition to contaminated soils, sediments, or sludges. All of these materials are sources of contamination of the underlying ground water and need to be considered when planning an overall site response. A key element of all existing ground-water remediation guidance is that site characterization and response actions should be implemented in a **phased approach**. In a phased approach, site response activities are conducted in a sequence of steps, such that information obtained from earlier steps is used to refine subsequent investigations, objectives, or actions. The recommended strategy for sites with NAPL contamination, such as wood treater sites, includes the following response actions and objectives [17].

Site investigations should be designed to delineate both NAPL zones and aqueous plumes. NAPL zones are those portions of the site where LNAPL or DNAPL contaminants (in the form of immiscible liquids) are suspected in the subsurface, either above, at, or below the water table. Aqueous plumes are portions of the site where contaminants are present in solution and not as immiscible liquids.

Early actions should be used to:

- Prevent exposure, both current and future, to ground-water contaminants;
- Prevent the further spread of the aqueous plume (plume containment);
- Control the further migration of contaminants to ground water from contaminated soils and subsurface NAPLs, where practicable (source containment); and
- Reduce the quantity of source material present in the subsurface (free-phase DNAPL), to the extent practicable (source removal/treatment).

Long-term remedial actions should be used to:

- Attain those objectives listed above that were not accomplished as early actions;
- Minimize further release of contaminants from soils and subsurface NAPLs to the surrounding ground water (source containment);
- Reduce the quantity of source material present in the NAPL zone (free- and residual-phase), to the extent practicable (source removal/treatment); and
- Restore as much of the aqueous plume as possible to cleanup levels (e.g., drinking water standards) appropriate for its beneficial uses. These beneficial uses should take into account anticipated future land use(s) (aquifer restoration).

For more information on NAPL contamination, see Box D.

1. **Identify the presumed or likely remedy options up front and allow for a more focused collection of data on the extent of contamination.**

This presumptive remedy guidance allows for the evaluation of only the primary cleanup alternative or a narrow range of options. The judgment as to whether evaluation of only the primary remedy is appropriate will depend on the degree of complexity and uncertainty at a site. Also, it may be appropriate to collect certain remedial design data before the drafting of the ROD or *Action Memorandum*, thereby allowing the action to proceed more quickly after signature of the decision document.

BOX B
Contacts for Additional Information

Headquarters Policy Contacts:
Frank Avvisato, Wood Treater Project Manager (703) 603-8949
Scott Fredericks, Presumptive Remedies Team Leader (703) 603-8771

Technical Contacts:
Harry Allen, Environmental Response Team (908) 321-6747
Frank Freestone, Office of Research and Development (908) 321-6632

Regional Contacts:

I	Mike Nalipinski	(617) 223-5503
II	Mel Hauptman	(212) 637-3952
III	Paul Leonard	(215) 597-3163
IV	Felicia Barnett	(404) 347-7791
V	Dion Novak	(312) 886-4737
VI	Cathy Gilmore	(214) 665-6766
VII	Diana Engeman	(913) 551-7746
VIII	Victor Ketellapper	(303) 293-1648
IX	Craig Cooper	(415) 744-2370
X	Eric Winiecki	(206) 553-6904

2. **Eliminate the need for the initial step of screening alternatives during the FS or EE/CA.**

   The NCP (section 300.430(e)(1)) states that the lead agency shall include an alternatives screening step *when needed* [emphasis added] to select a reasonable number of alternatives for detailed analysis. The Agency performed an analysis of FSs and RODs on the potentially available technologies for soils, sediments, and sludges at wood treater sites (see Appendix A) and found that certain technologies are appropriately and consistently screened out based on the criteria of effectiveness, implementability, and cost (consistent with section 300.430(e)(7)). Based on this analysis, the Agency has determined that the initial step of identifying and screening alternatives for FSs and EE/CAs for wood treater sites may not be necessary on a site-specific basis; instead, the FS or EE/CA may proceed immediately from the identification of alternatives to the detailed analysis, focusing on the technologies recommended in this directive. ' document and the accompanying FS/ROD ana... must be included in the ***Administrative Record*** to provide the basis for streamlining the analysis for wood treater sites in this way.

3. **Streamline the detailed analysis phase of the FS or EE/CA.**

   Once cleanup alternatives pass the initial screening step, they must be evaluated against the appropriate criteria defined in the NCP. Appendix A of this document summarizes the analysis EPA conducted on FSs/RODs for wood treater sites with contaminated soils, sediments, or sludges, and Appendix B provides generic evaluations of the different presumptive remedies against seven of the nine remedial criteria (excluding state and community acceptance). Both of these appendices should be used to streamline the detailed analysis phase of the FS. Appendices A and B can also be used to streamline the evaluation of removal action alternatives in an EE/CA. The generic analyses in Appendix B should be supplemented with site-specific information for the final respo... selection. For a more detailed discussion ... preparing an FS or EE/CA, see the references listed at the end of this document [16, 19].

   EPA expects that at least one of the presumptive remedies will be suitable for a wood treater site with principal threats that require the treatment of contaminated soils, sediments, or sludges. Circumstances under which other approaches may be appropriate include: unusual site soil characteristics; demonstration of significant advantages of innovative technologies over the presumptive remedies; and extraordinary community and state concerns. If such circumstances are encountered, additional analyses may be necessary or a conventional RI/FS or EE/CA may be performed.

DESCRIPTION OF WOOD TREATER SITES

The wood treating industry has been in existence in the United States for over 100 years. Wood is usually treated in cylinders, under pressure, with one or combination of the following types of preservatives:

- Pentachlorophenol (PCP) in petroleum or other solvents;
- Creosote (in petroleum or other solvents);
- Aqueous solutions of copper, chromium, and arsenic;
- Copper and arsenic, or copper, arsenic, and zinc solutions in ammonia; and
- Fire retardants (combinations of phosphates, borates, boric acid, and/or zinc compounds).

Older facilities traditionally used oil-based preservatives, while more modern facilities tend to use water-soluble preservatives. Water-soluble processes produce little or no wastewater, except for small amounts of metal-containing sludges. Oil-based processes produce sludge wastes and significant quantities of process wastewater. The processes performed at wood treater sites generally will result in contaminated soils, sediments, and sludges, and/or contaminated surface and ground water.

Box C provides a list of contaminants commonly found at wood treater sites; general chemical categories of contaminants are provided and specific chemicals or substances are identified under each category. As indicated in Box C, most of the organic contaminants found at wood treater sites are NAPLs, either in their pure form or as components of other substances that are NAPLs (e.g., petroleum fuels, creosote). Site managers should refer to Box D for background information on NAPLs and cleanup problems associated with these contaminants.

The three types of contaminants predominantly found at wood treater sites, either alone or in combination with each other -- or with total petroleum hydrocarbon (TPH) carrier oils -- are creosote, PCP, and chromated copper arsenate (CCA). Creosote is an oily, translucent brown to black liquid that is a very complex mixture of organic compounds, containing approximately 85% polynuclear aromatic hydrocarbons (PAHs), 10% phenolic compounds, and 5% nitrogen-, sulfur-, or oxygen-containing heterocycles. PCP is also an organic contaminant. In its pure form, PCP is a DNAPL; however, PCP is commonly found at wood treater sites as an LNAPL mixed into fuel oil or other

BOX C
Contaminants Commonly Found at Wood Treater Sites

ORGANICS

Dioxins/furans[1]
- Dibenzo-p-dioxins
- Dibenzofurans
- Furan

Halogenated phenols[1]
- Pentachlorophenol
- Tetrachlorophenol

Simple non-halogenated aromatics[2]
- Benzene
- Toluene
- Ethylbenzene
- Xylene

Polynuclear aromatic hydrocarbons[1]
- 2-Methylnaphthalene
- Chrysene
- Acenaphthene
- Fluoranthene
- Acenaphthylene
- Fluorene
- Anthracene
- Indeno(1,2,3-cd)pyrene
- Benzo(a)anthracene
- Naphthalene
- Benzo(a)pyrene
- Phenanthrene
- Benzo(b)fluoranthene
- Pyrene
- Benzo(k)fluoranthene

Other polar organic compounds
- 2,4-Dimethylphenol[1]
- 2-Methylphenol[1]
- 4-Methylphenol[1]
- Benzoic acid[1]
- Di-n-octyl phthalate
- N-nitrosodiphenylamine

INORGANICS

Non-volatile metals (compounds of)
- Chromium
- Copper

Volatile metals (compounds of)
- Arsenic
- Cadmium
- Lead
- Zinc

[1] **DNAPL(s) in pure form.**
[2] **LNAPL(s) in pure form.**

light organic substances. If PCP or other chlorinated phenols are present at a site, associated dioxins and/or furans may also be present in the approximate vicinity. If so, these dioxins and/or furans will likely exist in much lower concentrations than the associated chlorinated phenols. This document is not designed to address sites containing high levels of dioxins and/or furans. EPA is currently gathering information on the issue of dioxin/furan contamination; site managers should contact the Headquarters policy contacts listed in Box B for more information on this topic. CCA is an inorganic arsenical wood preservative. Other metal-containing preservatives that may be found at wood treater sites include ammoniacal copper arsenate (ACA) and ammoniacal copper-zinc arsenate (ACZA).

PRESUMPTIVE REMEDIES FOR WOOD TREATER SITES

The presumptive remedies for contaminated soils, sediments, and sludges constituting the principal threats at wood treater sites are described below. Bioremediation is the primary presumptive remedy for treating organic contamination of soils, sediments, and sludges at wood treater sites. Bioremediation has been selected as the primary presumptive remedy for treating organic contamination because it has been selected most frequently to address organic contamination at wood treater Superfund sites, and the Agency believes that it effectively treats wood treating wastes at a relatively low cost. If bioremediation is not feasible, thermal desorption may be the more appropriate response technology. In a limited number of situations (e.g., the treatment of "hot spots" such as sludges), incineration may be the more appropriate remedy. Immobilization is the primary presumptive remedy for treating inorganic contamination of soils, sediments, and sludges at wood treater sites.

An important consideration in determining which presumptive remedy technology is the most appropriate for a particular site is the future land use or uses anticipated for that site (see reference [27] and Box E of this document for more information on land-use considerations). Another important consideration in selecting the most appropriate presumptive remedy technology is determining what are the principal threats and low-level threats (including possible treatment residuals) at a site. Treatment technologies are the preferred remedies for addressing principal threats, while containment technologies in conjunction with institutional and/or engineering controls, are most likely to be appropriate for addressing low-level threats. Table 2 (Comparison of Presumptive Remedy Technologies), which is found at the end of this document, provides detailed information on th advantages, limitations, and costs of each of th presumptive remedies.

At many wood treater sites, it may be necessary to use a combination of control and treatment options as part of an overall treatment train to sufficiently reduce toxicity and immobilize contaminants. Institutional and/or engineering controls can be used in conjunction with one or more of the presumptive remedy technologies to enhance the long-term reliability of the remedy. Site managers should note that all *ex situ* remedy options require measures to protect workers and the community during the excavation, handling, and treatment of contaminants, and may be subject to RCRA land disposal restrictions. Box E (Practical Considerations) provides a discussion of land use, institutional and engineering controls, treatment trains, the remediation of "hot spots," and land disposal restriction issues.

Bioremediation — Bioremediation is the chemical degradation of organic contaminants using microorganisms. Biological activity (i.e., biodegradation) can occur either in the presence (aerobic) or absence (anaerobic) of oxygen. Aerobic biodegradation converts organic contaminants to various intermediate and final decomposition products, which may include various daughter compounds, carbon dioxide, water, humic materials, and microbial cell matter. Aerobic biodegradation may also cause binding of the contaminants to soil components, such as humic materials. Anaerobic biodegradation converts the contaminants to carbon dioxide, methane, and microbial cell matter.

Bioremediation may be an *ex situ* or *in situ* process. *Ex situ* bioremediation refers to the biological treatment of contaminants following excavation of the soil or other media, and includes composting, land treatment in lined treatment cells, treatment in soil piles, or the use of soil slurry reactors. *In situ* bioremediation is the in-place treatment of contaminants, and may involve the addition of nutrients, oxygen, or other enhancements into the subsurface.

EPA has more experience in implementing *ex situ* bioremediation than *in situ* bioremediation. In general, *ex situ* bioremediation is faster than *in situ* bioremediation, although the implementation of either *ex situ* or *in situ* bioremediation typically can require several years, as compared to approximately six months to a year for technologies like thermal desorption or incineration. *In situ* bioremediation may be less costly than *ex situ* bioremediation. However, at some wood treater sites, *ex situ* bioremediation may be able to achieve higher performance efficiencies than the *in situ* process due to increased access and contact between microorganisms, contaminants, nutrients, water, and electron acceptors.

The effectiveness of bioremediation is site- and contaminant-specific. Careful contaminant and matrix characterization (with particular attention to heterogeneity), coupled with ***treatability studies*** of appropriate scale and duration, are strongly recommended. Bioremediation can successfully treat soils, sediments, and sludges contaminated with organic contaminants, such as halogenated phenols and cresols, other polar organic compounds, non-halogenated aromatics, and PAHs. Studies on the bioremediation of creosote contamination indicate that bioremediation works well on 2-, 3-, and often 4-ring compounds, but generally not as well on 5- or 6-ring compounds.

Bioremediation may not be effective for the treatment of high levels of concentrated residual creosote in soils, sediments, or sludges. It may be necessary to separate this material for disposal or treatment by a different technology (e.g., thermal desorption or incineration) before attempting bioremediation. The remaining soils, sediments, or sludges, with lower levels of contamination, may then be amenable to bioremediation. Bioremediation generally is not appropriate for treating inorganic contamination at wood treater sites. Only limited data on the bioremediation of dioxins or furans are currently available; EPA is currently gathering information on the treatability of dioxins and furans (for more information, contact the individuals listed in Box B).

Thermal Desorption — Thermal desorption physically separates, but does not destroy, volatile and some semi-volatile contaminants from excavated soils, sediments, and sludges. Significant material handling operations may be necessary to sort and size the soils, sediments, or sludges for treatment. Thermal desorption uses heat or mechanical agitation to volatilize contaminants from soils, sediments, or sludges into a gas stream; subsequent treatment must be provided for the concentrated contaminants resulting from the use of this technology. Depending on the process selected, this technology heats contaminated media to varying temperatures, driving off water and volatile and semi-volatile contaminants. Off-gases may be condensed for disposal, captured by carbon adsorption beds, or treated with biofilters.

Treatability studies are recommended before full implementation of the thermal desorption technology. Thermal desorption can successfully treat halogenated phenols and cresols as well as volatile non-halogenated organic compounds at wood treater sites. It cannot, however, effectively separate non-volatile metals (e.g., copper) from the contaminated media. Some desorber units can treat PCBs, pesticides, and dioxins/furans in contaminated soils, sediments, or sludges.

If chlorine is present in the feed material (e.g., as a result of PCP), dioxin and furan formation may occur in the thermal desorber, stack, or air pollution control devices at temperatures of 350 °F and above. Thermal treatment systems can be designed and operated to minimize dioxin and furan formation and to remove these compounds from the stack gases. However, because pilot-scale devices do not always duplicate operating conditions at full scale, bench- or pilot-scale treatability studies alone may not be sufficient to verify dioxin/furan formation or control. A full-scale test, called a "Proof of Performance" test, with analyses for dioxins and furans should be completed. Safe thermal treatment operation should be confirmed prior to the use of thermal desorption.

Compliance with ***Applicable or Relevant and Appropriate Requirements (ARARs)*** and other laws should be considered when determining whether thermal desorption is conducted on- or off-site. On-site thermal desorption may be performed with a mobile unit; however, space availability may make this option infeasible. Thermal desorption may also be conducted off-site; however, the facilities used must be in compliance with the Superfund off-site rule before accepting material from a Superfund site. EPA is currently in the process of completing guidance that provides information on the safe implementation of thermal treatment technologies, including thermal desorption and incineration.

Incineration — Incineration generally treats organic contaminants by subjecting them to temperatures typically greater than 1,000°F in the presence of oxygen and a flame. During incineration, volatilization and combustion convert the organic contaminants to carbon dioxide, water, hydrogen chloride, and sulfur oxides. The incinerator off-gas requires treatment by an air pollution control (APC) system to remove particulates and to neutralize and remove acid gases (e.g., HCl). This technology may generate three residual streams: solids from the incinerator and APC system, water from the APC system, and air emissions from the APC system.

Incineration has consistently been demonstrated to achieve a performance efficiency in the 90 to 99% range. Incineration has successfully treated wood treater soil, sediment, and sludge contamination to cleanup levels that are more stringent than can be consistently attained by the other wood treater presumptive remedies. A substantial body of trial burn results and other quality-assured data verify that incineration can remove and destroy organic contaminants (including dioxins and furans) to the parts per billion or parts per trillion level. Consequently, incineration may be particularly effective in treating "hot spots" at wood treater sites.

Incineration, however, does not destroy metals. Metals will produce different residuals depending on the volatility of the compounds, the presence of certain compounds (e.g., chlorine), and the incinerator operating conditions. Improperly operated incinerators also have the potential to create dioxins and furans. Incineration of large volumes of contaminated media may be prohibitively costly.

Incineration may be performed on- or off-site. There may be significant considerations regarding the compliance of incineration with ARARs and other laws. On-site incineration may be performed with a transportable incineration unit; however, space availability and public opposition may make this option inappropriate. Whenever incineration is considered as an option to fulfill remediation goals, particular efforts should be made to provide the community with good information on incineration and to be responsive to any concerns raised by the community. Commercial incineration facilities (i.e., units permitted for the incineration of hazardous wastes, including incinerators and cement kilns) may be used when off-site incineration is desirable. However, only a limited number of these facilities are available nationwide. Permitting of additional on- and off-site incineration facilities will be affected by EPA's Strategy for Hazardous Waste Minimization and Combustion [37].

Immobilization — Immobilization reduces the mobility of a contaminant, either by physically restricting its contact with a mobile phase (solidification) or by chemically altering/binding the contaminant (stabilization). The most common solidification binders are cementacious materials, including Portland cement, fly ash/lime, and fly ash/kiln dust. These agents form a solid, resistant, aluminosilicate matrix that can occlude waste particles, bind various contaminants, and reduce the permeability of the waste/binder mass. Immobilization is particularly suited to addressing inorganic (e.g., CCA) contamination.

At wood treater sites, inorganic contamination is sometimes commingled with organic contamination. In these situations, a treatment train should be implemented that uses bioremediation, thermal desorption, or incineration to address organic contamination, followed by the immobilization of any significant residual inorganic contamination. There are limited full-scale performance data available on the immobilization of PAHs and PCP, either alone or commingled with inorganic contamination, where the concentration of total petroleum hydrocarbons is significantly more than 1%. Immobilization has been effective in treating soils with commingled organic and inorganic contamination with a total organic content of as much as 20-45%. Immobilization alone is not effective for treating volatile organic contaminants.

Site-specific treatability studies should be conducted to ensure that a solidification/stabilization formulation can be developed that meets site-specific requirements for low leachability and permeability, and high compressive strength. EPA is currently in the process of developing guidance on conducting solidification/stabilization treatability studies.

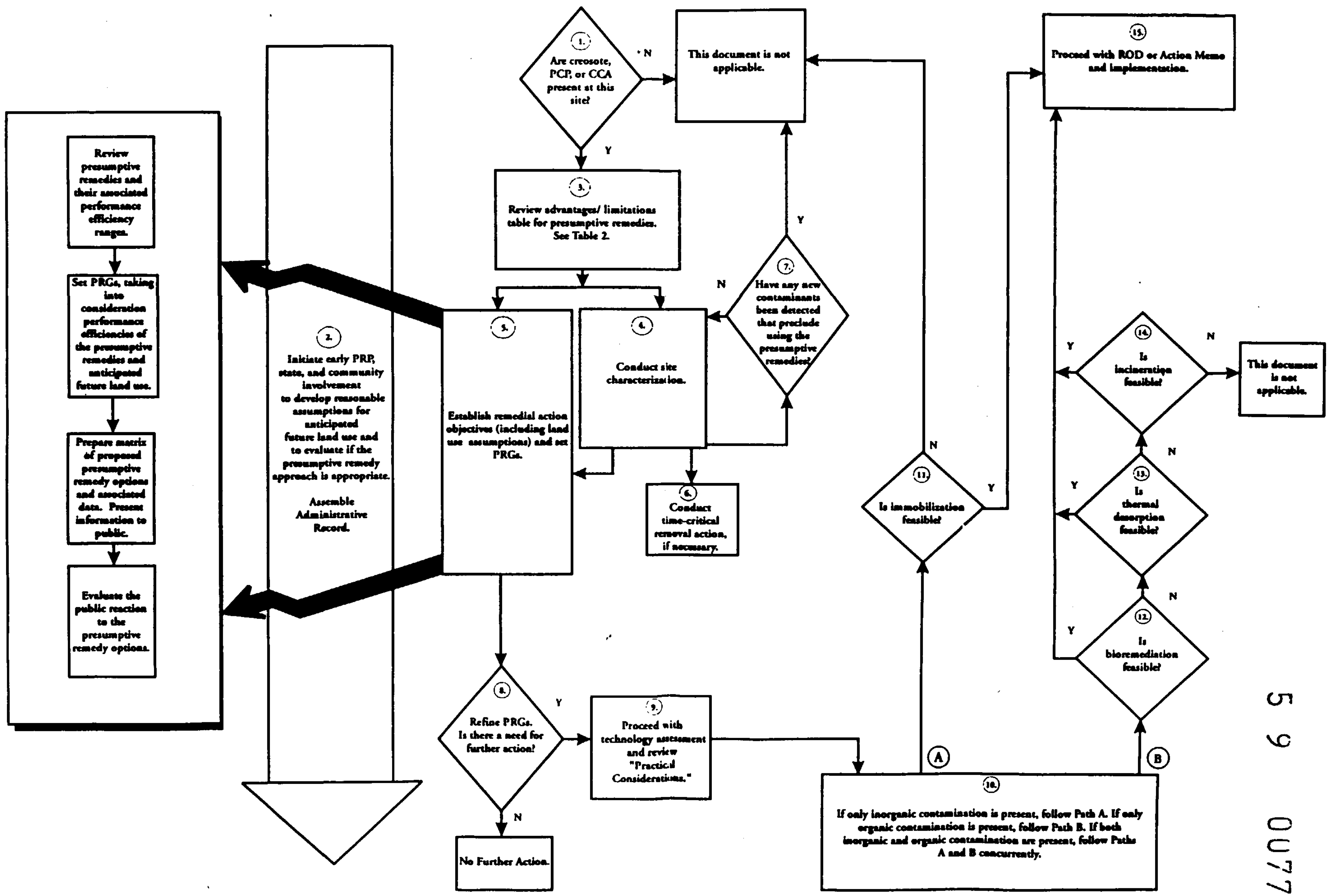
PRESUMPTIVE REMEDY PROCESS FOR WOOD TREATER SITES

This section and the accompanying "Decision Tree for Technology Selection at Wood Treater Sites" (Figure 1) describe the process for selecting a presumptive remedy or combination of remedies for cleaning up contaminated soils, sediments, and sludges at wood treater sites. This remedy selection process is consistent with and fits into the overall site remediation process outlined in the NCP.

Under the NCP, alternative remedies are to be evaluated and the preferred alternative is to be selected based on nine criteria. Presumptive remedies are technologies that have been found to be generally superior under the nine criteria to other technologies. This generic evaluation makes it unnecessary to conduct a detailed site-specific analysis of the other technologies.

The "decision tree" approach recommended here is a further streamlining of the usual NCP analysis. The decision tree is based on the Agency's findings that,

Figure 1: Decision Tree for ... nology Selection at Wood Treater Sites



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among the recommended technologies, a single preferred technology can be identified based on the nine criteria, but that the determination of which technology is preferred will depend on a few key variables such as the types of contaminants present and the feasibility of the technology. Once these factors are determined, the single recommended approach can be identified. This conclusion represents a judgement that, under the circumstances at the site, the preferred technology will be superior under the nine criteria. However, the decision tree avoids the need to go through a full nine-criteria analysis at the site-specific level; in effect, most of that analysis has already been performed and the only information needed to complete the analysis relates to variables specified in the decision tree.

The presumptive remedy process generally begins at the point in the overall NCP process where the removal and/or remedial site evaluation and ***Hazard Ranking System*** scoring steps have been completed and development of the RI/FS or EE/CA is about to begin. The presumptive remedy process streamlines the site characterization, technology assessment, and remedy selection steps.

The decision tree describes a presumptive remedy process that is dynamic, where site characterization, the evaluation of presumptive remedies, and the establishment and refinement of remedial action objectives (including future land use assumptions and ***Preliminary Remediation Goals (PRGs)***) are conducted interactively and concurrently. Site managers should attempt to involve the state, community, and potentially responsible parties (PRPs) in the presumptive remedy process as early as possible.

Presumptive remedy options should be evaluated considering their associated performance efficiencies and the cleanup levels they might achieve, and the future land uses that their implementation may make available. In most cases, treatability studies should be performed for the treatment technologies being considered. As discussed previously, the identification of presumed or likely remedies early in the cleanup process will allow for a more focused collection of data on the extent of contamination, eliminate the need for the initial step of identifying and screening alternatives during the FS or EE/CA, and streamline the detailed analysis phase of the FS or EE/CA.

The numbered steps and decision points in Figure 1, the "Decision Tree for Technology Selection at Wood Treater Sites," correspond to the similarly numbered paragraphs below. These paragraphs provide information and the underlying assumptions for each of the different steps and decision points in the presumptive remedy process. The decision tree should be used as a guide through the specific decision poi[illegible] and considerations that are necessary to choos[illegible] presumptive remedy.

1. **Are Creosote, PCP, or CCA Present at the Site?** This document focuses on cleaning up soils, sediments, and sludges at wood treater sites contaminated primarily with creosote, PCP, or CCA; if these contaminants are not present at the site, the presumptive remedy selection process outlined in the document is not appropriate for the site, and the conventional RI/FS or EE/CA process should be followed. Information on contaminants present at the site may be available from data collected during the removal and/or remedial site evaluation. If this information is not available, past chemical use at a particular facility can be ascertained from a number of sources, such as information from facility records, past sampling efforts by state or local agencies, or through information request letters.

2. **Initiate Early PRP, State, and Community Involvement.** Site managers should initiate a dialogue with the community, state representatives, and PRPs early in the process [illegible] identifying potential presumptive remedy optic[illegible] for a site. This dialogue should include [illegible] discussion of reasonably anticipated future land use. This discussion should be beneficial in establishing remedial action objectives and state ARARs, which, in conjunction with federal requirements, may provide PRGs. In addition, site managers should begin assembling the Administrative Record for the site.

3. **Review Advantages/Limitations Table for Presumptive Remedies.** Using information on the contaminants present at the site, site managers should begin reviewing the presumptive remedies for wood treater sites. Table 1 provides a listing of the presumptive remedies for wood treater sites and the contaminants for which they are applicable. Table 2 provides detailed information on the advantages, limitations, and costs of each of the presumptive remedies.

   Steps 4 and 5 of the decision tree represent separate aspects of initial site cleanup activities. However, these steps should be undertaken concurrently, with each step using informatior obtained from the other step.

TABLE 1
Evaluation of Presumptive Remedy Technology Options

Contaminants Present at Site	Presumptive Remedy Technology Options	Demonstrated Performance Efficiencies[1]
Organics: Creosote, PCP, or Creosote and PCP	Bioremediation	64-95% for PAHs and 78-98% for chlorophenols (F)[2]
	Thermal Desorption	82-99% (B,P,F)
	Incineration	90-99% (B,P,F)
Inorganics: CCA	Immobilization	80-90% TCLP[3] (B,P,F)
Organics and Inorganics: Creosote and CCA; PCP and CCA; or Creosote, PCP, and CCA	Bioremediation, Thermal Desorption, and/or Incineration, followed by Immobilization	See above

[1] Performance represents a range of treatability data. Percentages may vary depending on the contaminant(s). Bench- (B), pilot- (P), or full-scale (F) demonstration data may not be available for all contaminants. All performance efficiency data are taken from EPA's Contaminants and Remedial Options at Wood Preserving Sites [8], unless noted otherwise.

[2] These data represent current full-scale performance data for *ex situ* bioremediation conducted at three U.S. wood treater sites (all of which are listed on the *National Priorities List (NPL)*) and one Canadian wood treater site. The use of bioremediation at these four sites achieved remediation goals in all cases. Because the monitoring of biodegradation at these sites stopped after remediation goals were achieved, actual performance efficiencies at these sites may be higher than these numbers indicate. For a more detailed discussion of these performance data, see "Full-Scale Performance Data on the Use of Bioremediation at Wood Treater Sites," a technical background document for the wood treater site presumptive remedy initiative that is available at EPA Headquarters and the Regional Offices. EPA's Contaminants and Remedial Options at Wood Preserving Sites (1992) [8] provides the following pilot-scale performance data for bioremediation: an average of 87% for PAHs and 74% for halogenated phenols and cresols. The effectiveness of bioremediation tends to be highly variable and very site-specific. A significant component of this variability is the range of effectiveness in the remediation of different kinds of PAHs; studies on the bioremediation of creosote contamination indicate that bioremediation works well on 2-, 3-, and often 4-ring PAHs, but generally not as well on 5- or 6-ring PAHs. For example, the use of *ex situ* bioremediation at one of the wood treater NPL sites resulted in 95% removal of 2-ring PAHs, 83% removal of 3-ring PAHs, and 64% removal of 4+-ring PAHs. In practice, *in situ* bioremediation typically results in lower performance efficiencies than the *ex situ* process because *in situ* reactions are less controlled and involve lower mass transfer rates. To obtain additional performance data for bioremediation, contact the U.S. EPA's Center for Environmental Research Information (CERI) at: 26 W. Martin Luther King Drive, Cincinnati, Ohio 45268. CERI maintains a bioremediation data base called "Bioremediation in the Field Search System" (BFSS), which may be accessed electronically through bulletin boards at (301) 589-8366 or (513) 569-7610.

[3] TCLP (toxicity characteristic leaching procedure) is a specific analytical method; this method has been widely used in the past to evaluate the performance of immobilization. However, current information indicates that the SPLP (synthetic precipitation leaching procedure) or other procedures using distilled or site-specific water will produce more accurate results.

4. **Conduct Site Characterization.** Site characterization activities for wood treater sites using the presumptive remedy process should be designed to:

- Positively identify the site type (i.e., a wood treater site with creosote, PCP, or CCA contamination);
- Obtain data to determine whether the presumptive remedies are feasible for the site;
- Focus and streamline the collection of data to support the selection of presumptive remedies only; and
- Collect design data, thereby streamlining the data collection required during the remedial or removal design stage.

The overall site characterization process should proceed using multimedia sampling events whenever possible. Field screening methods should be integrated into the sampling and analysis plan to accelerate information gathering. Data quality objectives must reflect the ultimate use of the results; consequently, all samples taken during a single event may not require the same level of data quality.

Surface lagoons, soil areas, drip pads, and sediments should be sampled in a grid-like manner to determine the horizontal and vertical extent of contamination. Site managers should ensure that sampling for dioxins and furans is conducted at all wood treater sites known to have used chlorinated phenols, such as PCP. Soil, sediment, and sludge characterization relevant to treatment selection should reflect the information needs described in Tables 3A-D.

If a wood treating or other chemical at an abandoned site is still in its original containers, it should be returned to the manufacturer, if possible. Where any of the principal wood treating chemicals (creosote, PCP, or CCA) can be recovered in high enough concentrations to warrant reuse in any process, recycling becomes the preferred technology. The recognized U.S. Waste Exchanges are listed in Appendix A of the Technology Selection Guide for Wood Treater Sites [43].

During site characterization, a site-specific baseline ***risk assessment*** (or streamlined risk evaluation for a removal action) should be conducted to characterize materials that constitute principal threats (i.e., source materials, includi liquids, that are highly toxic or highly mol wastes that generally cannot be reliably containe or would present a significant risk to human health and the environment should exposure occur). This risk assessment should be conducted to determine whether sufficient threats or potential threats exist to warrant a response action.

The site-specific risk assessment should be used to determine remediation goals for the site. Risk-based remediation goals are often different for soils, sediments, and sludges at different depths. Shallow remediation goals are usually based on direct contact risks, while deeper remediation goals are usually based on ground-water impacts. Site managers should consider the ground-water strategy for the site because remediation goals for soils, sediments, and sludges are often set to protect ground-water quality. As discussed above, existing guidance on the remediation of ground water [6, 7, 17, 20, 38] and the forthcoming guidance on a presumptive ground-water approach, when available, should be consulted.

EPA is currently in the process of developir guidance on soil screening levels [30]; these levels represent contaminant concentrations in soil below which there is generally no need for federal concern for the protection of human health in a residential setting. When the final guidance is available, site managers should use it as a screening tool in determining the need for further assessment of soil contamination during the RI stage of cleanups at National Priorities List sites. For more information on conducting site characterization activities and risk assessments, site managers should refer to the references listed at the end of this document [1, 8, 16, 19, 23, 34 35, 36].

5. **Establish Remedial Action Objectives (Including Land Use Assumptions) and Set PRGs.** Promulgated federal and state standards should be assessed as potential ARARs for the site. As appropriate, other criteria, advisories, or guidance should be assessed as potential ***to be considereds (TBCs)***. For a more detailed discussion on identifying ARARs and TBCs, see the references listed at the end of this document [3, 4, 41].

Superfund site managers should also continue to evaluate the presumptive remedies and begin to develop remedial action objectives for the site. The following steps, as depicted in Figure 1, should be undertaken by site managers.

Review Presumptive Remedies and Associated Performance Efficiencies

Site managers should continue the review of the presumptive remedies that was initiated in Step 3, using additional information on site characteristics obtained under Step 4. Tables 1 and 2 provide data on performance efficiencies for the different presumptive remedy technologies. Information contained in these tables should be used to focus the information gathering activities being conducted under the site characterization step.

Set Preliminary Remediation Goals

As part of the overall remedial action objectives for the site, site managers should set PRGs. Initially, PRGs should be developed based on readily available information, such as ARARs and TBCs. Technical, exposure, and uncertainty factors should also be used to establish PRGs (see section 300.430(e)(2) of the NCP). Site managers should modify PRGs, as necessary, as more information becomes available. When setting PRGs for wood treater sites, site managers should also consider the performance efficiencies of the different presumptive remedies. In most cases, treatability studies will be necessary to determine the site-specific capabilities of a specific presumptive remedy. Reasonably anticipated future land use(s) of the site should also be considered when establishing PRGs. Site managers should consult EPA's guidance on land use in the Superfund remedy selection process [27]. This guidance calls for early interaction with citizens, local governments, and other entities to gather information to develop assumptions regarding anticipated future land use. These assumptions may be used in the baseline risk assessment, the development of alternatives, and remedy selection. Refer to Box E (Practical Considerations) for more information on future land use considerations.

Prepare Information and Present to Public

It is important that site managers involve the public at an early stage in the consideration of the various presumptive remedy options. Site managers should encourage the public to review the advantages and limitations of the presumptive remedies against each other and should consider this public input when selecting a presumptive remedy for a site. In particular, efforts should be made to engage the community and other interested parties in discussions concerning the establishment of PRGs and future land use issues.

Input from the community, state representatives, and PRPs may be obtained through a variety of methods, such as informal contacts or meetings with community leaders or groups. This early input on remedy selection should assist site managers in fostering community acceptance at later stages of the presumptive remedy selection process. Before seeking public input, the site manager should do the following: (1) contact Regional community relations staff for information on community acceptance (if further assistance is necessary, the individuals listed in Box B should be contacted); and (2) prepare a matrix of the applicable presumptive remedy options for the site. This matrix should contain data on the performance efficiencies, advantages, limitations, costs, and implementability of the various options, and should emphasize the full range of trade-offs between the alternatives. This information should be presented to the public to assist them in providing input on the remedy selection process. For a more detailed discussion on holding public meetings and community relations at Superfund sites, see the references listed at the end of this document [5, 42].

Evaluate Public Reaction to the Presumptive Remedy Options

If the public reacts favorably to one or more of the presumptive remedy options, site managers should proceed to the next step of the presumptive remedy process. However, if the public does not react favorably to any of the presumptive remedy options under consideration, site managers may wish to consider reviewing non-presumptive technologies, including innovative technologies, to determine if there are other options that may receive greater community acceptance while providing for sufficient overall protection of human health and the environment. If this is the case, a conventional RI/FS or EE/CA could be performed, or the FS could consider the presumptive remedy plus any specific alternatives believed to warrant consideration to establish a site-specific Administrative Record that supports the selection of a technology that is not specifically identified as a presumptive remedy. Site managers should note that all alternatives should generally be evaluated in a full nine-criteria analysis, even if objections are raised by members of the community. However, if opposition is intense, it may be justifiable to screen out an alternative early in the process for reasons of implementability.

6. **Conduct Time-Critical Removal Action, if Necessary.** Information from site characterization activities may indicate that the performance of a time-critical removal action is warranted. If so, site managers should conduct the removal action in accordance with the NCP and EPA removal program guidance. If subsequent non-time-critical removal actions or remedial actions are still required at the site, site managers should follow the presumptive remedy process, if appropriate.

7. **Identification of New Contaminants.** Continuing site characterization efforts performed under Step 4 may, at any time, identify new contaminants at the site. Newly identified contaminants should be evaluated to determine if their presence precludes using presumptive remedy technologies or makes the use of these technologies inappropriate. For example, the detection of significant DNAPL contamination of ground water at a site may indicate that contaminated soils, sediments, or sludges do not pose a principal human health and environmental threat and, therefore, may not require treatment or may only need to be contained. In these situations, site managers should follow the presumptive remedy approach for contaminated ground-water sites, when available. If newly identified contaminants do preclude or make inappropriate the use of a presumptive remedy identified in this document, this directive may not be applicable and the conventional RI/FS or EE/CA process may need to be followed.

8. **Refine PRGs. Is There a Need for Further Action?** Using additional information obtained from the site-specific baseline risk assessment, site managers should determine whether the site poses an unacceptable risk to human health or the environment. If the site does not pose an unacceptable risk, no further action is required. However, if it appears that an unacceptable risk does exist, site managers should proceed to the next step in the presumptive remedy process. Information from the baseline risk assessment should be used to refine the PRGs for the site.

9. **Proceed with Technology Assessment and Review "Practical Considerations."** After it has been determined that a cleanup action is warranted at the site, site managers should review the different presumptive remedy options and identify a proposed option. For a remedial acti[illegible] presumptive remedy options must be evalu[illegible] against the nine criteria required by sect[illegible] 300.430(e)(9) of the NCP; this should be documented in the detailed analysis section of an FS or Focused FS. Appendix A of this document summarizes the analysis EPA conducted on FSs/RODs for wood treater sites with contaminated soils, sediments, or sludges, and Appendix B provides generic evaluations of the different presumptive remedies against seven of the nine remedial criteria (excluding state and community acceptance). Both of these appendices should be used to streamline the detailed analysis phase of the FS. Appendices A and B can also be used to streamline the evaluation of removal action alternatives in an EE/CA. The generic analyses in Appendix B should be supplemented with site-specific information for the final response selection. During technology assessment, the factors listed in the "Practical Considerations" section (Box E) of this document should be reviewed to ensure a comprehensive evaluation of response alternatives.

10. **Begin the Technology Selection Process Based [illegible] the Types of Contamination Present at the Si[illegible]** If the only contaminants present at significa[illegible] levels (i.e., levels that may justify treatment) are inorganics, site managers should follow Path A in Figure 1 (i.e., proceed to Step 11) and evaluate the feasibility of immobilization. If the only contaminants present at significant levels are organics, site managers should follow Path B in Figure 1 (i.e., proceed to Step 12) and evaluate the feasibility of bioremediation. In situations where significant levels of both inorganic and organic contamination are present at the site, site managers should follow Paths A and B concurrently. In these situations, a treatment train should be implemented that uses bioremediation, thermal desorption, and/or incineration to address the organic contaminants and immobilization to address the inorganic contaminants.

11. **Is Immobilization Feasible?** Immobilization is the primary presumptive remedy for addressing significant levels of inorganic contamination in soils, sediments, and sludges at wood treater sites. If immobilization is not considered feasible for addressing inorganic contaminants present at th[illegible] site, this document is not applicable and site managers should review other non-presumptive

technologies. If the use of immobilization is feasible, site managers should proceed to Step 15.

12. **Is Bioremediation Feasible?** Bioremediation is the primary presumptive remedy for treating organic contamination of soils, sediments, and sludges at wood treater sites. However, the effectiveness of bioremediation is very site- and contaminant-specific. In addition, implementation of bioremediation remedies requires considerably more time than the implementation of the other presumptive remedies (i.e., several years for bioremediation as compared to approximately six months to a year for thermal desorption and incineration). Bioremediation can successfully treat soils, sediments, and sludges contaminated with organic contaminants such as halogenated phenols and cresols, other polar organic compounds, non-halogenated aromatics, and PAHs (particularly 2- and 3-, and often 4-ring compounds). However, bioremediation may not be feasible if a site exhibits high levels of concentrated residual creosote or dioxins and furans. Pilot/treatability study testing should be conducted to assess the feasibility of using bioremediation at a site. If the use of bioremediation is feasible, site managers should proceed to Step 15. If the use of bioremediation is not feasible, site managers should assess the use of thermal desorption.

13. **Is Thermal Desorption Feasible?** If bioremediation will not be sufficiently effective in achieving PRGs for the site, thermal desorption should be considered as the presumptive remedy for addressing organic contamination. Treatability studies should be conducted (including a Proof of Performance test if dioxin and/or furan formation is a concern) to ensure that thermal desorption is feasible for the site and will achieve the desired PRGs. If the use of thermal desorption is feasible, site managers should proceed to Step 15. If the use of thermal desorption is not feasible, site managers should assess the use of incineration.

14. **Is Incineration Feasible?** If high contaminant concentrations and/or treatability testing indicate that thermal desorption will not achieve the desired PRGs for the site, incineration should be considered as the presumptive remedy. If the use of incineration is feasible for the site, site managers should proceed to Step 15. If none of the three presumptive remedy options for treating organic contaminants are considered feasible for the site, this document is not applicable and site managers should review other non-presumptive technologies.

15. **Proceed with ROD or Action Memorandum.** At this point in the process, site managers should possess sufficient information to set final remediation goals and identify a preferred presumptive remedy option. This preferred option should be presented to the public for review and comment in the proposed plan. Because substantial community input has already been factored into the remedy selection process under Step 5, it is envisioned that significant negative input from the public should not be received at this point.

    The final step in the selection of a presumptive remedy is to document the decision in a ROD for a remedial action or an Action Memorandum for a removal action. As was discussed above, if a presumptive remedy is selected in the ROD or Action Memorandum, a copy of this document and its accompanying attachments must be included in the Administrative Record for the site. These materials will assist in justifying the selection of the presumptive remedy, and will support the elimination of the initial screening step of the FS or EE/CA and the streamlining of the detailed analysis phase of the FS or EE/CA.

CONCLUSION

The presumptive remedies for cleaning up soils, sediments, and sludges at wood treater sites that are contaminated primarily with creosote, PCP, or CCA are bioremediation, thermal desorption, incineration, and immobilization. Bioremediation is the primary presumptive remedy for treating organic contaminants, followed by thermal desorption and incineration, respectively. Immobilization is the primary presumptive remedy for treating inorganic contaminants. Based on site-specific information and remediation goals established for the site, one or more of these treatment technologies should be selected. If a wood treater site does not meet the conditions described in this document, the document is not applicable and the conventional remedy selection process should be followed.

BOX D

Background Information on NAPL Contamination

A non-aqueous phase liquid (NAPL) is a liquid that, in its pure form, does not readily mix with water but slowly partitions into the water phase. Dense NAPLs (DNAPLs) sink in water, while light NAPLs (LNAPLs) float on water. When present in the subsurface, NAPLs slowly release vapor and dissolved phase contaminants, resulting in a zone of contaminant vapors above the water table and a plume of dissolved contaminants below the water table. The term NAPL refers to the undissolved liquid phase of a chemical or mixture of compounds, and not to the vapor or dissolved phases. NAPLs may be present in the subsurface as either "free-phase" or "residual-phase" NAPLs. The free-phase is that portion of the NAPL that can continue to migrate and can flow into a well. The residual-phase is that portion trapped in pore spaces by capillary forces, which cannot generally flow into a well or migrate as a separate liquid. Both residual- and free-phase NAPLs are sources of vapors and dissolved contaminants.

The most common LNAPLs are petroleum fuels, crude oils, and related chemicals, which tend to be associated with facilities that refine, store, or transport these liquids. The following factors tend to make LNAPLs generally easier to locate and clean up than DNAPLs: (1) LNAPL contamination tends to be more shallow than DNAPL contamination; (2) LNAPLs tend to be found at the water table; and (3) LNAPLs are usually associated with specific types of facilities. However, LNAPL contamination that is trapped in soil pores below the water table may not be significantly easier to remediate than DNAPL contamination in the saturated zone.

DNAPLs pose difficult cleanup problems. These contaminants include chemical compounds and mixtures with a wide range of chemical properties, including chlorinated solvents, creosote, coal tars, PCBs, PCP, and some pesticides. Some DNAPLs, such as coal tars, are viscous chemical mixtures that move very slowly in the subsurface. Other DNAPLs, such as some chlorinated solvents, can travel very rapidly in the subsurface because they are heavier and less viscous than water. A large DNAPL spill not only sinks vertically downward under gravity, but can spread laterally with increasing depth as it encounters finer grained layers. These chemicals can also contaminate more than one aqu by penetrating fractures in the geologic layer that separates a shallow aquifer from a deeper aquifer. Thus, large rele of DNAPLs can penetrate to great depths and can be very difficult to locate and clean up.

The contamination problem at DNAPL sites has two different components: (1) the aqueous contaminant plume, and (2) the DNAPL zone, as shown in Figures D-1 and D-2. The aqueous contaminant plume includes those portions of the site where only dissolved contaminants are present in ground water. The DNAPL zone includes those portions of the site where immiscible liquids are present in the subsurface, either as free-phase or residual-phase compounds. Depending on the volume of the release and the subsurface geology, the DNAPL zone may extend to great depths and over large lateral distances from the entry location.

For a more detailed discussion on DNAPL contamination, see the references listed at the end of this document [7, 10, 11, 12, 13, 15, 17].

BOX D
Background Information on NAPL Contamination
(continued)

FIGURE D-1
Components of DNAPL Sites

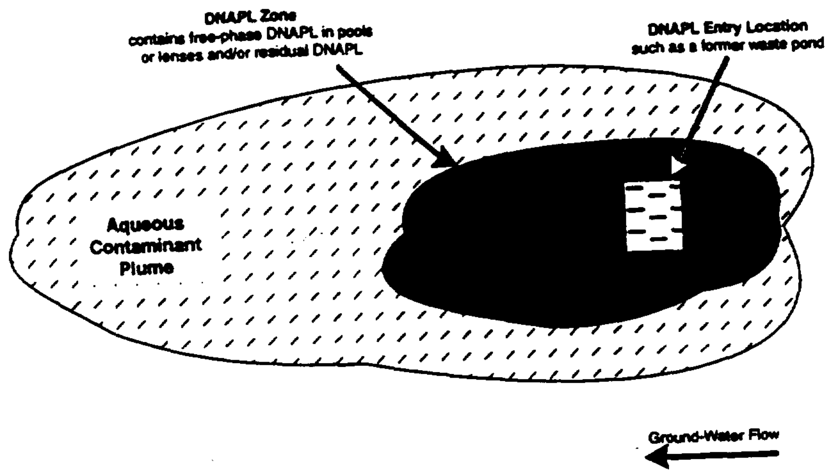
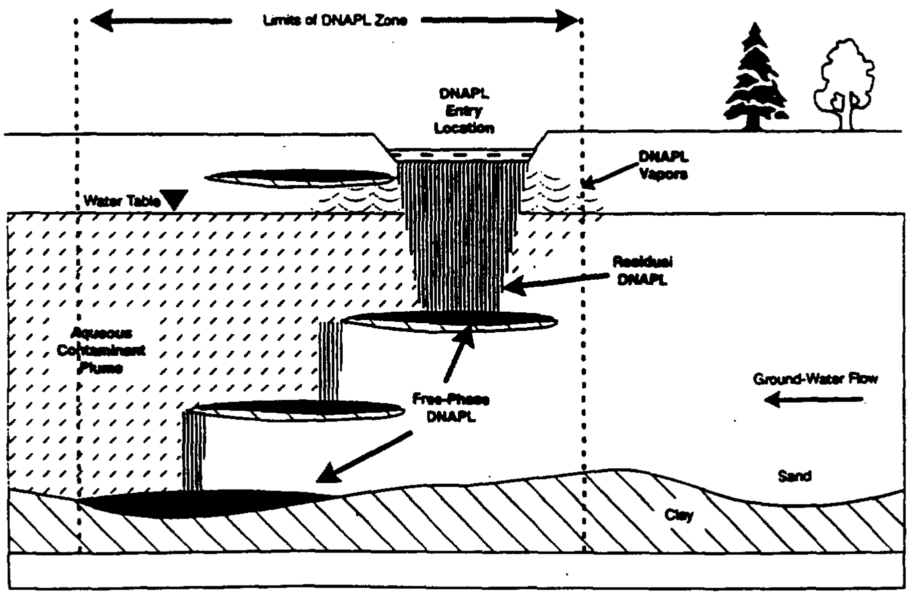


FIGURE D-2
Types of DNAPL Contamination and Contaminant Zones at DNAPL Sites
(Cross-Sectional View)



BOX E
Practical Considerations

Land use: In general, remedial action objectives should be formulated to identify response alternatives that will achieve cleanup levels appropriate for the reasonably anticipated future land use of a site. Early community involvement, with a particular focus on the community's desired future uses of property associated with the site, should result in a more democratic decisionmaking process, greater community support for remedies selected as a result of this process, and, in many cases, more expedited cleanups. Factors to consider may include: any recommendations or views expressed by members of the affected community; the land use history and current uses of the facility and surrounding properties, and recent development patterns where the facility is located; and the proximity of the contamination to residences, sensitive populations or ecosystems, natural resources, or areas of unique historic or cultural significance. For example, if it is anticipated that a site will be used for future industrial/commercial development, it may be appropriate to select a presumptive remedy (e.g., *in situ* bioremediation) that results in higher residual contaminant levels but is less costly than other options. EPA has developed guidance on land use in the Superfund remedy selection process [27].

Institutional and/or engineering controls: It may be appropriate to use institutional and/or engineering controls in conjunction with the presumptive remedy technologies described in this document to reduce current or potential human exposure via direct contact with contaminated soils, sediments, and sludges or through the use of contaminated ground water. Engineering controls are physical systems requiring construction and maintenance, such as soil caps, caps with liners, and vertical barrier walls. Institutional controls include the use of physical barriers, such as fences and warning signs, and the use of administrative restrictions, such as deed or lease restrictions. When vigorously enforced, institutional controls limit direct contact with and ingestion of soils, sediments, and sludges; however, unlike some engineering controls (e.g., caps), institutional controls do not reduce the potential for wind dispersal and inhalation of contaminants. Monitoring is generally needed to determine the effectiveness of institutional and/or engineering controls.

Institutional and/or engineering controls alone do not satisfy CERCLA's preference for achieving reductions of toxicity, mobility, or volume through treatment as a principal element of the remedy. Consequently, they are not generally recommended as the sole response to address contaminants that are deemed a principal threat at wood treater sites. However, the use of institutional and/or engineering controls after the treatment of a principal threat by one or more of the presumptive remedy technologies can enhance the long-term reliability of the remedy.

A cap is an engineering control that may be particularly useful in improving the overall protection of a presumptive remedy. A simple cap may involve only covering the treated area with uncontaminated native soil and/or seeding, fertilizing, and watering the area until vegetation has been established. A simple cap (soil only) may be appropriate for situations where direct contact and/or erosion are the prime threats, and is particularly appropriate following bioremediation because it ensures oxygen availability for continuing biodegradation. Caps that are intended to prevent surface water infiltration are typically comprised of soil and several other components, including a drainage layer, a geomembrane, and a compacted clay layer. Such caps, in addition to being effective in limiting direct contact exposure and reducing erosion, are also effective in limiting surface water infiltration, minimizing the vertical migration of residual contaminants, and minimizing ground-water contamination. However, caps that prevent infiltration will inhibit aerobic biodegradation, which generally makes the use of such caps following bioremediation inappropriate. For a more detailed discussion on the factors affecting the appropriate uses of caps, refer to the references listed at the end of this document [14, 18, 29].

BOX E
Practical Considerations
(continued)

Treatment trains: A single technology may not be sufficient to clean up an entire wood treater site. Remediation of sites often requires a combination of control and treatment options in order to sufficiently reduce toxicity and immobilize contaminants. The treatment train concept combines pretreatment and/or post-treatment activities with treatment technologies to achieve site-specific objectives and acceptable residual contaminant levels. For example, the implementation of a remedy might include institutional controls to control direct contact exposure, bioremediation to treat organic contamination (including excavation, capping, and monitoring activities), and immobilization to treat residual inorganic contamination. The pretreatment and post-treatment portions of the treatment train should be selected based on site-specific considerations.

"Hot spots": Hot spots (e.g., highly contaminated sludges) are generally defined as discrete areas within a site that contain hazardous substances, pollutants, or contaminants that are present in high concentrations, are highly mobile, or cannot be reliably contained, and would present a significant risk to human health or the environment should exposure occur. Hot spots will usually be considered principal threats at a site, as defined by the NCP. Site managers should be aware that the limitations of certain presumptive remedies (e.g., bioremediation) may preclude their use in cleaning up certain hot spots. In addition, responding to hot spots may require additional pretreatment and post-treatment activities, such as the use of institutional controls or capping. (For additional information, see the references listed at the end of this document [23].)

Land disposal restrictions (LDRs): All technologies that treat hazardous waste *ex situ* may cause the waste being treated to be subject to RCRA LDRs. *In situ* treatment of hazardous waste does not trigger LDRs because "placement" of the waste does not occur. LDRs establish treatment standards that must be met before a waste can be land disposed. These treatment standards are either concentration-based (hazardous constituents must be reduced to a set concentration) or, less frequently, technology-based (waste must be treated using a specified technology). EPA has promulgated LDR treatment standards for specific wood preserving wastes (K001 - sediments and sludges from the treatment of wastewaters resulting from processes using creosote or PCP) and anticipates proposing treatment standards for other wood preserving wastewaters in 1995. The Agency has also promulgated LDR treatment standards for RCRA characteristic wastes. If a wood treater waste exhibits one or more of the identified hazardous characteristics, it is subject to RCRA LDRs.

Wood treater wastes that qualify as "remediation wastes" and are placed in a Corrective Action Management Unit (CAMU, see 58 FR 8658-8685), whether at a Superfund site or RCRA corrective action site, do not have to meet LDRs. (Whether LDRs are triggered depends on whether remediation wastes are "placed" in a land-based unit, not on whether they are treated. LDRs do not apply to remediation wastes treated on-site and then placed in a CAMU.) The EPA Region is responsible for setting site-specific requirements for a CAMU, which could include LDRs. The LDR program also provides four exceptions to meeting LDRs that may be applicable to wood treater sites: (1) the treatability variance (see 40 CFR 268.44); (2) equivalent treatment; (3) the no-migration exemption (see 40 CFR 268.6); and (4) de-listing. The treatability variance is anticipated to be the primary route of compliance with LDRs for contaminated soil and debris; for more information, see the references at the end of this document [39, 40]. Site managers should consult with Regional RCRA program staff when addressing LDR issues at specific wood treater sites.

TABLE 2
Comparison of Presumptive Remedy Technologies

Note: Performance represents a range of treatability data. A number of variables, such as concentration and distribution of contaminants, matrix particle size, and moisture content can affect system performance. Bench- (B), pilot- (P), or full-scale (F) performance data may not be available for all contaminants. The performance efficiency data are taken from U.S. EPA's Contaminants and Remedial Options at Wood Preserving Sites [8], unless noted otherwise.

TECHNOLOGY	PERFORMANCE	ADVANTAGES	LIMITATIONS	COST
Bioremediation (*ex situ*)	64 - 95% for PAHs, 78 - 98% for chlorophenols (F)[1]	• More suitable for higher concentrations of organic contaminants than *in situ* processes. • Solid-phase treatment has been successfully demonstrated at wood treater sites. • Generally receives wide community acceptance.	• May require treatability studies due to a scarcity of full-scale performance data. Bench- or pilot-studies may be necessary. • Efficiency limited by lack of indigenous microbes, toxic metals, highly chlorinated organics, pH outside of 4.5 - 8.5 range, limited growth factors, or rainfall/ evapotranspiration rate/percolation rate ratio too high or too low. • Increases the volume of treated materials if bulking agents are added. • Excavation and material handling add to costs. • Land treatment of wastes is subject to land disposal restrictions (LDRs), unless "no-migration" is demonstrated.	$50 - $150 per cubic yard of soil, sediment, or sludge; or approximately $40 - $125 per ton of soil, sediment, or sludge.

[1] These data represent current full-scale performance data for bioremediation conducted at three U.S. wood treater sites (all three of which are listed on the NPL) and one Canadian wood treater site. The use of bioremediation at these four sites achieved remediation goals in all cases. Because the monitoring of biodegradation at these sites stopped after remediation goals were achieved, actual performance efficiencies at these sites may be higher than these numbers indicate. For a more detailed discussion of these performance data, see "Full-Scale Performance Data on the Use of Bioremediation at Wood Treater Sites," a technical background document supporting the wood treater site presumptive remedy initiative that is available at EPA Headquarters and Regional Offices. EPA's Contaminants and Remedial Options at Wood Preserving Sites (1992) [8] provides the following pilot-scale performance data for bioremediation: an average of 87% for PAHs and 74% for halogenated phenols and cresols. The effectiveness of bioremediation tends to be highly variable and very site-specific. A significant component of this variability is the range of effectiveness in the remediation of different kinds of PAHs; studies on the bioremediation of creosote contamination indicate that bioremediation works well on 2-, 3-, and often 4-ring PAHs, but generally not as well on 5- or 6-ring PAHs. For example, the use of *ex situ* bioremediation at one of the wood treater NPL sites resulted in 95% removal of 2-ring PAHs, 83% removal of 3-ring PAHs, and 64% removal of 4+-ring PAHs. To obtain additional performance data for bioremediation, contact the U.S. EPA's Center for Environmental Research Information (CERI) at: 26 W. Martin Luther King Drive, Cincinnati, Ohio 45268. CERI maintains a bioremediation data base called "Bioremediation in the Field Search System" (BFSS), which may be accessed electronically through bulletin [illegible]rds at [illegible] 589-8366 or (513) 569-7610.

Table 2
Comparison of Presumptive Remedy Technologies
(continued)

TECHNOLOGY	PERFORMANCE	ADVANTAGES	LIMITATIONS	COST
Bioremediation *(in situ)*	51% for PAHs, 72% for PCP (F)[2]	• Suitable for moderate concentrations of organic contaminants. • Can destroy organic contaminants in place without the high costs of excavation and material handling. • Minimizes the release of volatile contaminants into the air. • Generally receives wide community acceptance.	• May require treatability studies due to a scarcity of full-scale performance data. Bench- or pilot-scale studies may be necessary. • Efficiency limited by lack of indigenous microbes, toxic metals, highly chlorinated organics (e.g., even high levels of PCP), pH outside of 4.5 - 8.5 range, limited growth factors, non-uniform contaminant distribution, or rainfall/evapotranspiration rate/percolation rate ratio too high or too low. For example, low-permeability soils can hinder performance; however, hydraulic fracturing or other methods may be used to overcome this problem, at higher operating costs. • Cannot be used to directly destroy concentrated masses of non-aqueous phase liquids (NAPLs).	$50 - $100 per cubic yard of soil, sediment, or sludge.

[2] These data represent current full-scale performance data from a bioremediation demonstration project conducted at a Canadian wood treater site. Because the monitoring of biodegradation at this site stopped after a certain point, actual performance efficiencies at this site may be higher than these numbers indicate. For a more detailed discussion of these performance data, see "Full-Scale Performance Data on the Use of Bioremediation at Wood Treater Sites," a technical background document supporting the wood treater site presumptive remedy initiative that is available at EPA Headquarters and Regional Offices. EPA's Contaminants and Remedial Options at Wood Preserving Sites (1992) [8] provides the following pilot-scale performance data for bioremediation: an average of 87% for PAHs and 74% for halogenated phenols and cresols. The effectiveness of bioremediation tends to be highly variable and very site-specific. A significant component of this variability is the range of effectiveness in the remediation of different kinds of PAHs; studies on the bioremediation of creosote contamination indicate that bioremediation works well on 2-, 3-, and often 4-ring PAHs, but generally not as well on 5- or 6-ring PAHs. In practice, *in situ* bioremediation typically results in lower performance efficiencies than the *ex situ* process because *in situ* reactions are less controlled and involve lower mass transfer rates. To obtain additional performance data for bioremediation, contact the U.S. EPA's Center for Environmental Research Information (CERI) at: 26 W. Martin Luther King Drive, Cincinnati, Ohio 45268. CERI maintains a bioremediation data base called "Bioremediation in the Field Search System" (BFSS), which may be accessed electronically through bulletin boards at (301) 589-8366 or (513) 569-7610.

TABLE 2
Comparison of Presumptive Remedy Technologies
(continued)

TECHNOLOGY	PERFORMANCE	ADVANTAGES	LIMITATIONS	COST
Thermal Desorption	82 - 99% (B,P,F)	• Thermal treatments are well-established technologies for treating organic-contaminated media. • Thermal desorption can often produce a treated waste that meets treatment levels set by the Best Demonstrated Available Technology (BDAT) requirements of the RCRA land disposal ban.	• May warrant treatability studies due to a scarcity of full-scale performance data. Bench- or pilot-studies may be necessary. • Design and operation of unit and associated air pollution control devices must take into account the possible presence of halogenated organics, mercury, or corrosive contaminants. • Inorganic constituents that are not particularly volatile will not be effectively removed by thermal desorption. • If chlorine or chlorinated compounds are present, some volatilization of inorganic constituents in the waste may occur. • The contaminated medium must contain at least 20 - 30% solids in order to facilitate placement of waste material into treatment equipment. • Wastes with high-moisture content may need to be dewatered prior to processing in order to control costs and achieve desired performance. • Material handling of soils, sediments, or sludges that are tightly aggregated or largely clay can result in poor processing performance due to caking.	$150 - $400 per ton of soil, sediment, or sludge, excluding excavation, material handling, or disposal costs.

TECHNOLOGY	PERFORMANCE	ADVANTAGES	LIMITATIONS	COST
Thermal Desorption (continued)			• If a high fraction of fine silt or clay exists in the matrix, fugitive dusts will be generated and a greater dust loading will be placed on the downstream air pollution control equipment. • The total organic loading is limited by some thermal treatment systems to 10% or less to ensure that Lower Explosive Limits (LELs) are not exceeded. • A medium exhibiting a very high pH (greater than 11) or low pH (less than 5) may corrode thermal system components. • The treatment process may alter the physical properties of the treated material, particularly where waste matrices have a high clay content. The treated product should be evaluated to determine if the product should be mixed with other stabilizing materials or compacted. • Excavation and material handling add to costs. • With chlorinated feed, potential for dioxin and/or furan formation exists. Systems must be designed and operated carefully. • A full-scale Proof of Performance test, with dioxin and furan analysis if chlorinated feed is present, should precede cleanup operations.	

5 9 0035

TABLE 2
Comparison of Presumptive Remedy Technologies
(continued)

TECHNOLOGY	PERFORMANCE	ADVANTAGES	LIMITATIONS	COST
Incineration	90 - 99% (B,P,F)	• Ensures that specified cleanup levels can be achieved for a given site. • Can effectively remove nearly all contamination.	• High moisture content reduces capacity of incinerator. • Incineration of large volumes of contaminants may be prohibitively expensive. • Efficiency may be limited by high alkali metals or elevated levels of mercury or organic phosphorous. • If a high fraction of fine silt or clay exists in the matrix, fugitive dusts will be generated and a greater dust loading will be placed on the downstream air pollution control equipment. • A medium exhibiting a very high pH (greater than 11) or low pH (less than 5) may corrode incineration system components. • Excavation and material handling add to costs. • On-site incineration has the potential for community concern/opposition.	$150 - $400 per ton of soil, sediment, or sludge, excluding excavation, material handling, or disposal costs.

1 :2
Comparison of Presumpuive Remedy Technologies (continued)

TECHNOLOGY	PERFORMANCE	ADVANTAGES	LIMITATIONS	COST
Immobilization	80 - 90% TCLP[3] (B,P,F)	• Treatability test data indicate that metals in wood preservatives are amenable to solidification/stabilization. • Prevents/mitigates ground-water contamination. • Controls population exposure. • Effectively contains contaminants. • Reduces air emissions.	• High levels of organic compounds can retard or prevent setting of typical solidification/stabilization matrices. • The particular solidification/stabilization system that will perform well on a given contaminated material must be determined by site-specific screening and treatability tests. • Efficiency may be limited by total petroleum hydrocarbon (TPH) content greater than 1%, or humic matter greater than 20%.	$75 - $400 per ton (with landfilling on-site) and $100 - $500 per ton (with landfilling 200 miles off-site).
Capping	N/A (not a treatment technology)	• Capping reduces surface-water infiltration, reduces gas and odor emissions, improves aesthetics, and provides a stable surface over the waste. • Reduces direct contact exposure.	• Capping costs escalate as a function of topographic relief. • Does not treat contamination; contamination is left in place. • May slow down natural bioremediation processes.	$1 - $16 per cubic yard of capping material.

[3] TCLP (toxicity characteristic leaching procedure) is a specific analytical method; this method has been widely used in the past to evaluate the performance of immobilization. However, current information indicates that the SPLP (synthetic precipitation leaching procedure) or other procedures using distilled or site-specific water will produce more accurate results.

TABLE 3-A
Data Requirements for Bioremediation

DATA REQUIREMENT	IMPORTANCE OF INFORMATION
General Data Requirements	
Biochemical oxygen demand (BOD)	Provides estimate of biological treatability of soil, sediment, or sludge.
Chemical oxygen demand (COD)	Another estimate of biological treatability. The measure of the oxygen equivalent of organic content that can be oxidized by a strong chemical oxidant.
Contaminant solubility	Components with low solubility are difficult to remove from soil, sediment, or sludge because of low bioavailability.
Degradation rates of contaminants	Should be determined through treatability studies. Important to determine applicability of remedy.
Indigenous microorganisms	The PAH biodegradation activity of indigenous organisms must be measured to determine if appropriate microorganisms are present in sufficient quantity.
Inorganic contaminants	Important to determine applicability of remedy.
Limiting initial and final concentrations of contaminants	Should be determined through treatability studies with respect to the specific process.
Metals, inorganic salts concentrations	High metal concentrations may inhibit microbial activity. Some inorganic salts are necessary for biological activity.
Moisture content	May inhibit solid-phase aerobic remediation of soils, sediments, or sludges if greater than 80% of field capacity; soil, sediment, and sludge remediation inhibited if less than 40% of field capacity. Soil slurry reactors may operate with 80-90% moisture content (water/weight of soil).
Nutrients	Lack of certain nutrients reduces activity.
Oil and grease content	Oil and grease concentrations may inhibit soil, sediment, and sludge remediation at concentrations greater than 5% by weight, which may result in unacceptable lag times.
Organic content	Important to determine applicability of remedy. Important to determine horizontal and vertical extent of contaminants and to ensure that appropriate detection limits are used.
Particle size	Particle size affects access and contact between microorganisms, contaminants, nutrients, water, and electron acceptors.
Total organic carbon (TOC)	Indicates total organic carbon present and can be used to estimate waste available for biodegradation.

TABLE 3-A
Data Requirements for Bioremediation
(continued)

DATA REQUIREMENT	IMPORTANCE OF INFORMATION
General Data Requirements (continued)	
Variable waste composition	Large variations affect biological activity.
Redox potential (Eh)	Aerobic degradation: oxidation-reduction potential of the soil, sediment, or sludge must be greater than that of the organic contaminant for oxidation to occur.
Specific *In Situ* Data Requirements	
Soil, sediment, or sludge temperature	High or low temperatures affect microbial activity for *in situ* treatment (high temperatures tend to increase activity, low temperatures tend to decrease activity).
Position of water table	Important for remedy selection and implementation.
Site geology	Important to determine mass transfer capability.
Soil, sediment, or sludge permeability	Affects movement of water, oxygen, and nutrients for *in situ* treatment.
Specific *Ex Situ* Data Requirements	
Toxicity Characteristic Leaching Procedure (TCLP) analysis	Needed to determine if the soil, sediment, or sludge is a RCRA hazardous waste.

TABLE 3-B
Data Requirements for Thermal Desorption

DATA REQUIREMENT	IMPORTANCE OF INFORMATION
Bulk density of soil, sediment, or sludge	Used in converting weight to volume in material handling calculations.
Contaminant physical properties	Information on physical properties, such as boiling point, determines the required characteristics of the thermal desorption unit.
Inorganic contaminants	Important to determine applicability of remedy.
Metals content	Metals (As, Cd, Cr, Pb, Zn) can vaporize at high temperatures and must be removed from emissions.
Extent of organic contaminants	Need to determine horizontal and vertical extent of organic contamination to be excavated.
Moisture content	High moisture content increases feed handling and energy requirements.
Sulfur, chlorine, and organic phosphorous content	Contribute to acid gas formations at high concentrations.
Particle size	Oversized debris hinders processing. Fine particles can result in high particulate loading in flue gasses. Clay content will impede material handling and may interfere with waste processing.
pH	Extreme pH may be harmful to equipment.
Salt content	High salt content, depending on temperature, may cause material in the thermal unit to slag.
Soil, sediment, or sludge plasticity	Plastic soil, sediment, or sludge, when subjected to compressive forces, can become molded into large particles that are difficult to heat.
Toxicity Characteristic Leaching Procedure (TCLP) analysis	Needed to determine if the soil, sediment, or sludge is a RCRA hazardous or listed waste.
Flash point of soil, sediment, or sludge	Important to determine safe temperature parameters for the desorber unit.
Total organic carbon (TOC)	Provides estimate of material available for combustion, which may affect the temperature range available for thermal desorption.
Total chloride	Influences metal partitioning to the gas phase.

TABLE 3-C
Data Requirements for Incineration

DATA REQUIREMENT	IMPORTANCE OF INFORMATION
Bulk density of soil, sediment, or sludge	Used in converting weight to volume in material handling calculations.
Contaminant combustion characteristics	Required to determine the incinerator's combustion characteristics.
Heating value	Affects throughput and energy requirements.
Inorganic contaminants	Important to determine applicability of remedy.
Metals content	Metals (As, Cd, Cr, Pb, Zn) can vaporize at high temperatures and are difficult to remove from emissions.
Extent of organic contaminants	Need to determine horizontal and vertical extent of organic contamination to be excavated due to cost concerns.
Moisture content	High moisture content increases feed handling and energy requirements.
Sulfur, chlorine, and organic phosphorous content	Contribute to acid gas formations at high concentrations.
Particle size	Oversized debris hinders processing. Fine particles can result in high particulate loading in flue gasses.
pH	Extreme pH may be harmful to equipment.
Salt content	High salt content will cause material in the incinerator to slag.
Soil, sediment, or sludge plasticity	Plastic soil, sediment, or sludge, when subject to compressive forces, can become molded into large particles that are difficult to heat.
Toxicity Characteristic Leaching Procedure (TCLP) analysis	Needed to determine if soil, sediment, or sludge is a RCRA hazardous or listed waste.
Total organic carbon (TOC)	Provides estimate of material available for combustion.

TABLE 3-D
Data Requirements for Immobilization

DATA REQUIREMENT	IMPORTANCE OF INFORMATION
Coal or lignite content	May affect product quality.
Cyanides content	Affects bonding (greater than 3,000 ppm).
Halide content	Retards setting; leaches easily.
Inorganic salts content	Reduces product strength and affects curing rates (soluble salts of Mn, Sn, Zn, Cu, and Pb).
Metals content	Important for process considerations.
Phosphate concentration	Phosphate is a key reagent in some solidification/stabilization mixes to reduce metals (especially Pb) solubility; in high concentrations, phosphate may cause problems.
Oil and grease content[1]	Affects cementation, mix design, and cost.
Organic content[1]	Affects cementation, mix design, and cost.
Particle size	Affects bonding (if less than 200 mesh or greater than 1/4 inch diameter). Concrete is able to use larger particles.
Phenol concentration	Affects product strength (greater than 5%).
Sodium arsenate, borate, phosphate, iodate, sulfide, sulfate, carbohydrate concentrations	Retards setting and affects product strength.
Solids content	Low solids content indicates that de-watering is needed.
Semi-volatile organics	Requires the use of special mixes, and may inhibit bonding (if greater than 10,000 ppm).
Volatile organic concentrations	Volatiles have not been successfully treated with solidification/stabilization alone; volatiles should be removed or otherwise treated.

[1] Immobilization with lime or proprietary additives has been used to treat oily soils and petroleum sludge at petroleum industry sites; however, the structural properties of the product are poor, even when the material passes the TCLP (Toxicity Characteristic Leaching Procedure). High concentrations (e.g., greater than 20%) of naturally-occurring humic matter may also interfere with cement-based processes, but some success with higher levels of organics has been reported using modified lime products.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES

This Appendix summarizes the analyses that EPA conducted on Feasibility Study (FS) and Record of Decision (ROD) data from Superfund wood treater sites, which led to establishing bioremediation, thermal desorption, incineration, and immobilization as the presumptive remedies for wood treater sites with contaminated soils, sediments, and sludges. The analyses consisted of the following activities:

- Identifying wood treater sites;
- Determining the frequency of technology selection for wood treater sites;
- Identifying sites for the FS/ROD analysis; and
- Conducting the FS/ROD analysis.

Results of the FS/ROD analysis, along with a technical analysis of performance data on technology application, are part of the Administrative Record for this directive, which is available at EPA Headquarters and the Regional Offices. These analyses provide support for the decision to eliminate the initial alternatives identification and screening step for this site type. These analyses found that certain technologies are appropriately screened out based on effectiveness, implementability, and/or cost. Review of technologies against the nine remedial criteria led to elimination of additional alternatives. A discussion of each of the analyses is provided below.

<u>Identification of the Universe of Wood Treater Sites</u>

EPA identified the universe of wood treater sites listed on the National Priorities List from information contained in the following two sources: (1) *Contaminants and Remedial Options at Wood Preserving Sites*, U.S. EPA, EPA/600/R-92/182, 1992; and (2) *Innovative Treatment Technologies: Annual Status Report (Sixth Edition)*, U.S. EPA, EPA 542-R-94-005, 1994. The first source contained comprehensive lists of NPL and non-NPL wood treater sites prior to 1992. The second source contained information, current as of 1994, on the status of the implementation of innovative treatment technologies at a wide range of sites, including wood treater sites. By cross-checking the information in both of these documents, an overall list of 58 NPL wood treater sites was identified.

<u>Frequency of Technology Selection for Wood Treater Sites</u>

Table A-1 presents the distribution of remedial technologies selected at 52 of the 58 NPL wood treater sites (data on remedy selection were not available for the remaining six sites). These data were obtained from the two sources cited above and EPA's Superfund Records of Decision CD-ROM data base (March 1995). Table A-1 demonstrates that the four wood treater site presumptive remedies (bioremediation, thermal desorption, incineration, and immobilization) together were selected more often (39 out of the 50 sites for which remedy selection information was available, or approximately 78% of the time) than the other applicable technologies. Bioremediation, the primary presumptive remedy for treating organic contamination, was the remedy selected more often than any other technology (18 out of the 50 sites, or approximately 36% of the time).

TABLE A-1
Remedies Selected at NPL Wood Treater Sites

Primary Technologies Selected to Address Contaminated Soils, Sediments, and Sludges at Wood Treater Sites	Total Number of Sites Selecting Technology[1]
Bioremediation	18
Thermal Desorption	3
Incineration	13
Immobilization	13
Dechlorination	2
Solvent Extraction	1
Soil Flushing/Washing	6
Landfilling	4
Institutional Controls/Monitoring	2
To Be Determined[2]	2

[1] The total number of primary technologies selected is greater than the total of 50 sites for which remedy selection data were available because several sites selected more than one primary technology to address the principal threat of contaminated soils, sediments, and sludges (e.g., bioremediation to treat organic contamination and immobilization to treat inorganic contamination). Secondary technologies selected as part of a treatment train are not documented in this table.

[2] Remedial technology for contaminated soils, sediments, and/or sludges not yet selected.

<u>Identification of Sites for the FS/ROD Analysis</u>

The purpose of the FS/ROD analysis was to document the technology screening step and the detailed analysis in the FSs/RODs of wood treater sites, and to identify the principal reasons given for eliminating technologies from further consideration. To achieve a representative sample of FSs/RODs for the analysis, sites were selected according to the following criteria:

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES (continued)

- Sites were chosen to ensure a balanced distribution among the primary technologies for addressing contaminated soils, sediments, and sludges at wood treater sites (i.e., bioremediation, thermal desorption, incineration, immobilization, dechlorination, solvent extraction, soil flushing/washing, landfilling, and institutional controls/monitoring); and

- Sites were chosen to ensure an even distribution in geographic location and ROD signature date.

Using these criteria, a set of 25 NPL wood treater sites was chosen for the FS/ROD analysis; this represents approximately 43% of the total universe of NPL wood treater sites.

<u>FS/ROD Analysis</u>

The FS/ROD analysis involved a review of the technology screening phase, including any pre-screening steps, followed by a review of the detailed analysis and comparative analysis phases in each of the 25 FSs and RODs. Information derived from each review was documented on site-specific data collection forms, which are available for evaluation as part of the Administrative Record for this directive (available at EPA Headquarters and the Regional Offices).

For the screening phase, the full range of technologies considered was listed on the data collection forms, along with the key reasons given for eliminating technologies from further consideration. These reasons were categorized according to the three initial screening criteria: cost, effectiveness, and/or implementability. The frequency with which specific reasons were given for eliminating a technology from further consideration was then tallied and compiled into a screening phase summary table (Table A-2).

For the detailed analysis and comparative analysis, information on the relative performance of each technology/alternative with respect to the nine NCP criteria was documented on the site-specific data collection forms. In most cases, several different remedial technologies were combined in the FSs and RODs to form a remedial alternative or cleanup option. The disadvantages of a technology/alternative were then compiled into a detailed analysis/comparative analysis summary table, under the assumption that these disadvantages contributed to non-selection. The advantages and disadvantages associated with each cleanup option were highlighted. Table A-3 provides the summary information for the detailed analysis and comparative analysis phases.

Tables A-2 and A-3 demonstrate that non-presumptive remedy technologies are consistently eliminated from further consideration in the screening phase due to effectiveness, implementability, and/or excessive costs. In addition, the FS/ROD analysis indicates that, although certain technologies routinely passed the screening phase, these technologies were selected infrequently because they did not provide the best overall performance with respect to the nine criteria. This analysis (in addition to the technical background documentation in the Administrative Record) will support a decision by site managers to bypass the technology identification and screening step for a particular wood treater site and select one or more of the presumptive remedies for contaminated soils, sediments, and sludges. As previously discussed, this document and the accompanying FS/ROD analysis should be part of the Administrative Record for the site. Additional supporting materials not found in the Regional files can be provided by Headquarters, as needed.

APPENDIX A
TABLE A-2: SUMMARY OF INITIAL SCREENING PHASE FOR WOOD TREATER SITES

Remedial Technology or Treatment	# of FSs Technology Was Considered[1]	# of FSs Technology Passed Screening	# of FSs Technology Was Screened Out	# of FSs Where Criterion Contributed to Screening Out[2]		
				Cost	Effectiveness	Implementability
I. Institutional Controls						
A. Restrictions/Monitoring	23	22	1		1	
II. Containment						
A. Capping	42	28	14	5	5	9
1. unspecified	5	5	0			
2. asphalt/concrete	10	4	6	2	3	2
3. soil/bentonite/clay	13	8	5	2		5
4. multi-layer cover system	14	11	3	1	2	2
B. Closure-In-Place/On-Site Encapsulation/Vaults	10	4	6	1	3	5
C. Temporary On-Site Storage Pile	9	7	2			
D. Long-Term On-Site Landfill	16	9	7	1	2	5
III. Immobilization						
A. Solidification/Stabilization	23	15	8	2	7	4
IV. Treatment						
A. Biological Treatments	54	18	36	1	28	19
1. *in situ* bioremediation	18	5	13		12	9
2. *ex situ* bioremediation (e.g., lined land treatment units)	15	8	7		6	3

APPENDIX A
TABLE A-2: SUMMARY OF INITIAL SCREENING PHASE FOR WOOD TREATER SITES (continued)

Remedial Technology or Treatment	# of FSs Technology Was Considered[1]	# of FSs Technology Passed Screening	# of FSs Technology Was Screened Out	# of FSs Where Criterion Contributed to Screening Out[2]		
				Cost	Effectiveness	Implementability
3. off-site landfarming	4	0	4	1	2	3
4. soil/slurry bioreactor	12	5	7		3	2
5. anaerobic treatment	4	0	4		4	1
6. other	1	0	1		1	1
B. Other Thermal Treatments	49	9	40	7	23	20
1. thermal desorption	10	5	5	1	3	1
2. pyrolysis	9	0	9		5	5
3. vitrification	14	2	12	4	8	9
4. wet air oxidation	5	0	5		3	2
5. infrared treatment	9	2	7	2	2	1
6. other	2	0	2		2	2
C. Incineration	43	26	17	9	4	11
1. on-site	23	15	8	3	3	5
2. off-site	20	11	9	6	1	6
D. Chemical Treatments	30	9	21	7	13	12
1. dechlorination	12	4	8	3	5	4
2. solvent extraction	14	5	9	4	4	6
3. other	4	0	4		4	2

APPENDIX A
TABLE A-2: SUMMARY OF INITIAL SCREENING PHASE FOR WOOD TREATER SITES (continued)

Remedial Technology or Treatment	# of FSs Technology Was Considered[1]	# of FSs Technology Passed Screening	# of FSs Technology Was Screened Out	# of FSs Where Criterion Contributed to Screening Out[2]		
				Cost	Effectiveness	Implementability
E. Physical Treatments	42	12	30	5	21	13
1. soil flushing (*in situ*)	14	5	9	1	8	5
2. soil washing (*ex situ*)	19	7	12	2	7	3
3. attenuation (mixing with clean soil)	2	0	2	1	1	2
4. aeration/soil venting	5	0	5	1	3	2
5. macro-encapsulation/ overpacking	1	0	1		1	
6. other	1	0	1		1	1
V. Off-Site Options						
A. Off-Site RCRA Facility	23	19	4	3	1	2
B. Off-Site Sanitary Landfill	3	1	2		1	1
C. Off-Site Recycle/Reuse Facility	3	1	2		1	1

[1] Because several specific technologies within a general technology group (e.g., capping: unspecified capping, asphalt/concrete caps, soil/bentonite/clay caps, and multi-layer cover systems) were considered for each site, the total number of FSs in which a technology group was considered may be greater than 25.

[2] FSs may indicate more than one criterion for screening out a technology. Also, some FSs did not fully explain the criteria for screening out a technology. Therefore, the totals for these screening criteria may not be equal to the number of FSs in which a technology was screened out.

APPENDIX A
TABLE A-3: SUMMARY OF DETAILED ANALYSIS PHASE FOR WOOD TREATER SITES

Remedial Technology or Treatment	# of FSs/RODs Technology Was Considered[1]	# of FSs/RODs Technology Was Selected[2]	# of FSs/RODs Technology Was Not Selected	# of FSs/RODs Where Criterion Contributed to Non-Selection[3]						
				Overall Protectiveness	Compliance w/Federal ARARs	Reduction of Toxicity, Mobility, & Volume	Long-Term Effectiveness/ Permanence	Short-Term Effectiveness	Implementability	Cost
I. Institutional Controls										
A. Restrictions/ Monitoring	22	22	0							
II. Containment										
A. Capping	28	13	15	7	3	12	7	1	3	3
1. unspecified	5	2	3	1	1	2	1	1	1	1
2. asphalt/ concrete	4	2	2	1		2	1			
3. soil/bentonite/ clay	8	4	4	2	1	3	2			1
4. multi-layer cover system	11	5	6	3	1	5	3		2	1
B. Closure-In-Place/On-Site Encapsulation/ Vault	4	3	1			1	1		1	
C. Temporary On-Site Storage Pile	7	6	1	1		1				1
D. Long-Term On-Site Landfill	9	1	8	1	2	3	1	1	4	2

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APPENDIX A
TABLE A-3: SUMMARY OF DETAILED ANALYSIS PHASE FOR WOOD TREATER SITES
(continued)

Remedial Technology or Treatment	# of FSs/RODs Technology Was Considered[1]	# of FSs/RODs Technology Was Selected[2]	# of FSs/RODs Technology Was Not Selected	# of FSs/RODs Where Criterion Contributed to Non-Selection[3]						
				Overall Protectiveness	Compliance w/Federal ARARs	Reduction of Toxicity, Mobility, & Volume	Long-Term Effectiveness/ Permanence	Short-Term Effectiveness	Implementability	Cost
III. Immobilization										
A. Solidification/ Stabilization	15	11	4			3	1	1	1	1
IV. Treatment										
A. Biological Treatments	18	9	9	1		2	5	3	5	1
1. *in situ* bioremediation	5	2	3	1			3	1	1	
2. *ex situ* bioremediation	8	5	3			1	2	2	2	
3. soil/slurry bioreactor	5	2	3			1			2	1
B. Other Thermal Treatments	9	2	7			2	2	2	4	2
1. thermal desorption	5	2	3					2	1	1
2. vitrification	2	0	2			2	2		2	1
3. infrared treatment	2	0	2						1	

APPENDIX A
TABLE A-3: SUMMARY OF DETAILED ANALYSIS PHASE FOR WOOD TREATER SITES
(continued)

Remedial Technology or Treatment	# of FSs/RODs Technology Was Considered[1]	# of FSs/RODs Technology Was Selected[2]	# of FSs/RODs Technology Was Not Selected	# of FSs/RODs Where Criterion Contributed to Non-Selection[3]						
				Overall Protectiveness	Compliance w/Federal ARARs	Reduction of Toxicity, Mobility, & Volume	Long-Term Effectiveness/ Permanence	Short-Term Effectiveness	Implementability	Cost
C. Incineration	26	7	19	1	1	3	4	7	12	14
1. on-site	15	3	12	1	1	2	2	4	6	8
2. off-site	11	4	7			1	2	3	6	6
D. Chemical Treatment	9	4	5			2			2	2
1. solvent extraction	5	1	4			1			2	2
2. dechlorination	4	3	1			1				
E. Physical Treatment	12	6	6	1		1	3		4	1
1. soil flushing (*in situ*)	5	1	4	1			3		3	1
2. soil washing (*ex situ*)	7	5	2			1			1	

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APPENDIX A
TABLE A-3: SUMMARY OF DETAILED ANALYSIS PHASE FOR WOOD TREATER SITES (continued)

Remedial Technology or Treatment	# of FSs/RODs Technology Was Considered[1]	# of FSs/RODs Technology Was Selected[2]	# of FSs/RODs Technology Was Not Selected	# of FSs/RODs Where Criterion Contributed to Non-Selection[3]						
				Overall Protectiveness	Compliance w/Federal ARARs	Reduction of Toxicity, Mobility, & Volume	Long-Term Effectiveness/ Permanence	Short-Term Effectiveness	Implementability	Cost
V. Off-Site Options										
A. Off-Site RCRA Landfill	19	10	9	2	1	1	1		6	2
B. Off-Site Sanitary Landfill	1	0	1							
C. Off-Site Reclamation/ Recycling	1	1	0							

[1] Because several specific technologies within a general technology group (e.g., capping: unspecified capping, asphalt/concrete caps, soil/bentonite/clay caps, and multi-layer cover systems) were considered for each site, the total number of FSs/RODs in which a technology group was considered may be greater than 25.

[2] The total number of remedial technologies selected is greater than 25 because treatment trains consisting of several different technologies were selected at most sites. For example, the selection of an overall remedy may have included the selection of institutional controls to control direct contact exposure, bioremediation to treat organic contamination (including soil washing), and immobilization to address inorganic contamination.

[3] Information on state and community concerns was not included in this analysis because FSs do not contain this information, and RODs generally only reference supporting documentation (i.e., state concurrence letters and responsiveness summaries). FSs and RODs may indicate more than one criterion for non-selection of a technology. Therefore, the totals for these non-selection criteria may not be equal to the number of FSs/RODs in which a technology was not selected.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

BIOREMEDIATION

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
Provides protection by reducing concentrations of organic contaminants in soils, sediments, and sludges. *Ex situ* bioremediation requires measures to protect workers and the community during excavation, handling, and treatment. Does not impact the local environment with the proper implementation of erosion/sediment control measures.	Operation must comply with all federal and state regulations that are identified as ARARs. Requires compliance with RCRA removal, treatment, transportation, and land disposal regulations, if RCRA is determined to be an ARAR. Requires compliance with CERCLA off-site rule (if off-site treatment, storage, or disposal is used).	Residual contamination following treatment may require use of capping and/or institutional controls. Residual contamination may migrate. Hazardous substances left in place will require a five-year review. Bioremediation systems may require lengthy operation, in addition to long-term maintenance of cap integrity (if capping is implemented).	May reduce toxicity, mobility, and volume through degradation of organic contaminants; however, if bulking agents are added, volume may not necessarily be reduced. If used in conjunction with capping, minimizes mobility.	Microbial degradation is a relatively slow process that is highly site-specific and is affected by a multitude of factors. Some of these factors (e.g., electron acceptor and nutrient availability, and pH) may need to be examined in bench-scale studies during the design phase of site remediation to maximize aerobic activity and minimize process interferences. *Ex situ* bioremediation presents potential short-term risks to workers and community from air releases during excavation and treatment; requires air monitoring to address these short-term risks.	Requires relatively simple technologies; easy to construct and operate. May require bench- and/or pilot-scale studies during the design phase. Pilot-scale studies in the field are almost always required before full-scale implementation. Easy to economically maintain treatment until cleanup levels are achieved. Size of site may limit capability to perform some types of *ex situ* bioremediation.	*In situ* $50 - $100 per cubic yard of soil, sediment, or sludge. *Ex situ* $50 - $150 per cubic yard of soil, sediment, or sludge; or $40 - $125 per ton of soil, sediment, or sludge.

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

BIOREMEDIATION (continued)

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
In situ bioremediation may not be feasible for the treatment of subsurface soils, sediments, and sludges (depending upon variables such as contaminant type, soil type, depth to contamination, etc.). A simple cap, in conjunction with bioremediation, provides protection by reducing and/or controlling erosion and direct contact exposure to residual contamination.	Requires compliance with Hazardous Materials Transportation Act regulations (if off-site treatment is used). Requires compliance with location-specific ARARs. *Ex situ* bioremediation may need emission controls to ensure compliance with air quality standards during excavation and treatment.	*In situ* process generates little, if any, toxic waste streams that need to be disposed; *ex situ* may generate such streams.		Where it is feasible, *in situ* bioremediation requires the least soil disturbance and, therefore, presents the least short-term risks. Involves potential short-term risks from handling and transporting waste (if off-site treatment is used).		

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

THERMAL DESORPTION

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
Provides both short- and long-term protection by eliminating exposure to organic contaminants in soils, sediments, and sludges. Prevents further ground-water contamination and off-site migration. Requires measures to protect workers and the community during excavation, handling, and treatment.	Operation and design must comply with all federal and state ARARs concerning hazardous waste treatment facilities. Requires compliance with RCRA removal, treatment, transportation, and land disposal regulations, if RCRA is determined to be an ARAR. Requires compliance with CERCLA off-site rule (if off-site treatment, storage, or disposal is used).	Effectively removes source of contamination. Has been demonstrated as an effective technique for removing and concentrating organic contaminants in soils, sediments, and sludges. Would involve some treatment or disposal of residuals in addition, generally through use of carbon adsorption/ regeneration or disposal. Eliminates risks associated with direct contact or migration of wastes.	Significantly reduces toxicity, mobility, and volume of contaminants through treatment.	Presents potential short-term risks to workers and community from fugitive emissions during excavation and treatment (if on-site treatment is used). Requires air monitoring to address these short-term risks. Involves potential short-term risks from handling and transporting waste (if off-site treatment is used). Requires relatively short time frame to achieve cleanup levels.	Substantive permit requirements must be addressed. Mobile treatment units are readily available. Limited off-site treatment capacity exists. Used successfully at other Superfund sites to treat organic contaminants in soils, sediments, and sludges. Public may oppose technology, viewing it as similar to incineration.	$150 - $400 per ton of soil, sediment, or sludge, excluding excavation, material handling, or disposal costs.

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

THERMAL DESORPTION (continued)

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
	Requires compliance with Hazardous Materials Transportation Act regulations (if off-site treatment is used). Requires compliance with location-specific ARARs. Emission controls may be needed to ensure compliance with air quality standards during excavation and treatment. EPA's Draft Combustion Strategy is a TBC (e.g., for conducting risk assessments, etc.)				Requires engineering measures to control air emissions, fugitive dust, runoff, erosion, and sedimentation.	

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

INCINERATION

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
Provides both short- and long-term protection by permanently destroying organic contaminants in soils, sediments, and sludges. Prevents further ground-water contamination and off-site migration. Requires measures to protect workers and the community during excavation, handling, and treatment.	Operation and design must comply with all federal and state ARARs concerning hazardous waste treatment facilities. Requires compliance with RCRA removal, treatment, transportation, and land disposal regulations, if RCRA is determined to be an ARAR. Requires compliance with CERCLA off-site rule (if off-site treatment, storage, or disposal is used). Must meet Boiler and Industrial Furnace (BIF) regulations, which can be more restrictive than RCRA.	Effectively destroys nearly all contamination. Is a well-demonstrated technique for treating organic contaminants in soils, sediments, and sludges. Eliminates risks associated with direct contact or migration of wastes. Generates little, if any, toxic residues.	Significantly reduces toxicity, mobility, and volume of contaminants through treatment.	Presents potential short-term risks to workers and community from fugitive emissions during excavation and treatment (if on-site treatment is used). Requires air monitoring to address these short-term risks. Involves potential short-term risks from handling and transporting waste (if off-site treatment is used). Requires relatively short time frame to achieve cleanup levels.	Construction and substantive permit requirements of on-site incinerators may be somewhat difficult to meet. Mobile incinerators are readily available; these use common procedures and equipment. Limited off-site incineration capacity exists. Used successfully at other Superfund sites to treat organic contaminants in soils, sediments, and sludges.	$150 - $400 per ton of soil, sediment, or sludge, excluding excavation, material handling, or disposal costs.

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

INCINERATION (continued)

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
	Requires compliance with Hazardous Materials Transportation Act regulations (if off-site treatment is used). Requires compliance with location-specific ARARs. Emission controls may be needed to ensure compliance with air quality standards during excavation and treatment. EPA's Draft Combustion Strategy is a TBC (e.g., for conducting risk assessments, etc.)				Public opposition may make this technology infeasible. Requires a trial burn to demonstrate destruction efficiency and define operating parameters (if on-site treatment is used). Requires coordination with state and local officials to select transportation routes (if off-site treatment is used).	

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

IMMOBILIZATION

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
Provides both short- and long-term protection by containing contaminants in a fixed-soil/sediment/ sludge mass. Reduces the potential for further ground-water contamination and off-site migration. Reduces potential risks associated with inhalation, dermal contact, and ingestion of contaminated soils, sediments, and sludges.	Operation must comply with all federal and state ARARs. Requires compliance with RCRA removal, treatment, transportation, and land disposal regulations, if RCRA is determined to be an ARAR. Requires compliance with CERCLA off-site rule (if off-site treatment, storage, or disposal is used).	Represents a long-term solution that effectively reduces and/or eliminates the mobility of hazardous substances into the environment. Has been demonstrated as an effective technique for treating inorganic contaminants (primarily metals, such as chromium and arsenic) in soils, sediments, and sludges.	Significantly reduces the mobility of inorganic contaminants (and non-volatile organics, to some extent) by chemically binding and encapsulating them. Does not reduce volume or toxicity of contaminants. Volume may increase 30-50% through the mixing of the soil/sediment/ sludge with fixative agents.	Presents potential short-term risks to workers and community from air release during excavation and treatment (if on-site treatment is used). Involves potential short-term risks from handling and transporting waste (if off-site disposal is used). Requires relatively short time frame to achieve cleanup levels.	Requires relatively simple technologies; easy to construct and operate. Requires treatability testing. Used successfully at other Superfund sites to treat inorganic (primarily metals) contaminants in soils, sediments, and sludges.	$75 - $400 per ton of soil, sediment, or sludge (for on-site treatment). $100 - $500 per ton of soil, sediment, or sludge (for off-site disposal).

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

APPENDIX B
EVALUATION OF SELECTION CRITERIA FOR TECHNOLOGIES USED TO TREAT CONTAMINATED SOILS, SEDIMENTS, AND SLUDGES AT WOOD TREATER SITES:

IMMOBILIZATION (continued)

CRITERIA						
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost[1]**
Requires measures to protect workers and the community during excavation, handling, and treatment. Lower portions of the soil profile are often untreated.	Requires compliance with Hazardous Materials Transportation Act regulations (if off-site disposal is used). Requires compliance with location-specific ARARs. Emission controls may be needed to ensure compliance with air quality standards during excavation and treatment.	Requires air and ground-water monitoring to confirm long-term effectiveness. Requires proper management and/or institutional controls to address any residual risks associated with direct contact.		Short-term effectiveness maintained through strict environmental controls.		

[1] Actual cost of a remediation technology is highly site-specific and dependent upon target cleanup levels of contaminants, soil characteristics, and the design and operation of the remediation technology used.

GLOSSARY

Action Memorandum — A document that provides a concise written record of the decision selecting a removal action. It describes the site's history, current activities, and health and environmental threats; outlines the proposed actions and costs; and documents approval of the proposed action by the proper EPA Headquarters or Regional authority.

Administrative Record — A formal record established by the lead agency, it contains the documents that form the basis for the selection of a response action (e.g., analysis report, Feasibility Study, Record of Decision, Directives, etc.).

Applicable or Relevant and Appropriate Requirements (ARARs) — *Applicable requirements* are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. *Relevant and appropriate requirements* are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and are well-suited to the particular site.

Engineering Evaluation/Cost Analysis (EE/CA) — Required for non-time-critical removal actions, the EE/CA contains information on site characteristics, removal action objectives, and removal action alternatives. It is intended to identify the objectives of the removal action and to analyze the various alternatives that may be used to satisfy these objectives for cost, effectiveness, and implementability. The EE/CA process includes: conducting a removal site evaluation, notifying PRPs of their liability, preparing an EE/CA approval memorandum, and preparing a study documenting the removal action options. Although an EE/CA is similar to the RI/FS conducted for remedial actions, it is less comprehensive. The EE/CA is part of the Administrative Record file and is subject to the public comment and comment/response requirements for the Administrative Record.

Feasibility Study (FS) — A study undertaken by the lead agency to develop and evaluate options for remedial design. The FS emphasizes data analysis and is generally performed concurrently and in an interactive fashion with the Remedial Investigation (RI), using data gathered during the RI.

Hazard Ranking System (HRS) — The method used by EPA to evaluate the relative potential of hazardous substance releases to cause health or safety problems, or ecological or environmental damage.

Innovative Treatment Technologies — Technologies that have been tested, selected, or used for the treatment of hazardous substances or contaminated materials but lack well-documented cost and performance data under a variety of operating conditions.

National Priorities List (NPL) — The list compiled by EPA, pursuant to CERCLA section 105, of hazardous substance releases in the United States that are priorities for long-term remedial evaluation and response.

On-Scene Coordinator (OSC) — The federal official predesignated by EPA or the U.S. Coast Guard to coordinate and direct federal responses under Subpart D of the NCP, or the official designated by the lead agency to coordinate and direct removal actions under Subpart E of the NCP.

Preliminary Remediation Goals (PRGs) - Initial cleanup goals developed as part of the overall remedial action objectives. PRGs are established and refined based on a variety of information, including ARARs

GLOSSARY
(continued)

and TBCs, the baseline risk assessment, anticipated future land use(s) of the site, and technical, exposure, and uncertainty factors.

Principal Threats - Principal threats include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.

Record of Decision (ROD) — The final remedial action plan for a site or operable unit, which summarizes problems, alternatives, remedies, and the selected remedy. The ROD also includes the rationale for the selection of the final remedy, and explains how the selected remedy meets the nine evaluation criteria stated in the NCP.

Remedial Investigation (RI) — A process undertaken by the lead agency to determine the nature and extent of the problem presented by a release. The RI emphasizes data collection and site characterization, and is generally performed concurrently and in an interactive fashion with the Feasibility Study.

Remedial Project Manager (RPM) — The official designated by the lead agency to coordinate, monitor, or direct a remedial action under Subpart E of the NCP.

Remedial Site Evaluation — A process undertaken by the lead agency to collect data, as required, and evaluate a release or threat of release of hazardous substances, pollutants, or contaminants. The evaluation may consist of two steps: a preliminary assessment (PA) and a site inspection (SI).

Removal Site Evaluation — A process undertaken by the lead agency to identify the source and nature of a release or threat of release; it may include a removal preliminary assessment and, if warranted, a removal site inspection.

Risk Assessment — The qualitative and/or quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the cumulative presence or potential presence and/or use of specific pollutants.

Superfund Accelerated Cleanup Model (SACM) - The purpose of SACM is to make hazardous waste cleanups more timely and efficient. This will be accomplished through a greater focus on the front end of the process and better integration of all Superfund program components. The approach involves: (1) a continuous process for assessing site-specific conditions and the need for action; (2) cross-program coordination of response planning; (3) prompt risk reduction through early action (removal or remedial); and (4) appropriate cleanup of long-term environmental problems.

To Be Considereds (TBCs) — Non-promulgated advisories or guidance issued by federal or state governments that are not legally binding and do not have the status of potential ARARs. In many circumstances, TBCs will be considered along with ARARs as part of the risk assessment and may be used in determining the necessary level of cleanup for protection of health or the environment.

Treatability Studies — Preliminary studies in which a hazardous waste is subjected to a treatment process to determine if the waste is amenable to the process, what pretreatment activities are necessary, what the optimal process options are, and what is the efficiency of the process.

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