Appendix B

Feasibility Study

Former Gulf States Creosoting Site
Hattiesburg, Mississippi

4.0 Feasibility Study

The Feasibility Study (FS) serves as a mechanism for evaluating potential remedial options at uncontrolled hazardous substance sites. The FS is conducted in two phases: 1) development and screening of alternatives, and 2) detailed analysis of alternatives.

4.1 Development and Screening of Alternatives

The NCP requires that alternatives be developed that protect human health and the environment by recycling waste or by eliminating, reducing, and/or controlling risks posed by a site. The number and type of alternatives should be determined at each site taking into consideration the scope, characteristics, and complexity of the problems at the site. The steps in the development and screening of alternatives include the following: identification of ARARs, identification of remedial action objectives, development of general response actions, identification of screening technologies and process options, and assemblage of selected technologies into alternatives.

4.1.1 Identification of ARARs

CERCLA Section 121 requires that remedial actions comply with the requirements of all federal and duly established state environmental regulations. These regulations are referred to as Applicable or Relevant and Appropriate Requirements (ARARs). Requirements that are applicable to a release or remedial action include those that specifically address the hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at the site.

Relevant and appropriate requirements include those that are not applicable but may address problems or situations sufficiently similar to the circumstances of the release or remedial action and/or are well suited to the site. In addition to ARARs, other advisories, criteria, or guidance may be considered for a particular site. This category is referred to as the To Be Considered (TBC) category. Materials that fall into this category may also be used to develop the final remedy for the site.

The ARARs for the site are divided into three categories: chemical specific, location specific, and action specific. Chemical specific ARARs include regulations governing materials possessing certain chemical or physical characteristics or containing specific chemical compounds. Location specific ARARs are activity restrictions or design requirements based on the geographic or physical position of the site. Action specific ARARs are technology based and establish performance or design criteria for the management of the remedial action. ARARs and TBCs for the site are presented in Tables 4-1 through 4-4.

Table 4-1
Potential Chemical Specific ARARs

Former Gulf States Creososting Site
Hattiesburg, Mississippi

Standard, Requirement Citation, or Limitation	Citation	Description	Applicable	Relevant and Appropriate
Federal ARARs				
Safe Drinking Water Act				
National Primary Drinking Water Standards	40 CFR Part 141	Establishes health based standards for public water systems (maximum contaminant levels). MCLGs set at zero are not appropriate for target remedial goals at CERCLA sites.	No	Yes
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes welfare based standards for public water systems (secondary maximum contaminant levels).	No	No
Clean Water Act	33 USC 1251 - 1376			
Water Quality Criteria	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	No	Yes
Resource Conservation and Recovery Act (RCRA) as amended	42 USC 6905, 6912, 6924, 6925			
RCRA Ground Water Protection	40 CFR Part 264	Provides for the protection of ground water at solid waste management units.	No	Yes
RCRA SWMU Requirements	40 CFR Part 257	Provides for ground water protection standards, general monitoring requirements and technical requirements.	No	Yes
Hazardous Remediation Waste Management Requirements (HWIR-Media)	40 CFR Part 264, 270	Provides for corrective action management unit, staging piles, and remedial action plans	No	Yes
Clean Air Act	40 USC 1857			
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Act sets primary and secondary air standards at levels to protect public health and public welfare, respectively.	No	Yes
State ARARs				
Voluntary Cleanup and Redevelopment Program	MCA Section 49-35-21	Establishes risk-based remediation requirements.	Yes	No
Mississippi Ambient Air Quality Standards	APC-S-4	Establishes ambient air quality standards.	Yes	No

Table 4-2
Potential Action Specific ARARs

Former Gulf States Creososting Site
Hattiesburg, Mississippi

Standard, Requirement Citation, or Limitation	Citation	Description	Applicable	Relevant and Appropriate
Federal ARARs				
Clean Water Act	33 USC 1251 - 1376			
Requires use of Best Available Treatment Technology (BACT)	40 CFR 122	Use of best available technology economically achievable is required to control discharge of toxic pollutants to POTW.	Yes	No
National Pollutant Discharge Elimination System Permit Regulations	40 CFR 122 Subpart C	Use of best available technology economically achievable is required to control discharge of toxic pollutants to POTW.	Yes	No
Discharge must be consistent with the requirements of a water quality management plan approved by EPA.	40 CFR 122	Discharge must comply with EPA approved Water Quality Management Plan.	Yes	No
Discharge must be monitored and meet water quality standards	40 CFR 122	Discharge must comply with Water Quality Criteria.	Yes	No
Resource Conservation and Recovery Act (RCRA) as amended	42 USC 6905, 6912, 6924, 6925			
Identification of Hazardous Waste	40 CFR 261	Federal requirement for identification and classification of hazardous wastes.	No	Yes
Treatment of Hazardous Waste in a unit	40 CFR 264	Rules and requirements for the treatment of hazardous wastes.	No	Yes
Requirements for Generation, Storage, Transportation, and Disposal of Hazardous Waste	40 CFR 263, 264	Regulates storage, transportation, and operation of hazardous waste generators.	No	Yes
Land Disposal Restrictions	40 CFR 268	Establishes treatment standards for hazardous wastes and alternative treatment standards for contaminated soil.	No	Yes
Closure and Post Closure Requirements	40 CFR 264	Establishes standards for clean closure, closure with waste inplace, and post closure care.	No	Yes
Incineration	40 CFR 264.340 - 345	Establishes performance standards for incinerators.	No	Yes
State ARARs				
Wastewater regulations for NPDES Permits, Underground Injection Control Permits, Water Quality Based Effluent Limitations and Water Quality Certification		Establishes state standards for discharge of wastewater.	Yes	No
Hazardous Waste Management Regulations		Establishes state standards for generators and transporters of hazardous waste.	No	Yes
Solid Waste Management Regulations		Establishes minimum state criteria for all facilities that manage solid waste.	No	Yes
Mississippi Air Emission Regulations for the Prevention, Abatement and Control of Air Contaminants	APC-S-1	Establishes state standards for control of air emissions	Yes	No

Table 4-3
Potential Location Specific ARARs

Former Gulf States Creosoting Site
Hattiesburg, Mississippi

Standard, Requirement Citation, or Limitation	Citation	Description	Applicable	Relevant and Appropriate
Federal ARARs				
Clean Water Act				
Dredge or Fill Requirements	40 CFR 230	Requires permit for discharge of dredged or fill material into aquatic environment	No	No
Resource Conservation and Recovery Act (RCRA) as amended				
Location Standards	40 CFR 264.18 (b)	A TSD facility must be designed, constructed, operated, and maintained to avoid washout.	No	Yes
Fish and Wildlife Coordination Act				
Floodplain Management	40 CFR 6.302	Actions that are to occur in a floodplain should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial value.	No	No
Wetlands Protection	40 CFR 6, Appendix A	Requires that activities should be conducted to avoid to the extent possible adverse impacts associated with the destruction or modification of wetlands.	No	No
Sole Source Aquifer	Pub L No. 100-572 (1988)	Establishes procedures for development, implementation and assessment of programs designed to protect sole or principal source aquifers.	No	No

Table 4-4
To Be Considered Criteria and Guidance

Former Gulf States Creososting Site
Hattiesburg, Mississippi

Standard, Requirement Citation, or Limitation	Document No.	Date	Description
Federal TBCs			
RCRA Ground Water Monitoring Technical Enforcement Guidance Document	EPA/530-SW-86-055	September 86	Describes the essential components of a ground water monitoring system to meet the goals of RCRA.
Management of Remediation Waste under RCRA memorandum from Fields to RCRA/CERCLA Senior Policy Managers	None	October 14, 1998	Describes policy for evaluating material to determine if a material is a listed hazardous waste.
Treatment Technology Performance and Cost Data for for Remediation of Wood Preserving Sites	EPA/625/R-97/009	October 97	Presents data on remedial alternatives for wood preserving sites including cost and performance data.
OSWER Directives on RCRA	Various	Various	Describe USEPA policy and procedures including guidance and clarification.
Regulatory Development Branch Memorandums on RCRA	Various	Various	Provides interpretations on RCRA regulatory issues.
State TBCs			
Guidance for Remediation of Uncontrolled Hazardous Substance Sites in Mississippi	None	September 90	Presents the process for remediation of uncontrolled hazardous substance sites in Mississippi.

4.1.2 Identification of Remedial Action Objectives

The objectives of any proposed remedial actions for specific media at the site must include the following:

1. Identify those site-related COPCs that may pose risks to human health and the environment;
2. Define the scenarios of potential human and environmental exposure to site-related COPCs including the exposure route and the receptor;
3. Define an acceptable contaminant level or range of levels for each exposure route identified in the baseline risk assessment.

Site-related COPCs that may pose risks to human health or the environment have been identified through completion of Phase I and Phase II Remedial Investigations at the site. The baseline risk assessment defined the scenarios for actual and potential exposure of human receptors and the environment to site-related COPCs.

The acceptable range of contaminant levels for each exposure route has been defined as cumulative site carcinogenic risk level of less than 10^{-6} cancer risk for each individual COPC. This objective can be accomplished by either reducing the actual exposure of the site-related constituents to human and environmental receptors, by reducing concentrations of site-related COPCs, or by a combination thereof.

4.1.3 Development of General Response Actions

General response actions are defined as actions that satisfy the remedial action objectives. General response actions for the impacted media at the site include the following:

1. No action
2. Institutional control
3. Containment
4. Removal
5. Onsite treatment
6. Offsite treatment
7. In situ treatment
8. Onsite disposal
9. Offsite disposal

4.1.4 Identification and Screening of Technologies and Process Options

Remedial technologies and process options for soil and ground water are identified and screened in Table 4-5 and 4-6, respectively. These technologies and process options were rejected or retained for further evaluation and analysis based on technical implementability and best professional judgement. In general, one representative process option was selected for each technology type.

Table 4-5

Soil Technologies and Process Options
Initial Screening

Former Gulf States Creosoting Site
Hattiesburg, Mississippi

General Response Actions	Technology	Process Option
No Action	No Action	No Action
Institutional Controls	Site Access and Use Restrictions	Land Use Restrictions
		Fencing
	Environmental Monitoring	Air, Soil, and Surface Water Monitoring
Containment	Capping	Asphalt
		Concrete
		Clay
	Barrier System	Vertical Barrier
	Gradient Control	Extraction Wells
		Subsurface Drains
	Surface Controls	Surface Water Diversion/Collection System
Removal	Excavation	Removal of Subsurface Soils
	Recovery	NAPL Recovery
Onsite Treatment	Biological	Land Farming
Offsite Treatment	Thermal	Incineration
In Situ Treatment	Biological	In Situ Bioremediation
Onsite Disposal	Disposal	Onsite RCRA landfill
Offsite Disposal	Disposal	Industrial Waste Landfill
		RCRA Hazardous Waste Landfill

Table 4-6

Ground Water Technologies and Process Options
Initial Screening

Former Gulf States Creososting Site
Hattiesburg, Mississippi

General Response Actions	Technology	Process Option
No Action	No Action	No Action
Institutional Controls	Ground Water Use Restrictions	State Imposed Use Restrictions
	Environmental Monitoring	Ground Water Monitoring
Containment	Gradient Controls	Extraction Wells
		Injection Wells
Removal	Extraction	Extraction Wells
	Recovery	NAPL Recovery System
Onsite Treatment	Physical/Chemical	Activated Carbon
		Filtration
Offsite Treatment	Thermal	Incineration
In Situ Treatment	Biological	In Situ Bioremediation
Onsite Disposal	Discharge	Surface Water
Offsite Disposal	Discharge	POTW
	Recycle	Reuse NAPLs

Process options selected during the screening process include EPA presumptive remedies. Presumptive remedies for soils, sediments, and sludges at wood preserving sites include biological treatment, thermal desorption, and incineration. EPA has identified these presumptive remedies because they were highly effective at treating similar wastes at other CERCLA sites. EPA guidance indicates that presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

4.1.5 Assemblage of Selected Technologies into Alternatives

Based on the results of the identification and screening of technologies and process options, selected technologies have been assembled into alternatives. The definition of each alternative is presented in Sections 4.1.5.1 and 4.1.5.2.

4.1.5.1 Soil Remedial Action Alternatives

S-1 No Action - Site is left in its current condition. The NCP requires that the No Action alternative be retained and used as a baseline alternative for comparison.

S-2 Cap System - Installation of a cap system over the contaminated soil to prevent direct contact and minimize infiltration and contaminant migration.

S-3 NAPL Recovery System and In Situ Biological Treatment - Installation of a NAPL recovery system combined with in-place biological treatment of the contaminated soil.

S-4 Limited Removal and Offsite Disposal - Limited excavation of contaminated soils by conventional methods and disposal in an approved waste landfill.

S-5 Removal and Offsite Disposal/Treatment - Excavation of contaminated subsurface soils by conventional methods, treatment by approved methods (e.g., incineration, thermal desorption), and disposal in an approved waste landfill.

4.1.5.2 Ground Water Remedial Action Alternatives

GW-1 No Action - Site is left in its current condition. The NCP requires the No Action alternative be retained and used as a baseline alternative for comparison.

GW-2 Natural Attenuation and Ground Water Monitoring – Monitoring of certain ground water parameters that are indicative of the natural attenuation of contaminants. In addition, contaminant levels are monitored over time to observe meaningful trends.

GW-3 NAPL Recovery and Offsite Disposal – Installation of a NAPL recovery system combined with offsite disposal or recycling.

GW-4 Gradient Control and Physical/Chemical Treatment - Extraction wells pump contaminated ground water and effectively contain the spread of contaminant migration. In

addition, the ground water is treated by physical/chemical treatment, if necessary, and discharged to the POTW.

GW-5 Vertical Barrier System, Extraction, and Physical/Chemical Treatment - Installation of a vertical barrier around the perimeter of the contaminated soil and ground water to minimize the contaminant migration, combined with the extraction and physical/chemical treatment of the contaminated ground water.

4.2 Detailed Analysis of Alternatives

The detailed analysis of alternatives phase consists of the evaluation and presentation of information necessary to select an appropriate site remedy. During the detailed analysis, alternatives are assessed against nine specific evaluation criteria (see Section 4.2.1).

(Note: Since the available site data was determined to be adequate to evaluate remedial alternatives, no treatability investigations were conducted. However, prior to implementation, treatability studies may be conducted to determine the most effective process option for a selected technology).

4.2.1 Overview of Evaluation Criteria

Overall Protection of Human Health and the Environment
This evaluation criterion is used to determine if the alternative provides adequate protection of human health and the environment. The comparison of alternatives presented herein considered the results of the baseline risk assessment in evaluating whether an alternative meets this requirement.

Compliance with ARARs
This evaluation criterion is used to determine if an alternative meets all federal and state ARARs. Each alternative was evaluated to determine whether it complied with the ARARs presented in this report.

Long Term Effectiveness
The evaluation of alternatives under this criterion addresses the results of remedial action in terms of the residual risk at the site after the completion of the remediation. This criterion includes the following two components:

1. Magnitude of residual risk from untreated waste or treatment residuals
2. Adequacy and reliability of controls used to manage untreated wastes and treatment residuals

Reduction of Toxicity, Mobility, and Volume through Treatment
This evaluation criterion addresses the statutory preference for selecting a remedy that permanently reduces toxicity, mobility, or volume of the hazardous substance at the site.

Short Term Effectiveness
This evaluation criterion addresses the risks associated with the construction and implementation of the alternative. This criterion also addresses the environmental impacts of the alternative and the time until remedial objectives are achieved.

Implementability
This evaluation criterion is used to evaluate the technical and administrative feasibility of implementing an alternative and the availability of various services and materials. The technical feasibility analysis is based on the following factors:

1. Construction and operation
2. Reliability of technology
3. Ease of undertaking additional remedial action

Administrative feasibility is based on the activities needed to coordinate with other parties and agencies. The availability of various services and materials includes the following:

1. Adequate offsite treatment, storage capacity, and disposal services
2. Necessary equipment and specialists
3. Potential for obtaining competitive bids
4. Prospective technologies

Cost
This evaluation criterion is used to compare the cost of the alternatives, including capital costs and operations and maintenance. An order of magnitude cost estimate should be used to compare the cost of the alternatives.

State Acceptance
This evaluation criterion addresses the technical and administrative issues and concerns of the support agency regarding each alternative.

Community Acceptance
This criterion evaluates the issues and concerns the public may have regarding each of the alternatives.

4.2.2 Analysis of Alternatives

4.2.2.1 Descriptions of Alternatives for Soil

S-1 No Action
Consideration of this alternative is required by the NCP. The site is left in its current condition and no funds are expended for monitoring, control, or remediation. This alternative is used as a baseline alternative for comparison.

S-2 Cap System
This alternative would include the installation of a cap system over the contaminated soil to minimize the infiltration and migration of contaminants from the soil. This alternative would involve containment by concrete, asphalt, or clay cap, which would also require

surface drainage controls. The collected water would drain into existing drainage features at the site. The cap would eliminate or greatly reduce the infiltration of precipitation through contaminated soil to ground water. This alternative would require periodic ground water monitoring to monitor the effectiveness of the remedy.

S-3 NAPL Recovery and In Situ Biological Treatment
This alternative would involve the installation of a NAPL recovery system. The separate phase material in the soil would be collected and recovered for offsite treatment and disposal. In addition, in situ biological treatment would be incorporated to enhance biodegradation of the contaminants in the soil by providing electron acceptors (e.g., oxygen and nitrate), nutrients, moisture, and other amendments to the soil.

S-4 Limited Removal and Offsite Disposal
This alternative consists of limited excavation of contaminated soils by conventional methods and disposal in an approved waste landfill. In order to minimize the disruption of current site activities, a limited excavation of contaminated surface soils would be undertaken in areas where soils are not currently capped or contained. The excavated materials would be analyzed and profiled for offsite disposal in an approved waste landfill.

S-5 Removal and Offsite Treatment/Disposal
This alternative consists of excavation of contaminated soils by conventional methods and disposal in an approved waste landfill. All contaminated soils would be excavated and removed from the site for disposal at an approved landfill. The potential exists that materials excavated from the site may require thermal treatment (e.g., thermal desorption, incineration) prior to disposal.

4.2.2.2 Descriptions of Alternatives for Ground Water

GW-1 No Action
Consideration of this alternative is required by the NCP. The site is left in its current condition and no funds are expended for monitoring control, or remediation. This alternative is used as a baseline alternative for comparison.

GW-2 Natural Attenuation and Ground Water Monitoring
In this alternative, certain ground water parameters that are indicative of the natural attenuation of contaminants would be monitored. Contaminant levels would also be monitored over time to observe meaningful trends. It is anticipated that contaminants would naturally attenuate after source material is removed or controlled. In addition, periodic ground water monitoring of all existing wells would be implemented. Monitoring would continue for a period of approximately 5 years.

GW-3 Vertical Barrier, NAPL Recovery, and Offsite Disposal
This alternative would consist of installation of a vertical barrier around the perimeter of the contaminated soil and ground water to minimize the contaminant migration, combined with

NAPL recovery. A NAPL recovery system would be installed behind the vertical barrier for the collection and removal of NAPL. Once recovered, the material would be managed for offsite disposal or recycle.

GW-4 Gradient Control and Physical/Chemical Treatment
Under this alternative, extraction wells would pump contaminated ground water to provide containment and control of the contaminated ground water plume. The contaminated ground water would be treated by a physical/chemical treatment (e.g., separation, filtration, activated carbon) and discharged to the POTW or re-injected to provide additional containment of the contaminant plume. Implementation of this alternative would require aquifer testing and detailed ground water flow modeling.

GW-5 Vertical Barrier, Extraction, and Physical/Chemical Treatment
This alternative would consist of installation of a vertical barrier around the perimeter of the contaminated soil and ground water to minimize the contaminant migration, combined with physical/chemical treatment (e.g., separation, filtration, activated carbon) of the contaminated ground water. This alternative would consist of construction of a vertical barrier by sheet piling to minimize the potential for migration of contaminants. In addition, physical/chemical treatment would be used to treat the water and discharge to the POTW. Implementation of this alternative may require aquifer testing and detailed ground water flow modeling.

4.2.3 Comparison of Alternatives

Seven of the nine criteria outlined in Section 4.2.1 were used to evaluate each alternative. Evaluation of state and community acceptance were not addressed in this feasibility study. A summary of the evaluation of each alternative is presented for soil and ground water in Tables 4-7 and 4-8, respectively.

4.2.3.1 Comparison of Alternatives for Soil

Overall Protection of Human Health and the Environment
Alternatives S-3, S-4, and S-5 would provide the most protection to human health and the environment. Alternative S-4 is acceptable but may need to be combined with more protective ground water alternatives. Alternative S-2 would also be protective of human health and the environment by preventing direct contact with contaminated soil.

Compliance with ARARs
All alternatives, except S-1 No Action, meet the requirements of the ARARs presented in this report.

Long Term Effectiveness
Alternatives S-3 and S-5 provide the highest degree of long term effectiveness because both alternatives use treatment to reduce the hazards posed by site contamination. Alternative S-2 and S-4 provide some long term effectiveness. Alternative S-2 would require periodic

Table

Evaluation of Remedial Alternatives for Soil

Former Gulf States Creosoting Site
Hattiesburg, Mississippi

Criteria	S-1 No Action	S-2 Cap System	S-3 NAPL Recovery and In Situ Biological Treatment	S-4 Limited Removal and Offsite Disposal	S-5 Removal and Offsite Treatment/Disposal
Overall Protectiveness	No significant reduction in risk and presents a continued potential source of ground water contamination.	Reduces dermal contact and soil ingestion risk by eliminating exposure pathway.	Reduces risk by removal and treatment.	Reduces risk by excavation and disposal	Reduces risk by excavation, treatment, and disposal
Compliance with ARARs	Does not meet any ARARs since there is no action.	Meets all ARARs	Meets all ARARs	Meets all ARARs	Meets all ARARs
Long Term Effectiveness	Risk will remain and potentially increase.	Risk eliminated as long as cap is maintained. Inherent hazard of waste remains. Reliability of cap can be high if maintained.	Risk reduced through removal and treatment.	Risk reduced through removal and disposal.	Risk reduced through removal, treatment, and disposal.
Reduction of Toxicity, Mobility, or Volume	None, except through natural attenuation since there is no action.	Containment would reduce the mobility of contaminants but no reduction in toxicity or volume achieved.	Removal and treatment reduce the toxicity, mobility and volume of the contaminants.	Removal would reduce the toxicity, mobility, and volume of contaminants at the site. Toxicity and volume will be transferred to an approved disposal facility	Removal would reduce the toxicity, mobility, and volume of contaminants at the site. Toxicity will be reduced via treatment prior to disposal in an approved disposal facility.
Short Term Effectiveness	Continued impact from existing conditions	Temporary increase in dust and odor due to construction of containment.	Temporary increase in dust and odor due to construction of recovery system and treatment. Remedy may require longer time period to accomplish remedial action objectives.	Temporary increase in dust and odor due to construction of containment.	Temporary increase in dust and odor due to construction of containment.
Implementability	No approval, services, or capabilities required.	Services and capabilities readily available.	Services and capabilities readily available. May require specialized services and materials for implementation of in situ biological treatment.	Services and capabilities readily available.	Services and capabilities readily available.
Cost	None	Medium	Medium	Medium	High

Evaluation of Remedial Alternatives for Ground Water

Former Gulf States Creosoting Site Hattiesburg, Mississippi

Criteria	GW-1 No Action	GW-2 Natural Attenuation and Ground Water Monitoring	GW-3 Vertical Barrier, NAPL Recovery, and Offsite Disposal	GW-4 Gradient Control Physical/Chemical Treatment	GW-5 Vertical Barrier, Extraction, and Physical/Chemical Treatment
Overall Protectiveness	No significant reduction in risk and presents a continued source of offsite migration.	No significant reduction in risk and presents a continued source of offsite migration.	Reduces risk by removal	Reduces risk by containment and treatment	Reduces risk by containment and treatment
Compliance with ARARs	Does not meet any ARARs since there is no action.	May not meet ground water protection standards set forth in RCRA and Mississippi regulations.	Meets all ARARs	Meets all ARARs	Meets all ARARs
Long Term Effectiveness	Risk will remain and potentially increase.	Risk will remain and potentially increase. Biodegradation of contaminants will occur with favorable conditions.	Risk reduced through removal.	Risk reduced through treatment and containment.	Risk reduced through treatment and containment.
Reduction of Toxicity, Mobility, or Volume	None, except through natural attenuation since there is no action.	No reduction in toxicity, mobility, or volume.	Removal would reduce the toxicity and volume of contaminants.	Containment would reduce the mobility of contaminants and treatment reduces the toxicity and volume.	Containment would reduce the mobility of contaminants and treatment reduces the toxicity and volume.
Short Term Effectiveness	Continued impact from existing conditions	Remedy may require longer time period to accomplish remedial action objectives.	Temporary increase in dust and odor due to installation of recovery system.	Temporary increase in dust and odor due to installation of vertical barrier.	Temporary increase in dust and odor due to installation of vertical barrier.
Implementability	No approval, services, or capabilities required.	Services and capabilities readily available.	Services and capabilities readily available.	Services and capabilities readily available.	Services and capabilities readily available.
Cost	None	Low	Medium	Medium	Medium

inspection and maintenance of the cap system to ensure continued control of infiltration and prevention of direct contact with site contaminants.

Reduction of Toxicity, Mobility, and Volume through Treatment
Alternatives S-3 and S-5 use treatment and removal to reduce the mass of contaminated material at the site. Alternative S-4 uses no treatment technology but only transfers the contaminated soil to an approved disposal facility where it would be contained. Alternative S-2 does not reduce toxicity but controls by containment and would cause reduction of toxicity in the ground water by natural attenuation.

Short Term Effectiveness
Alternative S-3 is anticipated to have the greatest short term effectiveness. These options present the least amount of risk to workers, the community, and the environment. Alternatives S-4 and S-5 could release organic compounds during excavation and loading activities. However, remedial alternatives S-2, S-4, and S-5 could be implemented in a relatively short period of time. Alternative S-3 can be initiated in the same time frame as the other alternatives, but would require the most time to achieve remedial action objectives.

Implementability
All remedial alternatives are fairly simple to implement. Alternative S-3 is more complex due to the in situ biological treatment component. Alternative S-2 would require implementation of an inspection and maintenance program after completion of the project. All alternatives would require some ground water monitoring program to determine the effectiveness of the remedy with regard to migration of contaminants.

Cost
Unit costs from estimating guidance and EPA case studies were used to develop engineering cost estimates for each alternative (see Table 4-9). Alternative S-5 was the most expensive alternative. Alternatives S-2, S-3, and S-4 were significantly lower than Alternative S-5.

It is important to note that there are significant costs associated with imposing land use restrictions on the impacted portions of the site. Except for alternative S-5, all the soil alternatives considered would require the implementation of land use restrictions.

4.2.3.2 Comparison of Alternatives for Ground Water

Overall Protection of Human Health and the Environment
All alternatives, except GW-1 No Action, provide protection to human health and the environment. Alternatives GW-3, GW-4 and GW-5 are most protective due to the use of treatment or offsite disposal. Alternative GW-3 would remove source material but rely on natural attenuation to reduce concentrations in the ground water.

Table 4-9
Engineering Cost Estimates for Various Remedial Alternatives

Former Gulf States Creosoting Site
Hattiesburg, Mississippi

	Soil Remedies	Fill Area	Process Area	Southern RR Track Area
S-1	No Action	$0	$0	$0
S-2	Cap System	$200,000	$400,000	$300,000
S-3	NAPL Recovery and In Situ Biological Treatment	$300,000	$700,000	$400,000
S-4	Limited Removal and Offsite Disposal	$2,000,000	$500,000	$200,000
S-5	Removal and Offsite Treatment/Disposal	$5,000,000	$11,000,000	$1,500,000

	Ground Water Remedies		
G-1	No Action	$0	$0
G-2	Natural Attenuation and Ground Water Monitoring	$200,000	$200,000
G-3	Vertical Barrier, NAPL Recovery, and Offsite Disposal	$1,500,000	NA
G-4	Gradient Control, Physical/Chemical Treatment	NA	$1,500,000
G-5	Vertical Barrier, Extraction, and Physical/Chemical Treatment	$3,000,000	$3,000,000

Notes:
1. Costs in this table do not reflect those associated with cleanup of the northeast drainage ditch outlined in a separate *Removal Action Work Plan*

Compliance with ARARs

All alternatives, except GW-1 No Action and GW-2 Natural Attenuation and Ground Water Monitoring, meet the requirements of the ARARs presented in this report. Alternative GW-1 and GW-2 may not meet the requirements for ground water protection set forth in RCRA and the Mississippi Voluntary Cleanup and Redevelopment Program but may be acceptable when combined with other alternatives.

Long Term Effectiveness

Alternatives GW-3, GW-4 and GW-5 provide the highest degree of long term effectiveness due to the use of treatment and installation of recovery systems. Alternative GW-2 would rely on natural attenuation, which may be appropriate when combined with a more protective soil remedy.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives GW-4 and GW-5 use treatment to reduce the toxicity and volume. In addition, these alternatives use barrier systems to reduce the mobility of contaminated ground water. Alternative GW-3 uses a recovery system to reduce the toxicity and volume of the contaminants and a vertical barrier to reduce the mobility of the contaminants. Alternative GW-2 does not reduce the contaminant mobility and would use natural attenuation to reduce toxicity and volume.

Short Term Effectiveness

Alternatives GW-3 and GW-5 are anticipated to have the greatest short term effectiveness since they incorporate extraction of NAPL. Extraction of NAPL would remove a source of contamination in the ground water and may improve the effectiveness of the physical/chemical treatment system. The time required to accomplish remedial action objectives would be shorter with alternatives GW-3, GW-4 and GW-5.

Implementability

Alternatives GW-2 would be the simplest to implement since it only requires the implementation of a ground water monitoring program. Alternative GW-3 would be more complex due to the installation of the vertical barrier and recovery system. Alternatives GW-4 and GW-5 are the most complex. These alternatives would require installation and operation of extraction and injection wells.

Cost

Unit costs from estimating guidance and EPA case studies were used to develop engineering cost estimates for each alternative (see Table 4-9). Alternatives GW-4 and GW-5 were most expensive due to anticipated material use with physical/chemical treatment. Alternatives GW-3 was less expensive due to the reduced cost of operating the recovery system and reduced amount of material to be managed. GW-2 was the least expensive remedial alternative.

It is important to note that there are significant costs associated with imposing land use restrictions on the impacted portions of the site. All the ground water alternatives

considered would require the implementation of land use restrictions, at least until such time that constituent concentrations were reduced to levels below appropriate risk-based goals.

4.3 Selection of Preferred Remedy

The preferred alternatives for each area of the site are presented below. The selected alternatives are based on the comparison of alternatives combined with risk management considerations developed from the results of the baseline risk assessment. In some cases, a combination of alternatives was selected due to considerations of overall protection of human health and the environment, long term effectiveness, and cost.

4.3.1 Fill Area

Remedial alternative S-3, NAPL Recovery and In Situ Biological Treatment, is selected for soil in the fill area. The recovery of NAPL will allow natural biodegradation to occur more rapidly. Biological treatment is one of the presumptive remedies for the site.

For the ground water beneath the fill area, alternative GW-3, Vertical Barrier, NAPL Recovery, and Offsite Disposal, is selected. This remedy is selected due to the presence of perched NAPLs and in consideration of the shallow geology and hydrogeology beneath the fill area. In addition to the selected alternative, a ground water monitoring program will be implemented to continue the assessment of ground water conditions at the site.

4.3.2 Former Process Area

Remedial alternative S-3, NAPL Recovery and In Situ Biological Treatment, is selected for the soil in the former process area. Prior to undertaking remedial activities, additional investigations will be conducted to determine the presence and "recoverability" of NAPL. In areas where the existing asphalt cap or building foundations preclude direct contact with impacted soils, NAPL recovery will be undertaken. The asphalt pavement will also be inspected periodically and evaluated for overall integrity. In areas where impacted surface soils are exposed, in situ biological treatment will be performed. This remedy was selected because of short term effectiveness and ease of implementation, and will result in minimal disruption of the existing use of the property.

For ground water at the former process area, alternative GW-2, Natural Attenuation and Ground Water Monitoring is selected. This remedy was selected because of the limited offsite impact and the lack of potential receptors.

4.3.3 Northeast Drainage Ditch

For the sediment and soil in the northeast drainage ditch, alternative S-4, Limited Removal and Offsite Disposal, is selected. This remedy will eliminate the potential for direct contact with impacted media. After removal of the affected soil and sediment, a culvert will be installed to provide for drainage. The area surrounding the culvert will then be backfilled and planted with grass.