NR 700 REMEDIAL ACTION OPTIONS REPORT AND REMEDIAL ACTION PLAN FOR THE CHURCHYARD AND LOGEMANN BROTHERS PROPERTY SAUKVILLE, WISCONSIN

PREPARED FOR
GEORGIA GULF CORPORATION
ATLANTA, GEORGIA

PREPARED BY
RMT, INC.
MADISON, WISCONSIN

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EXECUTIVE SUMMARY

Georgia Gulf Corporation is a previous owner of the former Freeman Chemical Corporation facility in Saukville, Wisconsin. The chemical plant is now owned by Cook Composites and Polymers (CCP). Georgia Gulf is performing remedial actions at two off-site locations near the CCP plant—the Logemann Brothers property and the Churchyard.

Areas of Concern (AOCs) at the Logemann Brothers property include a former air curtain incinerator and an ash pile from the incinerator. Between 150 and 200 cardboard containers, reportedly containing inert materials, were buried near the former air curtain incinerator. Low levels of VOCs have been detected in unsaturated soil at both the former air curtain incinerator and the ash pile, and metals are present at background levels or at levels below the NR 700 generic soil cleanup standards. No data is available on groundwater chemistry at either the ash pile or the former air curtain incinerator. The remedial action objective for soil at the Logemann Brothers property is to prevent exposure to the waste materials. Because of the low levels of contamination present in this AOC, the remediation will consist of removal of the ash pile, the buried containers, and the incinerator structure and soil immediately adjacent to the incinerator; the excavated materials will be disposed of as solid waste. Soil samples will be collected for VOC analysis to confirm that residual contamination is not left behind after excavation.

The Churchyard is an area where overland flow and infiltration of solvents from the former urethane laboratory and former hazardous waste incinerator have contaminated soil and groundwater with high levels of VOCs and much lower levels of SVOCs. Groundwater in this area is captured by the active groundwater recovery system at the CCP facility. The primary remedial action objective for this AOC is to prevent exposure to contaminated soil, and a secondary objective is to reduce the mass of contaminants available to leach to groundwater. The remedial action will consist of soil excavation to the historical high water table and installation of a low-permeability liner to prevent recontamination of the clean soil used to backfill the excavation. The excavated soil will be taken to a biopile for treatment, and, after treatment, will be used as landfill daily cover.

Section 1
INTRODUCTION

1.1 Background

Georgia Gulf is responsible for undertaking remedial action at two Areas of Concern (AOCs) in Saukville, Wisconsin. The AOCs have been affected by historical manufacturing activities at what is now known as the Cook Composites and Polymers facility (CCP), formerly called the Freeman Chemical Corporation, in Saukville (Figure 1). Georgia Gulf was an owner of the former Freeman Chemical Company from 1988 to 1990.

Prior investigative work at these AOCs was undertaken as part of a comprehensive RCRA Facility Investigation (RFI) by CCP. The RFI report was submitted to Wisconsin Department of Natural Resources (WDNR) on October 30, 1995 (RMT, 1995). Conditional approval for the RFI was granted by the WDNR on March 22, 1996.

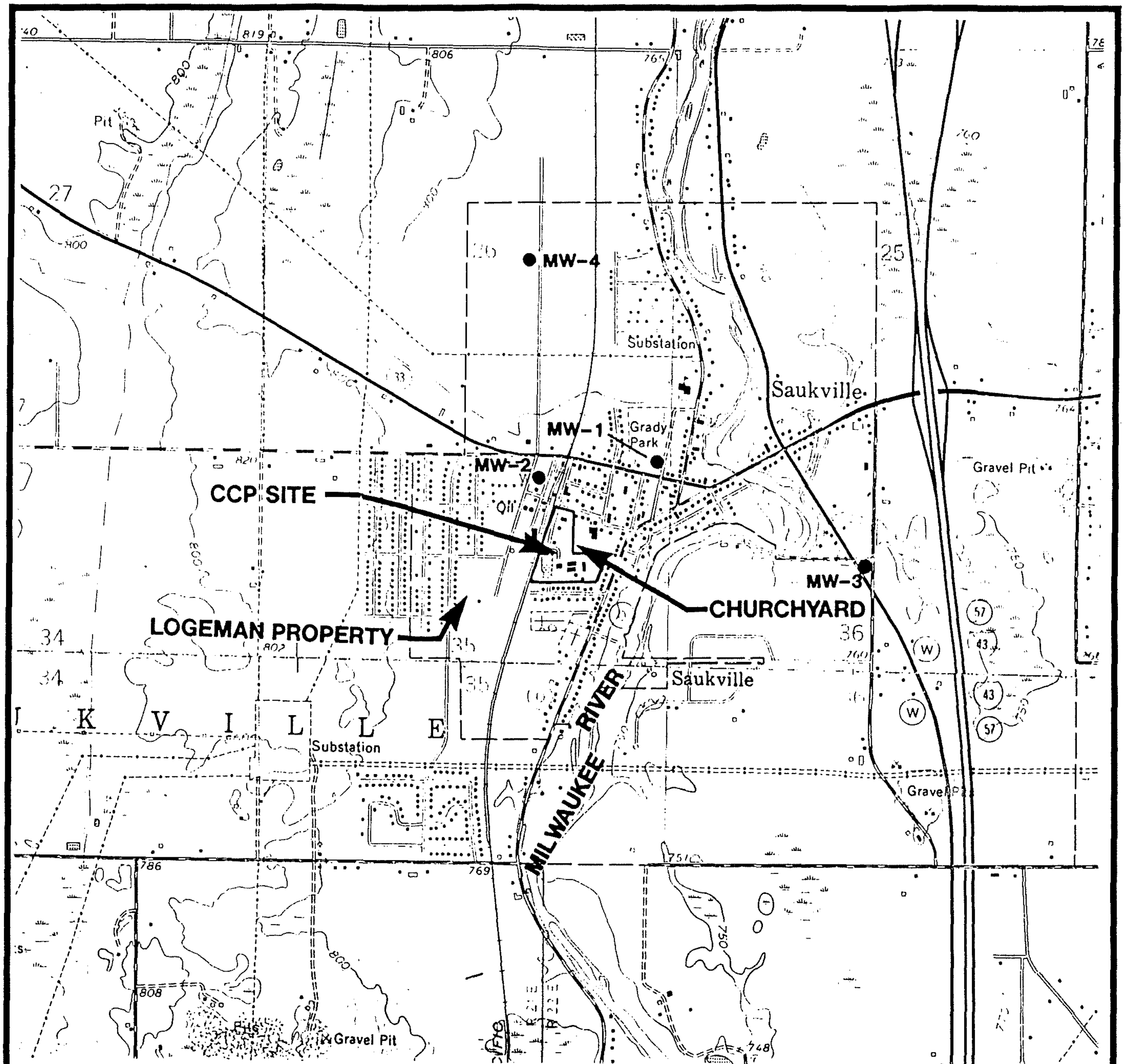
For the remainder of this report, the terminology of the RFI will be used. The Logemann Brothers property will be referred to as AOC 4. The churchyard parcel will be referred to as AOC 5.

1.2 Purpose and Scope

The purpose of this report is to evaluate and select a remedial action for the Churchyard and Logemann AOCs. This process is in general accordance with the requirements of WAC NR 700 and NR 500, respectively.

The scope of this report is intended to satisfy the content requirements of NR 722.13 (Remedial Action Options Report) and NR 724.09 (Design Report). It includes the following components:

- Calculation of site-specific soil cleanup standards
- Estimation of volume of soil exceeding these standards
- Screening of likely remedial technologies
- Evaluation of remedial options



STATE LOCATION

0 2000 4000

SCALE: 1"=2000'

SITE LOCATION MAP
GEORGIA GULF CORPORATION
SAUKVILLE, WISCONSIN

SOURCE: BASE MAP FROM PORT WASHINGTON WEST AND CEDARBURG, WISCONSIN 7.5 MIN. USGS QUADRANGLE.

RMT INC.

DWN. BY:	DSS
APPROVED BY:	
DATE:	MAY 1996
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FIGURE 1

- Screening of the alternatives on the basis of technical and economic feasibility, including an estimate of capital and annual costs.
- Recommendation of a preferred alternative for agreement by the WDNR.
- Design and construction details for the selected alternative.

Section 2

SUMMARY OF SITE CONDITIONS

This section summarizes the various site conditions affecting the evaluation of remedial alternatives. For more complete information, the reader is referred to the original RFI report for the project (RMT, 1995).

2.1 Site Contact

The following information describes the contact for the work on these AOCs:

Project title	NR 700 remedial action at the Churchyard and Logemann Brothers property
Location	Saukville, Wisconsin
Responsible party	Georgia Gulf Corporation 400 Perimeter Center Terrace Suite 595 Atlanta, GA 30346 ATTN: Carol R. Geiger
Consultant	RMT, Inc. 744 Heartland Trail Madison, WI 73717 608-831-4444 ATTN: Eugene L. McLinn

2.2 Regulatory Status

The Freeman Chemical Company (Freeman) entered into a Consent Agreement with the USEPA in 1987 to investigate and remediate five areas of concern (AOCs) at and near Freeman's facility in Saukville, Wisconsin (USEPA, 1987). At that time, interim remedial measures were put in place by Freeman to control the migration of contaminated groundwater and prevent further migration of solvents to the subsurface. The Freeman Chemical Company was purchased in 1988 by Georgia Gulf, who resold the Saukville plant to Cook Composites & Polymers (CCP) in 1990. At this time, CCP is responsible for the remediation of the environmental contamination at, and near, the CCP facility under the terms of the 1987

Consent Order for the site. Under the terms of the sale agreement between Georgia Gulf and CCP, CCP is responsible for the remediation of the on-site contamination, and Georgia Gulf is responsible for the remediation of the off-site contamination subject to the 1987 Consent Order.

A Corrective Measures Study (CMS) under RCRA is being prepared for CCP for the on-site AOCs. Additional information for the on-site AOCs is available in the RCRA Facility Investigation (RFI) report prepared for CCP (RMT, 1995). The on-site AOCs will not be discussed further in the current report.

The off-site areas for which Georgia Gulf is responsible are the Churchyard, which abuts the eastern edge of the CCP facility, and the Logemann Brothers property, which lies south of, and across the railroad tracks from, CCP (Figure 2). No manufacturing activities took place at either the Churchyard or Logemann Brothers property. Soil at the Churchyard has been affected by past practices that resulted in overland flow and the infiltration of solvents from the former hazardous waste incinerator and the former urethane laboratory at the former Freeman facility.

Freeman operated an air curtain incinerator at the Logemann Brothers property to dispose of solid waste from plant operations from the 1960s until 1972. Reaction water was occasionally used to quench the fire in the incinerator. Three areas at the Logemann Brothers property were affected by Freeman manufacturing activities. The concrete structure of the incinerator still stands. An estimated 150 to 200 20-gallon cardboard containers containing inert material (solidified resin) were disposed in a trench northwest of the air curtain incinerator. Finally, ash from the air curtain incinerator was deposited in the southwestern corner of the Logemann Brothers property. The Logemann Brothers property near the former incinerator and the ash pile is a cornfield.

Under the terms of the CCP's RCRA hazardous waste incinerator permit, CCP is responsible for the operation and maintenance of the groundwater recovery system, which provides hydraulic containment of the off-site and on-site groundwater contamination. Because the current groundwater recovery system provides for hydraulic containment of the VOC plume, the remedial actions being evaluated by Georgia Gulf, as discussed above, focus on reducing the potential for direct contact and source reduction through remediation of soil above the water table.

2.3 Geologic and Hydrogeologic Characteristics

Geologic and hydrogeologic characteristics are summarized as follows:

- The Churchyard is underlain by silty glaciolacustrine deposits and sandy till. The Logemann Brothers property is underlain by clayey to sandy glaciolacustrine deposits.

- The unconsolidated deposits vary between 10 and 30 feet thick in the Churchyard, and are approximately 30 feet thick at the Logemann Brothers property.

- The unconsolidated deposits are underlain by fractured, massive to thinly bedded dolomite, with a total thickness of approximately 700 feet in the study area.

- The depth to the water table in the Churchyard has varied from 5 to 15 feet below grade from 1992 to the present, as shown on a hydrograph for water table well W-37, which is located in the Churchyard (Figure 3). The depth to water at the Logemann Brothers property is estimated to be 15 feet below grade, but no observation wells are monitored near the ash pile or the former air curtain incinerator.

- Regionally, shallow groundwater flows toward the Milwaukee River. In the area of the CCP plant, groundwater flow is deflected toward the on-site groundwater extraction system. Shallow groundwater in the Churchyard flows toward the northern radial of Ranney collector RC-1 and the northeastern radial of RC-3.

- Groundwater flow near the CCP facility has a strong downward vertical component from the glacial deposits and the shallow dolomite toward the deep dolomite aquifer.

- Groundwater flow at the CCP site is strongly influenced by a groundwater recovery system. The system has three main components: three Ranney collectors that extract water from the glacial deposits; four shallow dolomite wells that extract groundwater from the shallow dolomite; and a deep dolomite well that creates inward gradients toward the site within the dolomite aquifer. Two of the Ranney collectors have radials that extend into the Churchyard. The groundwater recovery system is effective for preventing the off-site migration of groundwater affected by historical releases at the site. The shallow portions of the groundwater extraction system do not capture groundwater at the Logemann Brothers property.

Variation in Water Levels Over Time in the Churchyard

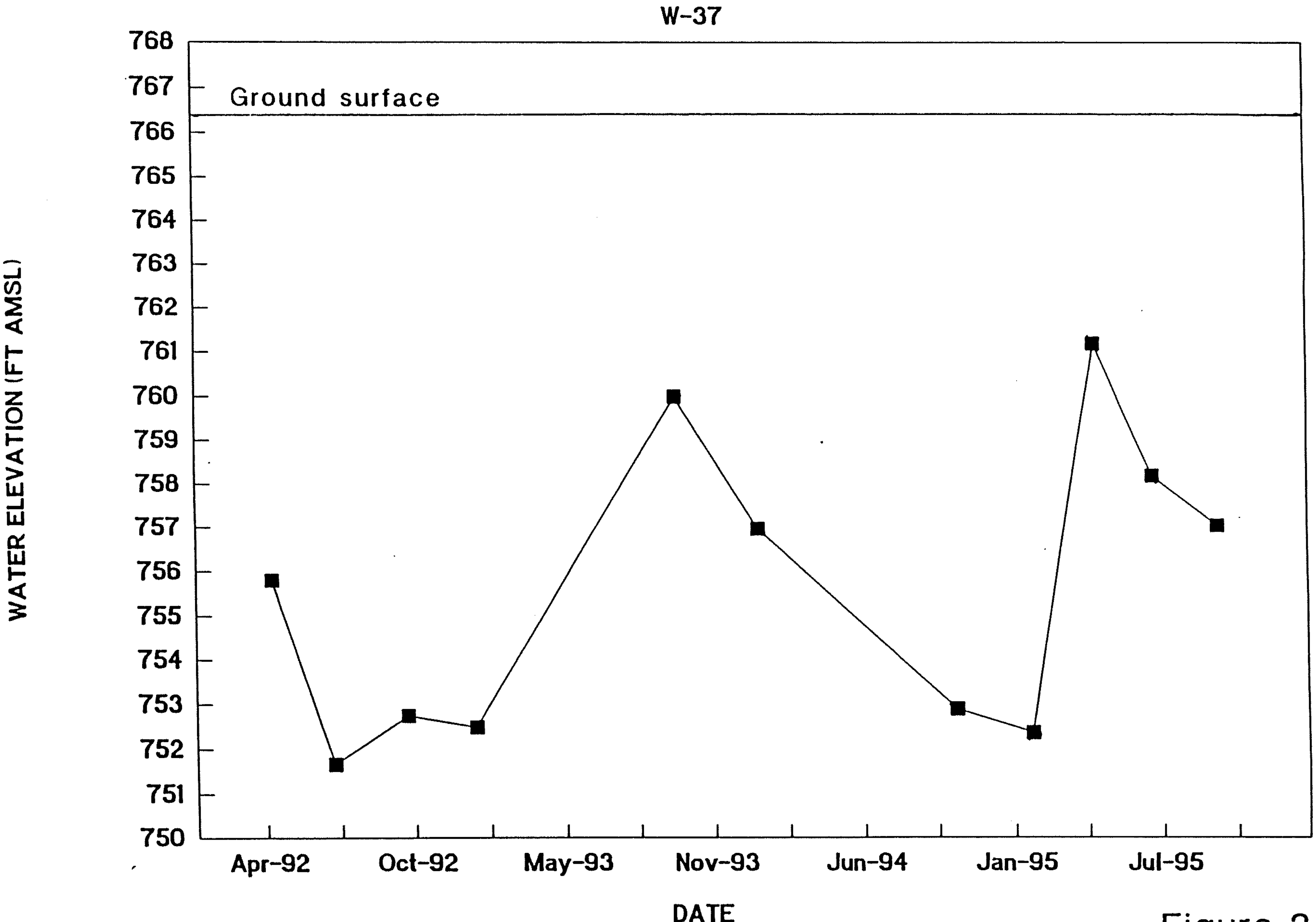

Figure 3

2.4 Nature and Extent of Contamination

The nature and extent of contamination resulting from past releases are summarized as follows:

- Soil chemistry was assessed through the collection and analysis of soil samples for Appendix IX parameters and BTEX. The maximum concentrations of VOCs in soil at AOCs 4 and 5 (Logemann Brothers property and the Churchyard) are shown on Table 1. In areas where VOC concentrations in soil exceed 1,000,000 μg/kg (or 0.1 weight percent), free product is likely present.

- At the former air curtain incinerator at AOC 4, BTEX and other VOCs were detected in unsaturated soil, but at concentrations that did not exceed NR 700 generic soil cleanup standards. Low levels of semivolatile organic compounds (SVOCs) were also detected in soil in this area. Arsenic was detected in shallow soil at the air curtain incinerator at concentrations similar to those detected in background samples.

- Between 100 and 150 cardboard containers reportedly filled with solidified resin, diatomaceous earth, and filter paper were disposed near the former air curtain incinerator at AOC 4. No soil samples were collected in this area, and there is no record of hazardous materials being disposed in this area.

- BTEX was detected in soil samples collected below the water table by the former air curtain incinerator, but no groundwater samples were collected here. The BTEX detected in these samples likely reflects the presence of BTEX in groundwater.

- At the ash pile at AOC 4, low levels (below the NR 700 generic soil cleanup standards) of BTEX and other VOCs were detected. Arsenic was detected in the ash at concentrations similar to those detected in background soil samples.

- At AOC 5, BTEX constituents were detected in shallow soil along the western edge of the ball field at concentrations to several millions of μg/kg, and the concentrations decrease to nearly nondetectable levels within 200 feet of the facility fenceline. SVOCs in shallow soil are present at levels of hundreds to thousands of μg/kg. SVOC concentrations are typically two orders of magnitude lower than BTEX concentrations in soil at the Churchyard, as shown on Figure 4. Chlorinated solvents are present at levels up to hundreds of μg/kg. Affected soil in this area is continuous with affected soil at CCP. The horizontal extent of BTEX in soil is roughly defined in this area.

TABLE 1 MAXIMUM DETECTED CONCENTRATIONS IN SOIL (μg/kg)

Analyte	Maximum Detected Concentration			NR 700 Generic Residential Cleanup Criterion	Background Concentration	Risk-Based Concentrations - Soil Ingestion (Residential) (USEPA, 1995)
	AOC 4 Ash Pile	AOC 4 Incinerator	AOC 5 Churchyard			
METALS						
Antimony	1,200	<2,400	NA	NS	<1,200	31,000
Arsenic	3,000	3,500	NA	39	2,700	430
Barium	47,000	31,000	NA	NS	56,000	5,500,000
Beryllium	<580	<1,000	NA	NS	<600	150
Cadmium	<1,200	<1,200	NA	8,000	<1,200	39,000
Chromium	12,000	12,000	NA	14,000	15,000	390,000
Cobalt	9,300	3,500	NA	NS	11,000	4,700,000
Copper	11,000	8,500	NA	NS	11,000	3,100,000
Lead	44,000	9,000	NA	50,000	14,000	NS
Mercury	<120	<120	NA	NS	<120	23,000
Nickel	12,000	11,000	NA	NS	12,000	1,600,000
Selenium	<700	<720	NA	NS	<360	390,000
Silver	<1,200	<1,200	NA	NS	<1,200	390,000
Thallium	<700	<720	NA	NS	<360	NS
Tin	<58,000	<60,000	NA	NS	<60,000	47,000,000
Vanadium	27,000	26,000	NA	NS	32,000	550,000
Zinc	50,000	35,000	NA	NS	53,000	23,000,000
SVOCS						
1,2-Dichlorobenzene	NA	<380	1,000	NS	<400	7,000,000
1,4-Dioxane	NA	1,500*	1,500*	NA	NA	58,000
2,4-Dimethylphenol	NA	<390	270	NS	<400	1,600,000
2-Methylnaphthalene	NA	<390	110	NS	<400	NS
2-Methylphenol	NA	<390	180	NS	<400	3,900,000
3-Methylphenol	NA	<780	280	NS	<800	3,900,000
Acetophenone	NA	<780	2,100	NS	<800	7,800,000
Isobutanol	NA	<1200	13,000	NS	<120	23,000,000
Naphthalene	NA	<390	860	NS	<400	3,100,000
Styrene	32	<6	<760	NA	NA	16,000,000

NOTES:
* = Sample collected from below water table.
NA = Not analyzed. NS = Not sampled.
All concentrations in μg/kg.
Concentrations in soil from RFI (RMT, 1995).

TABLE 1 MAXIMUM DETECTED CONCENTRATIONS IN SOIL (μg/kg)

Analyte	Maximum Detected Concentration			NR 700 Generic Residential Cleanup Criterion	Background Concentration	Risk-Based Concentrations - Soil Ingestion (Residential) (USEPA, 1995)
	AOC 4 Ash Pile	AOC 4 Incinerator	AOC 5 Churchyard			
VOCS						
Acetone	160	130	1,000	NA	NA	7,800,000
Benzene	5	22*	960	5.5	<6.0	22,000
Ethylbenzene	180	1,500*	56,000	2,900	<6.0	7,800,000
Tetrachloroethene	<7.5	<6.2	150	NS	<6.0	12,000
Toluene	14	39*	430,000	1,500	<6.0	16,000,000
Xylene	700	6,700*	2,800,000	4,100	<6.0	160,000,000
4-Methyl-2-pentanone	<15	37*	<1,500	NA	NA	NS
Fluorotrichloromethane	22	<6	<760	NS	NA	NS

NOTES:
* = Sample collected from below water table.
NA = Not analyzed. NS = Not sampled.
All concentrations in μg/kg.
Concentrations in soil from RFI (RMT, 1995).

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BTEX vs. SVOCs in Soil in Churchyard

Georgia Gulf - Saukville, WI

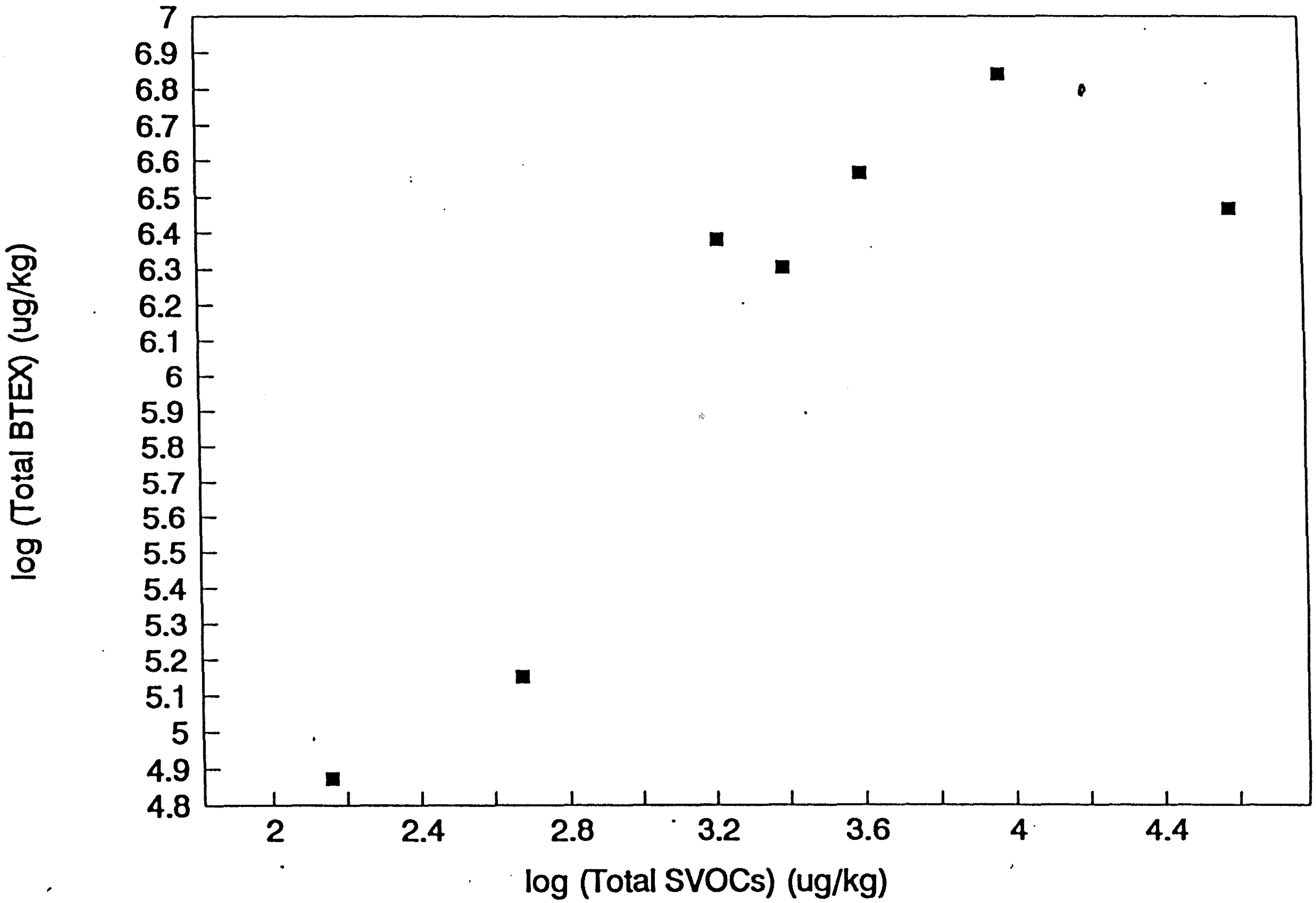

FIGURE 4

Section 3

REMEDIAL ACTION OBJECTIVES AND DESIGN BASIS

Constituents of concern (COCs) were detected in soil at AOCs 4 and 5 during the RFI. The necessity for remedial action for soil can be evaluated by comparing the concentrations detected in the unsaturated soil samples to the NR 700 generic cleanup standards for soil and by assessing potential exposure pathways.

3.1 Exposure Pathways

The presence of constituents of concern (COCs) described in Section 2 were evaluated during the RFI in the context of potential exposure pathways (RMT, 1995). The findings of this exposure assessment were as follows:

- ***AOC 4 - Logemann Brothers property - former air curtain incinerator*** - The COCs include metals and VOCs in soil, and potentially BTEX in groundwater. Local residents have unrestricted access to this area. If the area is sold and residentially developed in the future, then the potential for exposure of construction workers and residents increases significantly. Dermal contact, inhalation, and incidental ingestion are future potential exposure pathways for soil. No groundwater samples were collected in this area because no wells have been installed here to date. Shallow groundwater in the glacial deposits and the shallow dolomite at Area 4 is not controlled by the on-site recovery system. This area may be within the capture zone of the on-site deep dolomite recovery system.

- ***AOC 4 - Logemann Brothers property - ash pile*** - The COCs in this area include metals and VOCs in the ash. Low concentrations of SVOCs and VOCs were detected at depths greater than 2 feet below the ground surface. If the area is sold and residentially developed in the future, then the potential for exposure of construction workers and residents increases significantly. Local residents have unrestricted access to this location. Dermal contact, inhalation, and incidental ingestion are potential human exposure pathways to affected ash.

- ***AOC 5 - Churchyard*** - COCs in Area 5 include VOCs and SVOCs in soil and groundwater. Surface soil has been replaced to an approximate depth of 6 inches in portions of the western periphery of the Churchyard. In the depth interval from 0 to 2 feet below grade, BTEX concentrations in the millions of μg/kg have been observed in soil along the western periphery of this area. Dermal contact, incidental ingestion, and inhalation of soil vapors are potential exposure pathways. The affected area is available to be used as a playground for children at a school. If the area is sold and developed in the

BTEX was detected in saturated soil samples from this area, but groundwater samples were not collected. Consequently, impacts to groundwater in this area cannot be evaluated with the available data.

Soil samples from the Churchyard contain VOC concentrations that exceed the NR 700 generic residential cleanup criteria from shallow soil, less than 2 feet below grade, to the bedrock surface, approximately 25 feet below grade. The highest VOC levels in soil in the Churchyard were detected close to the fence that separates AOC 1, the former hazardous waste incinerator/former urethane lab, from the church property. Concentrations in soil decrease with increasing distance from the fence to nondetectable levels between 100 and 150 feet from the fence. The approximate limits of the area of affected soil are shown on Figure 2.

The water table is typically between 5 and 15 feet below grade here, as discussed in Section 2 of this report. Soil at depths greater than 5 feet below grade is at times saturated. The soil would become recontaminated after remediation when the water table rises. Consequently, the cleanup criterion for determining the vertical extent of unsaturated soil remediation will be a performance standard—the depth of the high water table, approximately 5 feet below grade. The cleanup standards for the lateral extent of remediation will be the NR 700 generic residential cleanup criteria for BTEX.

Many analytes were detected in soil samples from the on-site and off-site areas affected by manufacturing activities associated with the former Freeman Chemical Corporation. However, the most significant impacts occur in areas where reaction water was disposed. The chemical signature of areas affected by disposal of reaction water includes high concentrations of aromatic hydrocarbons, such as benzene, toluene, ethylbenzene, and xylenes. Consequently, these constituents (BTEX) have been selected as indicator parameters for confirmatory samples to verify that cleanup has been achieved.

3.3 Remedial Action Objectives

As a result of these potential exposures, the need for remedial action under NR 700 has been established. Specific remedial action objectives can be stated as follows:

- For AOC 4, the Logemann Brothers property, the primary remedial action objective is to reduce potential direct contact with surface materials.

- For AOC 5, the churchyard, the primary remedial action objective is to reduce potential direct contact with surface materials. A secondary objective is to reduce the mass of VOCs that could leach from shallow soil to the groundwater flow system.

3.4 Design Basis

The remainder of this report will develop and evaluate remedial action options which can satisfy these objectives. To define those alternatives, and later to develop cost estimates for them, it is necessary to make several quantitative assumptions regarding the extent of impacts and other site conditions. These assumptions are referred to as the "design basis" for the remedial action, and are summarized in the table at the base of Figure 2. Each of the assumptions are for preliminary planning purposes only. They are suitable only to allow a comparison among alternatives. The final scope of remedial action will be different.

The extent of the remedial action depends on the numerical standard that a response must achieve. These values have been developed according in substantial accordance with WDNR procedures and are described in Subsection 3.2.

Section 4

SCREENING OF REMEDIAL TECHNOLOGIES

This section identifies and screens an array of remedial technologies that could potentially be applied to manage contaminated soil at AOC 4 and AOC 5. These technologies were identified based on RMT's experience on other similar projects and on recent technical literature. Individual technologies will be combined in Section 5 to form remedial action options. For example, the remedial technology of excavation may be combined with an *ex situ* treatment technology to form a complete option. The selected remedial options for AOC 4 and AOC 5 will be presented in Section 6.

During the screening process, those technologies that may prove infeasible to implement, that rely on technologies that are unlikely to perform satisfactorily or reliably, or that do not achieve the remedial action objectives within a reasonable time period are eliminated. This screening process focuses on eliminating those technologies that have severe limitations for a given set of waste and site-specific conditions. The screening step may also eliminate technologies on the basis of inherent technology limitations.

4.1 Identification of Corrective Measure Technologies

4.1.1 No Corrective Action - Site Monitoring Only

This option has been included to provide a baseline against which other alternatives can be compared. In the "no action" option, remediation of the contaminated soil at AOC 4 and AOC 5 would be left to naturally occurring biological and physical site processes. Monitoring of these naturally occurring processes would be included in the "no action" alternative.

4.1.2 Containment Technologies

Technologies in this category are used to contain in place the impacted soil. The objective would be to provide a physical barrier over the impacted soil so that direct contact to the material is less likely.

This approach would, in general, be effective as long as the barrier was maintained, and was not breached by workers or other persons in the future. Specific options include the following:

- ***Soil cover*** - A soil cover may be constructed using general fill or low-permeability clay. A simple soil cover, consisting of up to several feet of new material, would make contact less likely by providing increased separation between the surface and the underlying impacted soil. A more substantial clay cover is typically used where there is an additional objective of reducing infiltration, and hence leaching, to the subsoil.

- ***Composite cover*** - A composite cover consists of a combination of low-permeability soil and a synthetic membrane. This type of cover typically provides the highest degree of effectiveness when the primary remedial objective is to reduce infiltration.

- ***Vapor barrier*** - A vapor barrier may consist of low-permeability soil or a synthetic membrane. It is often used to protect buildings or other areas from unwanted organic vapor migration and seepage. At AOC 5, it could also be used to reduce the upward migration of VOCs from the lower saturated zone or product layer.

- ***Hydraulic Barrier*** - A hydraulic barrier may be constructed to maintain a lower groundwater table elevation. A vertical low-permeability wall, such as sheet piling, in combination with a groundwater cutoff trench adjacent to AOC 5, for example, may provide additional control beyond what is already provided by the CCP Ranney collector system. Such an option does not directly reduce current soil contaminant concentrations, but would reduce the chance that additional contaminants are introduced via groundwater transport in the future.

4.1.3 Removal Technologies

Technologies in this category apply to the removal of impacted soil from the two areas of concern. Removal of the soil would achieve the remedial action objectives by eliminating the potential for future contact or leaching. The soil would be subject to a subsequent treatment or disposal option as part of an integrated alternative. Removal options include the following:

- ***Conventional excavation*** - The use of backhoes and standard earthmoving equipment would be considered conventional excavation. This technology is implementable and reliable, although access agreements for work on the Churchyard and Logemann properties would be required.

- ***Conventional excavation with dewatering*** - Excavation at AOC 5 may be constrained by the presence of high groundwater. Some impacted soil may become saturated in wet years or seasons. If excavation below the water table was required, then some form of construction dewatering would be necessary. Groundwater pumped during dewatering would likely contain volatile constituents, and would need to be disposed with other pumped groundwater at the adjacent CCP facility via the ongoing sanitary sewer discharge.

4.1.4 *In Situ* Treatment Technologies

Technologies in this category provide treatment of the soil in-place. Excavation and above grade processing would not be required. The objective of the treatment process would be to remove or degrade the volatile contaminants such that future leaching would be reduced.

- ***Soil vapor extraction (SVE)*** - With SVE, VOCs are removed from the soil through the utilization of forced or drawn air currents. A common configuration for SVE consists of a high-volume vacuum air pump that is connected through a manifold system to slotted pipe, which is buried in the zone of contamination. The piping may be placed in horizontal or vertical orientations and will draw air through the soil from an effective radius of over 100 feet in pervious soil. Miscellaneous airflow meters, bypass and flow control valves, and sampling ports are generally incorporated into the design to facilitate airflow balancing and to assess system efficiency.

  SVE is most effective in remediating soil contaminated with highly volatile products, such as gasoline or solvents. SVE can also increase the supply of oxygen necessary for bioremediation. Systems can be operated either continuously or in cycles, usually over an extended period of time, likely for years.

- ***SVE with dewatering*** - As described above, AOC 5 may be subject to seasonal or annual high groundwater. The presence of high groundwater limits the implementability of SVE for two reasons: (1) vapors cannot be extracted from soil that is already saturated; and (2) the application of a vacuum to the soil with a shallow water table may elevate the water table further to the point where it occludes the well screen.

  These conditions may be mitigated by dewatering the area. This may be accomplished by the use of external pumping wells, or by the addition of a pump to the bottom of the SVE well itself. In either event, the pumped groundwater is likely to be contaminated, and would need to be disposed with other pumped groundwater at the CCP facility via the current sanitary sewer discharge.

- ***Intrinsic bioremediation*** - Organic compounds are naturally removed from unsaturated soil over time through biological degradation. There are several factors that affect the efficiency of these natural processes, including soil porosity, depth to groundwater, infiltration rates, soil moisture content, soil temperature, and soil aeration.

  Intrinsic biological processes at AOC 4 and AOC 5 are undoubtedly already at work, reducing organic constituents of concern in the unsaturated soil over time. However, given the interim WDNR guidance on bioremediation (WDNR, 1993), intrinsic bioremediation would not be acceptable as the only remedial measure because the contamination extends through the unsaturated soil column, and has contributed to groundwater contamination at AOC 5. Therefore, intrinsic remediation alone is not considered a viable alternative for AOC 5. However, it may supplement other active remediation measures.

- ***Enhanced bioremediation*** - Enhanced bioremediation is the process by which the growth and activity of naturally occurring microorganisms are influenced by engineered processes to enhance their effectiveness in degrading contaminants within the natural environment. Certain microorganisms, through their metabolic processes, will biodegrade petroleum hydrocarbons. Biodegradation of BTEX under aerobic conditions is typically more efficient than biodegradation under anaerobic conditions. Stimulation of the growth and activity of aerobic microorganisms is accomplished through the introduction of oxygen and nutrients.

  An active bioremediation system may consist of a network of injection points that are capable of introducing water enriched with nutrients and an appropriate electron acceptor (e.g., oxygen) into the contaminated soil and groundwater. The nutrient-enriched groundwater flows from the infiltration area through the affected zone. In some cases, the amended groundwater is captured downgradient of the treatment area and is either recycled, or treated and discharged. An active system can also be created within the vadose zone alone by the periodic surface application of supplemental nutrients. Natural infiltration is then relied upon to distribute nutrients vertically across the affected soil thickness. Continued hydraulic control would be needed to prevent the spread of contaminated groundwater until the remediation is completed.

  The underlying geology and organic contaminants at AOC 4 and AOC 5 are amenable to bioremediation. However, construction of the necessary nutrient and oxygen delivery systems for the large areas involved, and the need to limit future disruption to adjacent property owners, make this a less desirable technology.

- ***Vitrification*** - Vitrification is a process by which the soil is converted to a glass-like substance via the introduction of an electric current. The converted material typically exhibits little to no leachability. It is similarly innocuous to direct contact.

- ***Biological treatment*** - Excavated soil may be biologically treated in above-grade mounds or windrows. Microbial activity may be enhanced, as described above, by supplemental nutrients or oxygen. This option is commonly applied in an on-site manner for soil volumes of up to several hundred or a few thousand cubic yards. Increasingly, off-site commercial "biopiles," which are usually located at conventional landfill facilities, are also available.

  This treatment technology would be very amenable to the organics present at this facility. However, the large volumes of soil involved would make on-site processing impractical, and off-site management may be cost prohibitive.

- ***Chemical extraction*** - Organics that are recalcitrant to treatment by other means may be removed from soil by means of chemical extraction. An extraction fluid is passed through the soil, or conversely, the soil is immersed in the fluid. The concentrated extract is then processed separately.

  This technique is usually considered for only a few compounds that are difficult to treat by any other means, and has not been widely applied. It is not an appropriate treatment option for AOC 4 and AOC 5 because far more straightforward options are available.

4.1.6 Disposal Technologies

Options in this category are for final deposition of excavated soil, which may or may not be subsequently treated. Three basic options include the following:

- ***On-site placement*** - This option involves returning treated soil to its original excavation. Implementation would require WDNR approval, since such soil may otherwise be classified as a solid waste. This option is straightforward and achieves a beneficial reuse of the material as general fill.

- ***Subtitle D facility*** - If the soil is classified as a solid waste, it must be disposed as such at a Subtitle D licensed facility. Although, in theory, Georgia Gulf could construct and permit its own facility for this purpose, this would not be a practicable option, and the only viable approach would be to dispose of the material at an existing commercial landfill.

- ***Subtitle C facility*** - If the soil is classified as a hazardous waste, it must be disposed as such at a Subtitle C licensed facility. Depending on its solvent concentration, the soil may be subject to land disposal restrictions, which require minimum treatment prior to land disposal. Again, as a practical matter, the only option for AOC 4 and AOC 5 would be disposal at an existing commercial off-site facility.

4.2 Screening of Remedial Action Technologies

The screening of technologies is summarized in Table 2. Site, waste, and technology characteristics that were used to screen inapplicable technologies are described in more detail below:

- ***Site characteristics*** - The available site data were reviewed to identify conditions that may limit or promote the use of certain technologies. Technologies that are clearly precluded by site characteristics were eliminated from further consideration.

- ***Waste characteristics*** - The identification of waste characteristics that limit the effectiveness or feasibility of technologies is an important part of the screening process. Technologies that are clearly limited by these waste characteristics were eliminated from consideration. Waste characteristics particularly affect the feasibility of *in situ* methods, direct treatment methods, and land disposal (on-/off-site).

- ***Technology limitations*** - During the screening process, the level of technology development; the performance record; and the inherent construction, operation, and maintenance problems for each technology were reviewed. Technologies that are unreliable, that perform poorly, or that are not fully demonstrated were eliminated in the screening process.

General screening ratings for the purposes of evaluating implementability, reliability, and duration within Table 2 are as follows:

- ***Implementability:***

  - Implementable - Technology has been readily implemented at other sites with similar site and waste characteristics. Site or waste characteristics at AOC 4 and AOC 5 will require minor or no modifications to the traditional technology to allow implementation.

  - Moderately implementable - Site or waste characteristics will require major modifications to the traditional technology to allow implementation.

  - Not implementable - Site or waste characteristics preclude this technology from being implemented.

  State and federal regulations that may limit or preclude the implementation of a specific technology were considered under this column of Table 2.

TABLE 2

SCREENING OF REMEDIAL TECHNOLOGIES BASED ON IMPLEMENTABILITY, RELIABILITY, AND TIME
GEORGIA GULF PROPERTIES

Technology Category	Remedial Technology[1]	Screening Basis			
		Implementability		Reliability	Duration
		AOC 4	AOC 5		
No action	No corrective action, site monitoring only	Not applicable	Not applicable	Not applicable	Not applicable
Containment technologies	Soil cover	Implementable	Implementable	Reliable	Short
	Composite cover	Implementable	Implementable	Reliable	Short
	Vapor barrier	Implementable	Implementable	Reliable	Short
Removal technologies	Conventional excavation	Implementable	Implementable	Reliable	Short
	Conventional excavation with dewatering	Implementable, if needed	Implementable, if needed	Reliable	Short
In Situ treatment technologies	Soil vapor extraction	Implementable	Implementable	Reliable	Long
	Soil vapor extraction with dewatering	Implementable, if needed	Implementable, if needed	Reliable	Long
	Intrinsic bioremediation	Moderately implementable	Moderately implementable	Moderately Reliable	Very long
	Enhanced bioremediation	Moderately implementable	Moderately implementable	Reliable	Long
	Vitrification	Not implementable	Not implementable	Reliable	Short
	Stabilization/Solidification	Not implementable	Not implementable	Reliable	Short
Ex situ treatment technologies	On-site thermal treatment	Not implementable	Not implementable	Reliable	Short
	On-site biological treatment	Not implementable	Not implementable	Reliable	Medium to long
	On-site chemical extraction	Not implementable	Not implementable	Reliable	Short
	Off-site thermal treatment	Implementable	Implementable	Reliable	Short
	Off-site biological treatment	Implementable	Implementable	Reliable	Medium to long
Disposal technologies	On-site Subtitle D facility	Not implementable	Not implementable	Reliable	Medium
	On-site Subtitle C facility	Not implementable	Not implementable	Reliable	Medium
	On-site placement	Implementable	Implementable	Reliable	Short
	Off-site Subtitle D facility	Implementable	Implementable	Reliable	Short
	Off-site Subtitle C facility	Implementable	Implementable	Reliable	Short

NOTES:

1 Shaded corrective measure technologies were eliminated on the basis of the screening of implementability, reliability, or time.

- ***Reliability:***
  - Reliable - Technology has consistently achieved the remedial action objectives at other sites with similar site and waste characteristics. Technology should achieve the remedial action objectives, given the site and waste characteristics at AOC 4 and AOC 5.
  - Moderately reliable - Technology may achieve the remedial action objectives, given the site and waste characteristics. However, modifications to the traditional technology would be necessary.
  - Not reliable - Technology limitations preclude this technology from reliably achieving the objectives.
- ***Duration:***
  - Very long - Technology will require more than 10 years, and may not achieve remedial action objectives.
  - Long - Technology can achieve remedial action objectives, but it will take between 2 to 10 years.
  - Medium - Technology can achieve remedial action objectives, and usually within 2 years.
  - Short - Technology can achieve remedial action objectives, and usually within less than 6 months.

4.3 Selection of Technologies and Assembly of Alternatives

The technologies in Table 2 were screened to determine which ones were appropriate for further consideration. The justification for the selection is as follows:

- Among the containment technologies, the use of a **vapor barrier** or **hydraulic barrier** may each be appropriate as part of another remedial action. Both the soil cover and composite liner are implementable and reliable, but they do not represent a significant improvement in the reduction of potential future contact when compared to the current condition.
- **Conventional excavation** is implementable and reliable. If high water is encountered, an appropriate dewatering step can be added.
- Among the *in situ* treatment technologies, **SVE** provides the highest degree of implementability and reliability. The remaining technologies are moderately to fully implementable and reliable, but they are not as appropriate for the nature and degree of VOC contamination. The shorter duration of such technologies as vitrification and stabilization/solidification does not compensate for the other advantages of SVE.

- Among the *ex situ* treatment technologies, both **off-site thermal treatment** and **off-site bioremediation** are implementable and reliable. The remaining options consist of on-site technologies. As a group, on-site treatment technologies are not implementable because Georgia Gulf does not own the affected land, and does not have the space or facilities available. The properties are located in a mixed residential area, and large-scale on-site processing would likely not be acceptable.

- Treatment residuals may be disposed of at either an **off-site Subtitle C** or **off-site Subtitle D** facility, depending on the final regulatory classification of the soil. The **on-site placement** of residuals generated from an off-site treatment process, back into the original excavation, is also retained. Construction of on-site waste disposal facilities is not implementable due to the nature of the surrounding area.

Each of these technologies can be used as part of an integrated remedial alternative. Various combinations are possible. Three such alternatives are outlined in Table 3. For purposes of subsequent analysis and cost estimating, it is assumed that the material will be classified as a nonhazardous waste and that it can be disposed at an off-site Subtitle D facility.

Of the various combinations, the only option considered for AOC 4 is excavation and off-site disposal. This is because the material from that location does not appear to be highly contaminated, and consists not only of impacted soil but also of various debris and solids. It would be more straightforward to dispose of this material directly as solid waste, rather than to attempt to treat it in some fashion.

A fourth alternative is also contained in Table 3 that does not specifically comprise a soil remedial action. This alternative consists of the use of a hydraulic barrier to lower the water table at AOC 5. As described in Section 4, the intent would be to reduce the chance that a rising water table in the future would "re-contaminate" clean backfill soil after an excavation action had been undertaken. This alternative could be selected as an enhancement to Alternatives 2 or 3. It would consist of straightforward, readily available technology used in similar groundwater control projects.

Similarly, Alternative 5 could be selected as an enhancement to reduce vapor transport upward from impacted groundwater or floating product. This would also serve to reduce the potential for re-contamination of clean backfill over time.

For each of the alternatives, additional details are provided in the following section.

TABLE 3

SUMMARY OF REMEDIAL ACTION OPTIONS
GEORGIA GULF PROPERTIES

Remedial Action Options	AOC 4 - Logeman Property	AOC 5 - Churchyard
Alternative #1	Excavation and off-site disposal at a Subtitle D facility	Soil vapor extraction excavation.
Alternative #2	Excavation and off-site disposal at a Subtitle D facility	Excavation, off-site thermal treatment, and on-site placement of residuals.
Alternative #3	Excavation and off-site disposal at a Subtitle D facility	Excavation, off-site biological treatment and off-site disposal at a Subtitle D facility.
Alternative #4	Not applicable	Hydraulic barrier enhancement.
Alternative #5	Not applicable	Vapor barrier enhancement.

Section 5

EVALUATION OF REMEDIAL ACTION OPTIONS

This section describes the broad concepts of each remedial action option, and evaluates the technical and economic feasibility. This evaluation leads to a selection of a preferred alternative for AOC 4 and AOC 5.

5.1 Description of Options

Details of each remedial action option are described below:

- ***Alternative 1*** - This action would consist of the excavation of all debris and impacted soil at AOC 4 and its disposal at a local Subtitle D facility. It is estimated that this action will involve a total of 5,100 cubic yards of material. For cost-estimating purposes, it is assumed that the material will be disposed at a licensed Subtitle D disposal facility.

  At AOC 5, an SVE system would be constructed over a 37,000–square foot area where soil concentrations exceed the soil cleanup standards. This would consist of shallow PVC collection trenches connected to a central vacuum blower. The blower and related equipment and instrumentation would be housed in a small, free-standing building on the property. The ground surface would be completed with an asphalt surface to reduce the potential for the short-circuiting of the atmospheric air to the system.

  It is expected that the SVE system would operate for 5 to 10 years. Operation and maintenance costs are included in the cost estimate.

- ***Alternative 2*** - This alternative would consist of the same response for AOC 4. At AOC 5, an assumed volume of 6,200 cubic yards of material would be excavated using conventional methods and transported to an off-site facility for thermal treatment. The facility would utilize a low-temperature treatment unit, fully permitted within the state.

  It is assumed that the treated residuals would be tested to confirm adequate VOC destruction. After this, the material would be transported back to AOC 5 and used as backfill. Both AOC 4 and AOC 5 would be restored with a vegetative surface.

  For this alternative, no operation and maintenance costs are assumed since the remedial action would be completed once the locations are restored.

- ***Alternative 3*** - This alternative is similar to Alternative 2, with the exception that excavated material from AOC 5 would be treated at a commercial, off-site biological treatment facility (also known as a "biopile"), and then disposed at a Subtitle D landfill. Material from AOC 4 would be disposed directly at the landfill.

  Again, no operation and maintenance costs are assumed.

- ***Alternative 4*** - This alternative would serve as an enhancement to the excavation alternatives (2 and 3). The objective would be to provide a higher level of protection against the possible future "re-contamination" of clean backfill from product on a rising water table.

  This alternative consists of constructing a hydraulic barrier wall along the property boundary between CCP and the Churchyard. The barrier wall will essentially consist of a collection trench approximately 330 feet long, excavated to about 10 feet below ground surface (to about elevation 756), and backfilled with gravel. A 6- to 10-inch–diameter perforated pipe will be installed near the trench bottom so that collected groundwater can be directed, by gravity, to sump RC-3 where it will be discharged into the sanitary sewer.

  A steel sheet pile cut-off wall will be located along the entire downgradient side of the collection trench and embedded at least 5 feet below the collection trench base. The purpose of the sheet pile wall will be to impede groundwater migration from the Churchyard property into the collection trench and facilitate groundwater collection from the CCP property.

  No operation and maintenance costs are assumed. Rather, it is assumed that the water collected from the system would be discharged in to the sanitary sewer as part of the current groundwater collection and disposal system.

- ***Alternative 5*** - This alternative is an enhancement to Alternatives 2 and 3 and would consist of a barrier layer that would separate the clean soil backfill from the remaining groundwater contaminants and eliminate re-contamination from volatilization and soil pore gas migration. The barrier layer would consist of a 40-mil geomembrane.

  As proposed, the geomembrane would cover an area approximately 150 feet by 250 feet, and would extend up the excavation sideslopes on the northern, southern, and western sides. The geomembrane barrier would be sloped to the east to drain uncontaminated surface water infiltration. A 12-inch–thick, select granular fill layer would be placed near the barrier to facilitate this drainage. All other excavation and clean fill placement costs related to this alternative are included in Alternatives 2 or 3.

5.2 Technical Feasibility

Each of the alternatives is technically feasible. In this sub-section, specific implementation issues are discussed. In addition, each alternative is compared to a "no action" response.

- ***Alternative 1*** - This alternative achieves the remedial action objectives by a combination of removal and *in situ* treatment. In both cases, the potential for future contact is reduced, compared to the current condition or a "no action" response. Both the proposed excavation and the SVE work are technically feasible.

  The use of SVE is made somewhat more difficult, although not impossible, by several local circumstances. As described earlier, AOC 5 is subject to high water table conditions. This would require certain design features to be incorporated into the project, such as the use of lower vacuum blowers or combined vapor extraction/groundwater pumping. In addition, the site is in a sensitive location. The equipment building must be discreetly situated, and appropriate noise reduction measures must be taken. Finally, Georgia Gulf does not have long-term control over land use at AOC 5, and wants to complete the remedial action in this area as quickly as possible. The long time frame that would be required for SVE at the Churchyard reduces the feasibility of this remedial option.

  At AOC 4, it is assumed that the excavated material can be classified as a solid waste and that waste disposal approval can be obtained at a local Subtitle D facility. After remediation, both this location and AOC 5 would be restored to an appropriate condition considering that Georgia Gulf will no longer have a presence at the properties.

  None of these items reduce the feasibility of the alternative. Any unique features required to overcome these issues can be incorporated into the final design of the alternative.

- ***Alternative 2*** - This alternative achieves the remedial action objectives by directly removing all impacted material from the AOCs. For the highly impacted material from AOC 5, treatment is provided. The treated residuals would be returned to the property, but would not create a potential future exposure pathway, because VOC removal would be complete.

  There are no specific issues that would reduce the feasibility of this alternative. The off-site thermal treatment facility would be either fixed-base, or established temporarily for the purpose of this project. Transportation of excavation materials, and the return of treated residuals, would create increased traffic in the short term, but this should not be a limiting factor. Appropriate site security and dust mitigation could be implemented to make the excavation work less disruptive to the surrounding community.

The effectiveness of this alternative could be compromised by re-contamination of a part of the clean backfill. Three transport mechanisms are likely: (1) vapor phase VOCs could migrate from the contaminated groundwater to unsaturated soil in the vadose zone; (2) VOCs could be adsorbed on soil from the dissolved phase if the water table rises in the future; and (3) any floating product on the current water table could be "smeared" across overlying soil as the water table rises and falls in the future.

The current Ranney well collector system operated by CCP appears to capture affected groundwater at AOC 5. Adjacent to the shallow collectors, the water table is maintained at a depressed elevation. However, away from these collectors, the water table is probably free to fluctuate in response to surrounding conditions.

Once the excavation is complete, the restored areas would provide future use opportunities. Compared to the "no action" response, there would be fewer restrictions placed on future activities in the area. Compared to Alternative 1, this alternative would restore the area in a shorter time.

- ***Alternative 3*** - As with Alternative 2, this alternative achieves the remedial action objectives by directly removing all impacted material. In this alternative, treatment would be provided at a commercial "biopile," and the treated residuals would be disposed at an adjoining landfill. This alternative is feasible.

  The potential for re-contamination of the clean backfill is the same for this alternative as for Alternative 2. The degree of possible future effects is similarly uncertain.

  As with Alternative 2, the restored areas would provide future use opportunities. This would be achieved immediately upon backfilling the areas with clean material.

- ***Alternative 4*** - This enhancement could be selected in combination with either Alternative 2 or 3. The objective would be to provide a barrier to groundwater flow, while providing increased upgradient capture of groundwater before it reaches AOC 5.

  The concepts for this alternative are technically feasible. The barrier could be installed using conventional technology. Construction of the alternative would require coordination with the groundwater recovery system operated at CCP, but this is not expected to be limiting. It would also require acceptance of an increased volume of groundwater to the sanitary sewer by the Saukville authorities.

While the capture of groundwater afforded by this system may not be 100 percent complete, it would provide an improvement in conditions. Increased protection would be provided until such time as the existing groundwater remediation efforts and natural degradation are able to reduce groundwater concentrations to sufficiently low levels.

- ***Alternative 5*** - This enhancement could be selected in combination with either Alternative 2 or 3. The objective would be to provide a barrier to the migration of vapors from the water table or other unsaturated soils not addressed by the current remediation.

  Construction of the vapor barrier is technically feasible. It would employ methods and materials commonly used in landfill gas or methane collection systems. The construction would be integrated with the excavation of soils such that the barrier would be placed in the bottom of the excavation as work proceeds.

  The excavation will be left unlined on the eastern side so that infiltrating water may drain from the lined area. The possibility exists that some VOCs may migrate into the clean backfill via diffusion around the eastern edge of the liner. However, the potential for diffusive flux of VOCs into the clean backfill is much less on the eastern edge of the excavation than on the western edge, because the main mass of affected soil in the vadose zone is on the western edge of the Churchyard, and at the CCP property, as documented in the RFI (RMT, 1995). Diffusive flux is driven by concentration gradients, and will be most significant when concentration gradients are greatest. VOC concentrations in soil on the eastern edge of the excavation will be less than the NR 700 generic cleanup standard, so the concentration gradient between the clean backfill and the adjacent soil should be slight. Consequently, migration of VOCs from the affected soil in the vadose zone into the clean backfill is not expected to recontaminate the clean backfill.

5.3 Economic Feasibility

A cost estimate has been prepared for each of the remedial action alternatives. This estimate includes direct and indirect costs associated with implementation. Annual operations and monitoring costs are also included for those alternatives that have are not completed in a single year. A summary is included in Table 4, and details are contained in Appendix A.

These estimates are based on broad concepts only, and are suitable only for comparison purposes. They are not suitable for budgeting purposes. Final costs will be different.

TABLE 4

SUMMARY OF COSTS FOR REMEDIAL ACTION OPTIONS
GEORGIA GULF PROPERTIES

Remedial Action Options	Title[1]	Present Worth Cost[2]
Alternative #1	Soil vapor extraction	$ 1,500,000
Alternative #2	Off-site thermal treatment	1,900,000
Alternative #3	Off-site biological treatment	1,800,000
Alternative #4	Hydraulic barrier enhancement	200,000
Alternative #5	Vapor barrier enhancement	200,000

NOTES:

1 Alternatives 1 through 3 include the common elements of excavation and off-site disposal for AOC 4.

2 Costs for Alternatives 4 and 5 would be additive to those for Alternatives 2 or 3.

Each cost includes one or more common direct and indirect cost elements. These include the following:

- Site preparation and access (access road, fencing, staging areas, etc.)
- A pre-design sampling event to further define the limits of contamination.
- Engineering design, bidding assistance, construction observation during remediation, and preparation of a construction documentation report.

Other specific assumptions on which the costs are based include the following:

Alternative 1

- For AOC 4, 5,100 cubic yards of soil will be excavated and disposed as a solid waste at the cost of $20/ton (1 cubic yard equals 1.5 tons).
- At AOC 5, SVE will be applied using shallow trenches over an area of 37,000 square feet. A small free-standing equipment building with separate power supply will be built.
- AOC 5 will be restored with an asphalt surface. No other improvements, drainage modifications, etc., are included.
- No off-gas treatment is assumed.

Alternative 2

- At AOC 5, 6,200 cubic yards (9,300 tons) of soil will be thermally treated at a unit cost of $32 per ton.
- Treated material will be returned to the excavation.
- The area will be restored with a vegetative surface.

Alternative 3

- At AOC 5, 6,200 cubic yards (9,300 tons) of soil will be treated at an off-site biopile, followed by disposal at a Subtitle D landfill (unit cost equals $25 per ton).
- The excavation will be backfilled with clean fill and restored with a vegetative surface.

Alternative 4

- The sheet pile wall will be 350 feet long by 15 feet deep.
- A recovery trench will be installed behind the wall to a depth of 12 feet. Half of the excavated soil will require off-site disposal at a biopile.
- The discharge from the trench will gravity-drain to an existing nearby manhole for the Ranney collector system.

Alternative 5

- The barrier will be comprised of a 40-mil geomembrane (XR-5®) over an area of 37,500 square feet.
- A drainage layer of 1 foot of sand will be placed over the membrane.

Section 6

SELECTION OF A REMEDIAL ACTION

This section will recommend a remedial action for AOC 4 and AOC 5. A rationale will be provided, with additional detail concerning the implementation of the selected remedy.

6.1 Rationale for Selection

The recommended remedial action is a combination of Alternatives 3 and 5. This combination will provide for excavation and treatment at a commercial biological treatment facility, along with installation of a vapor barrier to reduce the chance for future re-contamination at AOC 5. At AOC 4, excavated material will be disposed directly at a Subtitle D facility.

This combination provides protectiveness at a reasonable cost. Excavation of the impacted soil is preferred over *in-situ* SVE because Georgia Gulf does not have long-term control over the site, and there is a desire to complete the remediation in a shorter rather than longer time period. There is no significant obstruction to a large excavation at this location. Off-site biological treatment is an acceptable means of disposal, and can be accomplished at a lower cost than the alternative of thermal treatment.

6.2 Implementation Schedule

An approximate schedule for implementing these actions is as follows:

Preparation of final construction plans and specifications	2 months after report approval by WDNR
Bid period and initiation of activities	1 month
Completion of construction	3 months, assuming commencement during the construction season
Submittal of construction documentation	1 month

This schedule will commence upon WDNR approval of this Remedial Action Options Report and the recommended remedy.

6.3 Cost

The cost estimate for this alternative at the present time was discussed in Section 5. Until a final design is completed, it is not possible to refine the estimate further. A final cost will be established at the time the project is finally put out for bid for construction.

6.4 Time Frame for Compliance with Applicable Standards

The applicable standards for this remediation will be the approved soil cleanup standards. These will be achieved at the time excavation is complete. According to the scheduled described above, this will be accomplished within 6 months of WDNR approval of the selected remedy.

6.5 Performance Measurement

As described above, the performance of the selected remedy will be measured by the attainment of the soil cleanup standards. As the AOCs are excavated, soil samples will be screened in the field with a gas chromatograph mounted in a mobile laboratory to determine the extent of affected soil and hence the limits of excavation. The analytical methodologies used in the mobile laboratory will be consistent with those specified in EPA Method 8020. Confirmatory samples for site closure will be analyzed at a Wisconsin-certified laboratory using EPA Method 8020 for BTEX.

Section 7
REMEDIAL DESIGN

This section will discuss the design of the selected remedial actions to be implemented for AOC 4 and 5.

7.1 Description of Remedial Action

The remedial action will consist of the excavation of contaminated material within the unsaturated zone at AOC 4 and AOC 5, the installation of a vapor barrier at AOC 5, and the subsequent backfilling of both affected areas.

7.1.1 Excavation

As mentioned in Subsection 6.1, excavation of the impacted material is the preferred method of remediation because Georgia Gulf does not have long-term control over the site, and there is a desire to complete the remediation in a relatively short time period. At AOC 5, the criterion for determining the vertical extent of the excavation will be the depth to the high water table. This elevation, which was recorded in April 1995, is approximately 5 feet below the existing grade. The base of the excavation will slope at a minimum grade of 0.5 percent from west to east in order to promote positive drainage of infiltration water above the vapor barrier to an area of uncontaminated nonsaturated soils. Soils excavated from AOC 5 will be directly loaded into trucks and transported to a permitted Subtitle D facility where they will be bioremediated prior to being land-disposed.

At AOC 4, the extent of the demolition and excavation will be determined based on the visual observation of the specific materials involved (i.e., the buried drums, ash, concrete structures). As they are demolished and excavated, these materials will be loaded into trucks and hauled off-site for disposal at a licensed Subtitle D facility.

7.1.2 Vapor Barrier System

After the excavation is completed at AOC 5, a vapor barrier system will be installed to reduce the possibility of contaminating the clean backfilled soils due to migration of organic vapors. The vapor barrier system will consist of a 6-inch layer of bedding material, a geomembrane liner, and a 1-foot granular drainage layer. A typical construction detail is illustrated in Figure 5. The purpose of the individual vapor barrier system components is as follows:

Bedding Material Layer - *In situ* soils consist of a till unit that is a silty sand with gravel. In order to minimize the possibility of puncturing the geomembrane liner and to minimize direct contact with the contaminated soils, a 6-inch sand bedding layer will be placed over the *in situ* soils within the excavation. This material will provide separation from the gravel and the contamination in the *in situ* soil.

Geomembrane Liner - A geomembrane liner will be placed over the bedding material layer, extending up the short excavation slopes on the northern, southern, and western perimeter. The liner will be sloped to the east at a minimum of 0.5 percent to facilitate drainage of water that infiltrates through the overlying backfill. The geomembrane, XR-5®, manufactured by the Seaman Corporation of Wooster, Ohio, consists of a high-strength polyester base fabric that is encapsulated within an ethylene interpolymer alloy (EIA) coating. The EIA coating of the XR-5® geomembrane has been shown to be chemically resistant to a wide range of chemical exposures, including acids and hydrocarbons. In order to provide long-term performance as a vapor barrier and be resilient to the potential installation stresses, the geomembrane will have a minimum thickness of 40 mils (0.040 inch).

Granular Drainage Layer - After the geomembrane liner is installed, a 1-foot layer of sand will be placed. This layer will allow water that infiltrates through the overlying backfill to drain off the geomembrane to an area of uncontaminated soils to the east. This material will not contain any stones longer than 4.75 mm (#4 U.S. sieve) that could compromise the integrity of the liner.

7.1.3 Backfill

Above the vapor barrier system at AOC 5, general fill material will be used to backfill and restore the excavated area to pre-excavation grades. General fill will be used to backfill the excavations at AOC 4 at the former air curtain incinerator and at the buried drum area. Compaction of the general fill will be performed at AOCs 4 and 5 to minimize settlement. The final surface at AOC 4 will be restored with 6 inches of topsoil and vegetated with a common seed mixture, and at AOC 5 with sod.

PLOT DATA

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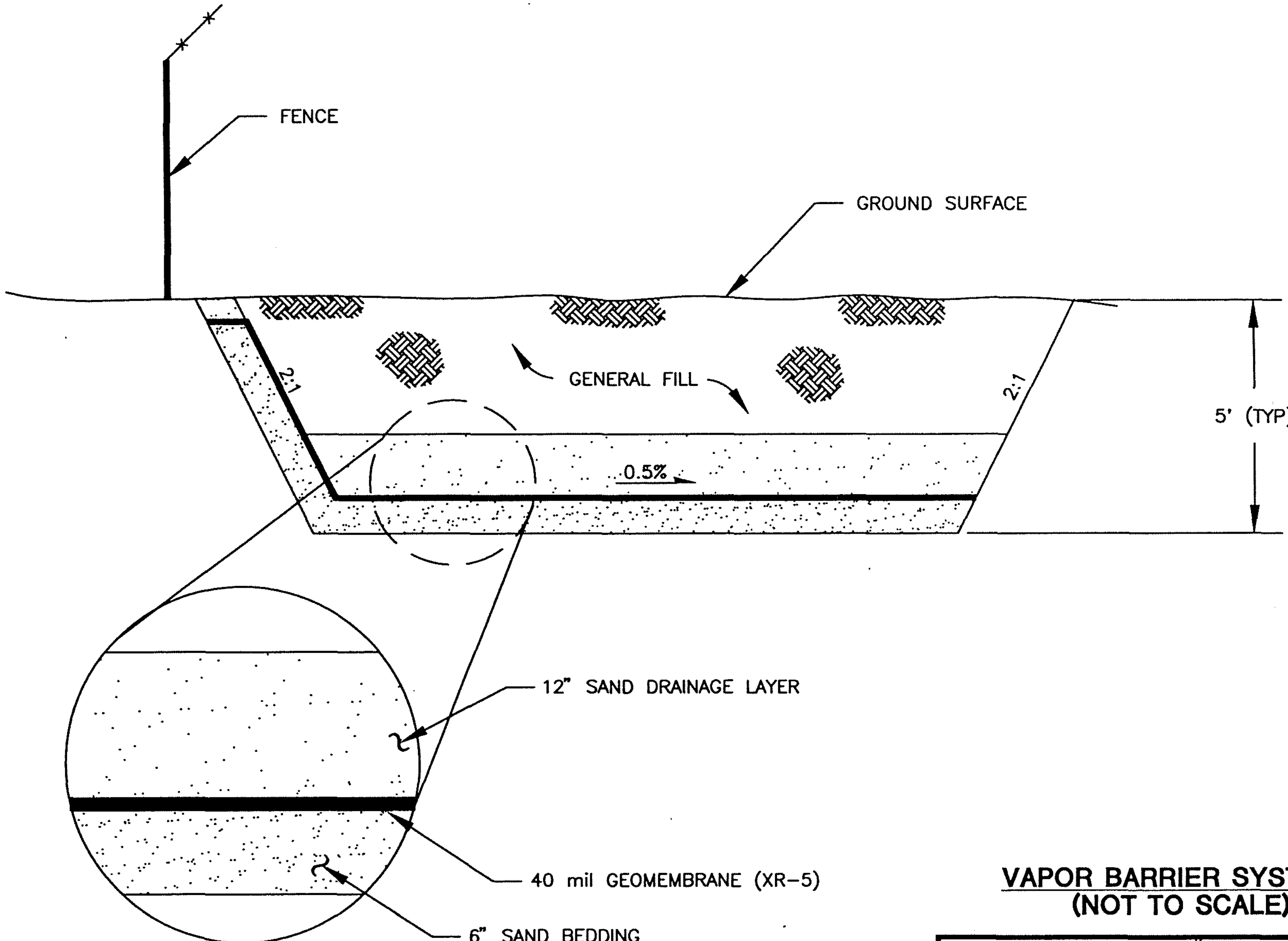

VAPOR BARRIER SYSTEM
(NOT TO SCALE)

RMT INC.	DWN. BY: AKS
	APPROVED BY: ELM
	DATE: JUNE 1996
	PROJ. # 3974.05
	FILE # 39740501.DWG

FIGURE 5

7.2 Construction Procedures

Construction is to progress under the following principals and practices:

7.2.1. Pre-Construction

A topographical survey will be performed at AOCs 4 and 5 prior to the beginning of construction. The purpose of the survey will be to provide horizontal and vertical control during construction. The survey will also provide control for documentation purposes.

At AOC 5, an investigative program will also be implemented prior to the start of construction. The purpose of the program will be to help better delineate the area of contamination and the corresponding limits of construction.

7.2.2 Site Preparation and Approvals

The work locations will be prepared by bringing in necessary equipment and temporary job trailers. Gravel access roads and staging areas will be constructed. AOC 5, and possibly AOC 4 as well, and will be secured with temporary chain-link fencing to limit public access to the excavation. Local permits and approvals will be obtained by the contractor before commencing work.

7.2.3 Excavation

Standard excavation equipment and practices will be used for the removal of contaminated soil at AOCs 4 and 5. The base of the excavation at AOC 5 will typically be 5 feet below the existing grade. The base will be maintained at a minimum grade of 0.5 percent to promote positive drainage of infiltration water. Contaminated soil will be transported to a permitted landfill facility via covered dump trucks.

7.2.4 Confirmation Sampling

As the excavations proceed, soil samples will be collected for chemical analysis to confirm that the affected soil has been removed at AOCs 4 and 5. Soil samples will be collected from the excavations and will be analyzed for BTEX at the jobsite with a mobile laboratory equipped with a gas chromatograph to initially determine the extent of soil removal. The analytical methodologies for screening analysis of the soil samples will be consistent with those specified in EPA Method 8020.

Soil samples will be collected from the excavations at AOCs 4 and 5 to confirm that the soil cleanup standards have been attained after the initial soil excavations are complete. The confirmatory soil samples will be preserved with methanol, stored on ice, and shipped to a Wisconsin-certified laboratory with chain-of-custody documentation via overnight delivery service or courier for chemical analysis for BTEX to document the extent of remediation. The analytical methodologies for confirmatory analysis of the soil samples will be consistent with those specified in EPA Method 8020. The proposed soil sampling program for the confirmatory sampling is outlined in Table 5.

At the Churchyard (AOC 5), soil samples for closure documentation will be collected at the 5-foot depth at 25-foot intervals along the northern, eastern, and southern edges of the excavation. The base of the excavation will extend to 5 feet below grade, as discussed in Subsection 3.2 of this report. Closure documentation samples will not be collected from the base of this excavation. Similarly, the western edge of the excavation will be defined by the fenceline between CCP and the Churchyard, and closure documentation samples will not be collected at this location, because the excavation will not extend onto CCP's property.

At the Logemann Brothers property (AOC 4), soil samples for closure documentation will be collected at 25-foot intervals along the edges of the excavations at the ash pile, former air curtain incinerator, and in the buried container area near the former incinerator. Soil samples will be collected from the base of the excavations on 25-foot centers.

7.2.5 Bedding Material Layer

A 6-inch bedding layer will be placed on all surfaces that will be covered by the geomembrane at AOC 5. These surfaces include the base of the excavation and the north, south, and west excavation slopes. This material will be sand and will not contain any cobbles or rocks that could compromise the integrity of the geomembrane liner. The bedding layer will be fine graded prior to placement of the geomembrane.

TABLE 5

SOIL SAMPLING PROGRAM TO CONFIRM REMEDIATION

Area of Concern	Analytical Parameters	Frequency of Sampling	Estimated Number of Samples
AOC 4 • Ash Pile • Former incinerator • Buried drum area	BTEX by EPA Method 8020	Every 25 feet along the perimeter of the excavation, and on 25-foot centers within the footprint of the excavation	20 - ash pile 9 - incinerator 7 - buried containers
AOC 5 - Churchyard	BTEX by EPA Method 8020	Every 25 feet along the perimeter of the excavation	22

7.2.6 Geomembrane Liner

A 40-mil geomembrane liner (XR-5®) will be placed over the base, as well as the north, south, and west sideslopes of the excavation at AOC 5. The following measures will also be taken in regards to liner installation:

- Field seaming of the geomembrane will be minimized by factory-fabricating the geomembrane into several large panels.
- Industry standards and manufacturer's installation procedures will be adhered to in regard to geomembrane placement, seaming, and covering with overlying material.
- Vehicular traffic over the geomembrane will be kept at a minimum. Prior to any vehicular traffic over the geomembrane, adequate amounts of soil will be placed over the geomembrane for protection.
- The membrane will be covered with the drainage layer material as soon as feasibly possible to minimize exposure to the elements.

7.2.7 Drainage Layer

A 1-foot granular drainage layer will be placed directly over the geomembrane at AOC 5. This material will be placed using low ground pressure equipment, operating on a minimum 12-inch thickness of sand. No vehicles or equipment will be allowed to operate directly on the geomembrane. Placement of this material will begin as soon as feasibly possible in order to protect the integrity of the flexible membrane liner.

7.2.8 Backfill

The excavated area will be brought to within 6 inches of the pre-construction conditions through the use of a general fill material at AOCs 4 and 5. Compaction will be performed to minimize settlement. A 6-inch topsoil layer will then be placed over the disturbed area.

7.2.9 Revegetation/Site Closure

Upon completion of construction activities at AOCs 4 and 5, all disturbed areas will be revegetated or brought back to their respective pre-construction conditions.

7.3 Construction Documentation

The construction at AOCs 4 and 5 will be performed by competent contractors with experience in remedial projects of this type. The work will be observed by RMT staff under the direction of a professional engineer. Daily documentation reports will be maintained at the jobsite. Quantities will be documented via hand measurements, a final survey and load tickets.

At the completion of the remedial action at AOCs 4 and 5, a construction documentation report will be submitted to the WDNR. The report will contain descriptive and photographic documentation. Drawings will be used to illustrate the final horizontal and vertical extent of removal. The report will be submitted within one month after the completion of construction

Section 8

REFERENCES

RMT, Inc. 1995. RCRA facility investigation additional studies report. Cook Composites and Polymers. Saukville, Wisconsin. October 1995.

USEPA. 1987. Administrative order on consent, V-W-88-R-002, between USEPA and Freeman Chemical Corporation. October 19, 1987.

USEPA. 1995. Risk-based concentration table, July-December 1995. Memorandum from Roy Smith, USEPA Region 3, Philadelphia, Pennsylvania. October 20, 1995.

WDNR. 1993. Natural biodegradation as a remedial option - interim guidance. Memorandum from Mark Giesfeldt to ERR program staff dated February 8, 1993.

APPENDIX A

CONCEPTUAL COST ESTIMATES

TABLE A1

CONCEPTUAL COST ESTIMATE
FOR NR 700 REMEDIAL ACTION OPTIONS REPORT

GEORGIA GULF
Project # 3974.03

REMEDIAL ALTERNATIVE 1 AOC 4 - Excavation with Off-Site Disposal
AOC 5 - Soil Vapor Extraction

LINE ITEM	UNIT	UNIT COST	AOC 4 QUANTITY	AOC 4 TOTAL	AOC 5 QUANTITY	AOC 5 TOTAL
DIRECT CAPITAL						
MOBILIZATION	%	2%	372,000	8,000	301,000	7,000
SITE PREPARATION						
Security fencing	LF	13.30	600	8,000	535	8,000
Access road	SY	5.30	1,900	11,000	720	4,000
Staging area	SY	5.30	1,200	7,000	3,700	20,000
CONSTRUCTION/SITE WORK						
Trenching, piping, backfill/compaction	LF	74.00	0	0	750	56,000
SVE trenches	EA	3,000.00	0	0	9	27,000
Clean fill	CY	2.00	0	0	350	1,000
Clearing and grubbing	AC	2,000.00	1	2,000	0	0
Excavation	CY	5.00	5,100	26,000	0	0
Dewatering, wellpoints	LFHdr	325.00	0	0	0	0
Soil pre-processing	CY	5.00	0	0	0	0
Soil treament, thermal desorption	TON	32	0	0	0	0
Load and haul	CY	15.00	5,100	77,000	350	6,000
Clean fill, backfill/compact (excavation)	CY	6.00	5,100	31,000	0	0
Surface restoration, topsoil/seeding	AC	1,000.00	1	1,000	0	0
Surface restoration, asphalt	SY	20.40	0	0	3,700	76,000
Remediation building	LS	25,000.00	0	0	1	25,000
Interior mechanical and electrical work	LS	27,000.00	0	0	1	27,000
New electrical service and power drop	LS	5,000.00	0	0	1	5,000
Incinerator demolition	SF	10.00	2,850	29,000	0	0
PURCHASED EQUIPMENT						
SVE system skid	LS	15,000.00	0	0	1	15,000
Control panel	LS	15,000.00	0	0	1	15,000
Pumps and controls	LS	1,500.00	0	0	1	2,000
OFF-SITE DISPOSAL						
Landfill disposal, Subtitle D	TON	20.00	7,700	154,000	0	0
Biopile disposal	TON	25.00	0	0	525	14,000
Drum disposal	EA	140.00	150	21,000	0	0
Demolition waste disposal	TON	20.00	210	5,000	0	0
SUBTOTAL, DIRECT CAPITAL COSTS				380,000		308,000
INDIRECT CAPITAL COSTS						
Pre-design/confirmation of extent	%	5%	380,000	19,000	308,000	16,000
Design	%	10%	380,000	38,000	308,000	31,000
Bidding and construction assistance	%	10%	380,000	38,000	308,000	31,000
Construction documentation	%	5%	380,000	19,000	308,000	16,000
Laboratory Analysis						
Confirmation of treatment	TON	1.00	0	0	0	0
Extent of excavation confirmation	EA	80.00	28	3,000	0	0
Air permit application assistance	LS	5,000.00	0	0	1	5,000
Waste profile acceptance assistance	LS	5,000.00	1	5,000	1	5,000
Startup/shakedown	LS	10,000.00			1	10,000
Contingency	%	30%	380,000	114,000	308,000	93,000
SUBTOTAL, INDIRECT CAPITAL COSTS				236,000		207,000
TOTAL CAPITAL COSTS				616,000		515,000
ANNUAL OPERATION AND MAINTENANCE COSTS						
Operating labor	MO	1,000.00	0	0	12	12,000
Maintenance labor	MO	500.00	0	0	12	6,000
Power	MO	375.00	0	0	12	5,000
Analytical	EA	100.00	0	0	12	2,000
Administration	MO	2,000.00	0	0	12	24,000
Contingency	%	30%	0	0	49,000	15,000
SUBTOTAL, ANNUAL O&M COSTS				0		64,000
PRESENT WORTH OF ANNUAL COSTS n = 8 years, interest rate = 8%, P/A = 5.75		5.75	0	0	64,000	368,000
TOTAL (total capital + present worth of annual o&m costs)				616,000		883,000

GRAND TOTAL 1,499,000

ASSUMPTIONS:

1. Costs rounded up to the nearest thousand dollars.
2. Perimeters, areas, and volumes of AOC's determined from Figure 2.
3. Piping quantities based on individual lines connecting each SVE extraction trench.
4. Hauling soil to a thermal desorption unit or landfill based on an one hour (one-way) travel time.
5. Dewatering costs do not include costs for water disposal.
6. Costs determined from vendor quotes, Means Construction Cost data, and estimates from other similar projects.
7. Mobilization costs are assumed to be 2% of direct capital costs.
8. 50% of trenching soils require disposal at a Biopile.
9. The SVE system assumed not to include off-gas treatment.
10. Contingency is assumed to be 30% of direct capital and 30% of annual O&M.
11. All costs are based on preliminary concepts only. They are intended for comparison among alternatives and not for final budgeting.
12. Drum disposal is assumed to be considered a solid waste.
13. AOC 4 waste is assumed to be solid waste.
14. AOC 5 soil waste is assumed to be special waste.

TABLE A2

CONCEPTUAL COST ESTIMATE
FOR NR 700 REMEDIAL ACTION OPTIONS REPORT

GEORGIA GULF
Project # 3974.03

REMEDIAL ALTERNATIVE 2 AOC 4 - Excavation with Off-Site Disposal
AOC 5 - Excavation with Off-Site Thermal Treatment

LINE ITEM	UNIT	UNIT COST	AOC 4 QUANTITY	AOC 4 TOTAL	AOC 5 QUANTITY	AOC 5 TOTAL
DIRECT CAPITAL						
MOBILIZATION	%	2%	372,000	8,000	788,000	16,000
SITE PREPARATION						
Security fencing	LF	13.30	600	8,000	535	8,000
Access road	SY	5.30	1,900	11,000	720	4,000
Staging area	SY	5.30	1,200	7,000	3,700	20,000
CONSTRUCTION/SITE WORK						
Trenching, piping, backfill/compaction	LF	74.00	0	0	0	0
SVE trenches	EA	3,000.00	0	0	0	0
Clean fill	CY	2.00	0	0	0	0
Clearing and grubbing	AC	2,000.00	1	2,000	0	0
Excavation	CY	5.00	5,100	26,000	6,200	31,000
Dewatering, wellpoints	LFHdr	325.00	0	0	810	264,000
Soil pre-processing	CY	5.00	0	0	6,200	31,000
Soil treament, thermal desorption	TON	32	0	0	9,300	298,000
Load and haul	CY	15.00	5,100	77,000	6,200	93,000
Clean fill, backfill/compact (excavation)	CY	6.00	5,100	31,000	6,200	38,000
Surface restoration, topsoil/seeding	AC	1,000.00	1	1,000	1	1,000
Surface restoration, asphalt	SY	20.40	0	0	0	0
Remediation building	LS	25,000.00	0	0	0	0
Interior mechanical and electrical work	LS	27,000.00	0	0	0	0
New electrical service and power drop	LS	5,000.00	0	0	0	0
Incinerator demolition	SF	10.00	2,850	29,000	0	0
PURCHASED EQUIPMENT						
SVE system skid	LS	15,000.00	0	0	0	0
Control panel	LS	15,000.00	0	0	0	0
Pumps and controls	LS	1,500.00	0	0	0	0
OFF-SITE DISPOSAL						
Landfill disposal, Subtitle D	TON	20.00	7,700	154,000	0	0
Biopile disposal	TON	25.00	0	0	0	0
Drum disposal	EA	140.00	150	21,000	0	0
Demolition waste disposal	TON	20.00	210	5,000	0	0
SUBTOTAL, DIRECT CAPITAL COSTS				380,000		804,000
INDIRECT CAPITAL COSTS						
Pre-design/confirmation of extent	%	5%	380,000	19,000	804,000	41,000
Design	%	10%	380,000	38,000	804,000	81,000
Bidding and construction assistance	%	5%	380,000	19,000	804,000	41,000
Construction documentation	%	5%	380,000	19,000	804,000	41,000
Laboratory Analysis						
Confirmation of treatment	TON	1.00	0	0	9,300	10,000
Extent of excavation confirmation	EA	80.00	28	3,000	33	3,000
Air permit application assistance	LS	5,000.00	0	0	0	0
Waste profile acceptance assistance	LS	5,000.00	1	5,000	1	5,000
Startup/shakedown	LS	10,000.00				
Contingency	%	30%	380,000	114,000	804,000	242,000
SUBTOTAL, INDIRECT CAPITAL COSTS				217,000		464,000
TOTAL CAPITAL COSTS				597,000		1,268,000
ANNUAL OPERATION AND MAINTENANCE COSTS						
Operating labor	MO	1,000.00	0	0	0	0
Maintenance labor	MO	500.00	0	0	0	0
Power	MO	375.00	0	0	0	0
Analytical	EA	100.00	0	0	0	0
Administration	MO	2,000.00	0	0	0	0
Contingency	%	30%	0	0	0	0
SUBTOTAL, ANNUAL O&M COSTS				0		0
PRESENT WORTH OF ANNUAL COSTS n = 8 years, interest rate = 8%, P/A = 5.75		5.75	0	0	0	0
TOTAL (total capital + present worth of annual o&m costs)				597,000		1,268,000

GRAND TOTAL 1,865,000

ASSUMPTIONS:

1. Costs rounded up to the nearest thousand dollars.
2. Perimeters, areas, and volumes of AOC's determined from Figure 2.
3. Piping quantities based on individual lines connecting each SVE extraction trench.
4. Hauling soil to a thermal desorption unit or landfill based on an one hour (one-way) travel time.
5. Dewatering costs do not include costs for water disposal.
6. Costs determined from vendor quotes, Means Construction Cost data, and estimates from other similar projects.
7. Mobilization costs are assumed to be 2% of direct capital costs.
8. 50% of trenching soils require disposal at a Biopile.
9. The SVE system assumed not to include off-gas treatment.
10. Contingency is assumed to be 30% of direct capital and 30% of annual O&M.
11. All costs are based on preliminary concepts only. They are intended for comparison among alternatives and not for final budgeting.
12. Drum disposal is assumed to be considered a solid waste.
13. AOC 4 waste is assumed to be solid waste.
14. AOC 5 soil waste is assumed to be special waste.

TABLE A3

CONCEPTUAL COST ESTIMATE
FOR NR 700 REMEDIAL ACTION OPTIONS REPORT

GEORGIA GULF
Project # 3974.03

REMEDIAL ALTERNATIVE 3 AOC 4 - Excavation with Off-Site Disposal
AOC 5 - Excavation with Off-Site Biopile treatment

LINE ITEM	UNIT	UNIT COST	AOC 4 QUANTITY	AOC 4 TOTAL	AOC 5 QUANTITY	AOC 5 TOTAL
DIRECT CAPITAL						
MOBILIZATION	%	2%	372,000	8,000	692,000	14,000
SITE PREPARATION						
Security fencing	LF	13.30	600	8,000	535	8,000
Access road	SY	5.30	1,900	11,000	720	4,000
Staging area	SY	5.30	1,200	7,000	3,700	20,000
CONSTRUCTION/SITE WORK						
Trenching, piping, backfill/compaction	LF	74.00	0	0	0	0
SVE trenches	EA	3,000.00	0	0	0	0
Clean fill	CY	2.00	0	0	0	0
Clearing and grubbing	AC	2,000.00	1	2,000	0	0
Excavation	CY	5.00	5,100	26,000	6,200	31,000
Dewatering, wellpoints	LFHdr	325.00	0	0	810	264,000
Soil pre-processing	CY	5.00	0	0	0	0
Soil treament, thermal desorption	TON	32	0	0	0	0
Load and haul	CY	15.00	5,100	77,000	6,200	93,000
Clean fill, backfill/compact (excavation)	CY	6.00	5,100	31,000	6,200	38,000
Surface restoration, topsoil/seeding	AC	1,000.00	1	1,000	1	1,000
Surface restoration, asphalt	SY	20.40	0	0	0	0
Remediation building	LS	25,000.00	0	0	0	0
Interior mechanical and electrical work	LS	27,000.00	0	0	0	0
New electrical service and power drop	LS	5,000.00	0	0	0	0
Incinerator demolition	SF	10.00	2,850	29,000	0	0
PURCHASED EQUIPMENT						
SVE system skid	LS	15,000.00	0	0	0	0
Control panel	LS	15,000.00	0	0	0	0
Pumps and controls	LS	1,500.00	0	0	0	0
OFF-SITE DISPOSAL						
Landfill disposal, Subtitle D	TON	20.00	7,700	154,000	0	0
Biopile disposal	TON	25.00	0	0	9,300	233,000
Drum disposal	EA	140.00	150	21,000	0	0
Demolition waste disposal	TON	20.00	210	5,000	0	0
SUBTOTAL, DIRECT CAPITAL COSTS				380,000		706,000
INDIRECT CAPITAL COSTS						
Pre-design/confirmation of extent	%	5%	380,000	19,000	706,000	36,000
Design	%	10%	380,000	38,000	706,000	71,000
Bidding and construction assistance	%	10%	380,000	38,000	706,000	71,000
Construction documentation	%	5%	380,000	19,000	706,000	36,000
Laboratory Analysis						
Confirmation of treatment	TON	1.00	0	0	0	0
Extent of excavation confirmation	EA	80.00	28	3,000	33	3,000
Air permit application assistance	LS	5,000.00	0	0	0	0
Waste profile acceptance assistance	LS	5,000.00	1	5,000	1	5,000
Startup/shakedown	LS	10,000.00				
Contingency	%	30%	380,000	114,000	706,000	212,000
SUBTOTAL, INDIRECT CAPITAL COSTS				236,000		434,000
TOTAL CAPITAL COSTS				616,000		1,140,000
ANNUAL OPERATION AND MAINTENANCE COSTS						
Operating labor	MO	1,000.00	0	0	0	0
Maintenance labor	MO	500.00	0	0	0	0
Power	MO	375.00	0	0	0	0
Analytical	EA	100.00	0	0	0	0
Administration	MO	2,000.00	0	0	0	0
Contingency	%	30%	0	0	0	0
SUBTOTAL, ANNUAL O&M COSTS				0		0
PRESENT WORTH OF ANNUAL COSTS n = 8 years, interest rate = 8%, P/A = 5.75		5.75	0	0	0	0
TOTAL (total capital + present worth of annual o&m costs)				616,000		1,140,000

GRAND TOTAL 1,756,000

ASSUMPTIONS:
1. Costs rounded up to the nearest thousand dollars.
2. Perimeters, areas, and volumes of AOC's determined from Figure 2.
3. Piping quantities based on individual lines connecting each SVE extraction trench.
4. Hauling soil to a thermal desorption unit or landfill based on an one hour (one-way) travel time.
5. Dewatering costs do not include costs for water disposal.
6. Costs determined from vendor quotes, Means Construction Cost data, and estimates from other similar projects.
7. Mobilization costs are assumed to be 2% of direct capital costs.
8. 50% of trenching soils require disposal at a Biopile.
9. The SVE system assumed not to include off-gas treatment.
10. Contingency is assumed to be 30% of direct capital and 30% of annual O&M.
11. All costs are based on preliminary concepts only. They are intended for comparison among alternatives and not for final budgeting.
12. Drum disposal is assumed to be considered a solid waste.
13. AOC 4 waste is assumed to be solid waste.
14. AOC 5 soil waste is assumed to be special waste.

TABLE A4

CONCEPTUAL COST ESTIMATE
FOR NR 700 REMEDIAL ACTION OPTIONS REPORT

GEORGIA GULF
Project # 3974.03

REMEDIAL ALTERNATIVE 4 AOC 5 - Hydraulic Barrier Enhancement

			AOC 5	
LINE ITEM	UNIT	UNIT COST	QUANTITY	TOTAL
DIRECT CAPITAL				
MOBILIZATION	LS	8,000.00	1	8,000
SITE PREPARATION				
Remove and restore CCP fencing and other facilities	LS	5,000.00	1	5,000
CONSTRUCTION/SITE WORK				
Shoring installation	SF	20.00	3,500	70,000
Collection trench excavation	LF	15.00	380	6,000
Collection trench piping installation	LF	1.00	380	1,000
Collection trench backfill	TON	10.00	375	4,000
Tie into RC-3	LS	2,000.00	1	2,000
Polymers to keep excavation open	LS	1,000.00	1	1,000
Restoration	LS	1,500.00	1	2,000
Load and haul (50% of trench soils)	CY	15.00	230	4,000
Miscellaneous related construction	LS	20,000.00	1	20,000
PURCHASED EQUIPMENT				
OFF-SITE DISPOSAL				
Landfill disposal, subtitle D	TON	20.00	0	0
Biopile disposal	TON	25.00	350	9,000
SUBTOTAL, DIRECT CAPITAL COSTS				132,000
INDIRECT CAPITAL COSTS				
Design	%	10%	132,000	14,000
Bidding and construction assistance	%	5%	132,000	7,000
Construction documentation	%	5%	132,000	7,000
Laboratory Analysis				
Confirmation of treatment	TON	1.00	0	0
Extent of excavation confirmation	EA	80.00	0	0
Air permit application assistance	LS	5,000.00	0	0
Waste profile acceptance assistance	LS	5,000.00	1	5,000
Startup/shakedown	LS	10,000.00		
Contingency	%	30%	132,000	40,000
SUBTOTAL, INDIRECT CAPITAL COSTS				73,000
TOTAL CAPITAL COSTS				205,000
ANNUAL OPERATION AND MAINTENANCE COSTS				
Operating labor	MO	1,000.00	0	0
Maintenance labor	MO	500.00	0	0
Power	MO	375.00	0	0
Analytical	EA	100.00	0	0
Administration	MO	2,000.00	0	0
Contingency	%	30%	0	0
SUBTOTAL, ANNUAL O&M COSTS				0
PRESENT WORTH OF ANNUAL COSTS n = 8 years, interest rate = 8%, P/A = 5.75		5.75	0	0
TOTAL (total capital + present worth of annual o&m costs)				205,000

GRAND TOTAL 205,000

ASSUMPTIONS:
1. Costs rounded up to the nearest thousand dollars.
2. Perimeters, areas, and volumes of AOC's determined from Figure 6.
3. Piping quantities based on individual lines connecting each SVE extraction trench.
4. Hauling soil to a Biopile based on an one hour (one-way) travel time.
5. Dewatering costs do not include costs for water disposal.
6. Costs determined from vendor quotes, Means Construction Cost data, and estimates from other similar projects.
7. 50% of trenching soils require disposal at a Biopile.
8. Contingency is assumed to be 30% of direct capital and 30% of annual O&M.
9. All costs are based on preliminary concepts only. They are intended for comparison among alternatives and not for final budgeting.
10. Site preparation is assumed to be done by others; these costs are reflected in other alternatives.

TABLE A5

CONCEPTUAL COST ESTIMATE
FOR NR 700 REMEDIAL ACTION OPTIONS REPORT

GEORGIA GULF
Project # 3974.03

REMEDIAL ALTERNATIVE 5 AOC 5 - Vapor Barrier Enhancement

LINE ITEM	UNIT	UNIT COST	AOC 5 QUANTITY	AOC 5 TOTAL
DIRECT CAPITAL				
MOBILIZATION	LS	5,000.00	1	5,000
SITE PREPARATION				
Additional grading	SY	1.00	8,500	9,000
Select fill layer below membrane	CY	14.00	1,400	20,000
CONSTRUCTION/SITE WORK				
Geotextile fabric above and below membrane	SY	0.90	17,000	16,000
Geomembrane, 40 ml VDPE	SF	1.00	37,500	38,000
Drainage layer above membrane	CY	14.00	1,400	20,000
Miscellaneous related construction	LS	20,000.00	1	20,000
PURCHASED EQUIPMENT				
Pumps and controls	LS	1,500.00	0	0
OFF-SITE DISPOSAL				
Landfill disposal, Subtitle D	TON	20.00	0	0
Biopile disposal	TON	25.00	0	0
SUBTOTAL, DIRECT CAPITAL COSTS				128,000
INDIRECT CAPITAL COSTS				
Design	%	10%	128,000	13,000
Bidding and Construction Assistance	%	10%	128,000	13,000
Construction documentation	%	5%	128,000	7,000
Laboratory Analysis				
Confirmation of treatment	TON	1.00	0	0
Extent of excavation confirmation	EA	80.00	0	0
Air permit application assistance	LS	5,000.00	0	0
Waste profile acceptance assistance	LS	5,000.00	0	0
Startup/shakedown	LS	10,000.00		
Contingency	%	30%	128,000	39,000
SUBTOTAL, INDIRECT CAPITAL COSTS				72,000
TOTAL CAPITAL COSTS				200,000
ANNUAL OPERATION AND MAINTENANCE COSTS				
Operating labor	MO	1,000.00	0	0
Maintenance labor	MO	500.00	0	0
Power	MO	375.00	0	0
Analytical	EA	100.00	0	0
Administration	MO	2,000.00	0	0
Contingency	%	30%	0	0
SUBTOTAL, ANNUAL O&M COSTS				0
PRESENT WORTH OF ANNUAL COSTS n = 8 years, interest rate = 8%, P/A = 5.75		5.75	0	0
TOTAL (total capital + present worth of annual o&m costs)				200,000

GRAND TOTAL 200,000

ASSUMPTIONS:

1. Costs rounded up to the nearest thousand dollars.
2. Perimeters, areas, and volumes of AOC's determined from Figure 6.
3. Costs determined from vendor quotes, Means Construction Cost data, and estimates from other similar projects.
4. Mobilization costs for this alternative are for this alternative only. Additional mobilization costs are included in other alternatives.
5. Contingency is assumed to be 30% of direct capital and 30% of annual O&M.
6. All costs are based on preliminary concepts only. They are intended for comparison among alternatives and not for final budgeting.