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Remedial Action Assessment System (RAAS): Evaluation of Selected Feasibility Studies of CERCLA Hazardous Waste Sites

G. Whelan
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April 1990

Prepared for the
Office of Environment, Safety, and Health
U.S. Department of Energy
Washington, D.C. 20585
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REMEDIAL ACTION ASSESSMENT SYSTEM (RAAS): EVALUATION OF SELECTED FEASIBILITY STUDIES OF CERCLA HAZARDOUS WASTE SITES

G. Whelan
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(a) R. W. Beck and Associates

EXECUTIVE SUMMARY

The Multimedia Environmental Pollutant Assessment System (MEPAS) has been developed, and the Remedial Action Assessment System (RAAS) is being developed to help implement the Remedial Investigation (RI), Endangerment Assessment (EA), and Feasibility Study (FS) processes under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986 in a more consistent, timely, and cost-effective manner. MEPAS and RAAS can be integrated into the process to 1) focus on and prioritize the environmental issues at a waste unit, and 2) screen remedial alternatives to ensure that the appropriate environmental issues are addressed and that only the most appropriate remedial alternatives are highlighted for final consideration. MEPAS is a user-friendly, computer-based system that is designed to assess environmental issues/problems on the basis of limited site data by performing a physics-based transport, exposure, and health effects assessment. The RAAS feasibility study assessment methodology (currently under development) investigates remedial action alternatives by 1) identifying appropriate individual (unit) processes that can help meet Applicable or Relevant and Appropriate Requirements (ARARs or cleanup standards), 2) integrating unit processes into treatment trains, 3) evaluating each remedial alternative with respect to performance, reliability, implementability, and short- and long-term effectiveness, and 4) evaluating the potential risk to surrounding sensitive receptors (using the MEPAS or other appropriate methodology) for the waste streams associated with each remedial alternative.

Although the U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) have developed excellent guidance on the RI/EA/FS process, practical tools are still needed to help implement this guidance. Just as MEPAS can provide a preliminary EA (i.e., an assessment of source-to-receptor transport and risk), the RAAS methodology can provide a preliminary FS (i.e., can identify cleanup options). The objective of RAAS is to provide a rapid, user-friendly system to help screen appropriate treatment technologies for a given site and specific conditions and then to relate these technologies to remedial alternatives. The list of remedial actions

developed will provide alternatives to be considered in the FS. Having this list would help in effectively implementing the RI/FS compression effort that is currently under way at all DOE facilities and EPA sites.

The objective of this effort is to initiate the development of a data base relating waste and site characteristics with selected treatment processes, which can then be used in developing the RAAS methodology. This compression effort comprises the following two steps:

- Collecting selected readily and publicly available CERCLA FSs and Records of Decision (RODs) for remediating hazardous waste sites. Treatment technologies identified in these documents will form the basis of alternative Remedial Actions (RAs) to be considered in the RAAS methodology. The FSs reviewed for the current study were those associated with EPA CERCLA sites under the jurisdiction of EPA (as opposed to the State). DOE sites have not been included in this initial study because FSs at DOE facilities had not been fully collected at the time of this report. DOE sites will be included in the next review.

- Reviewing the selected FSs and developing a data base from this literature. The data base contains the following information:

  - CERCLA FS and ROD remedial technology findings

  - a summary of why these technologies were considered for the particular waste and site characteristics

  - a summary of technologies divided into source- and migration-control categories

  - a summary of technologies divided by treatment mode (i.e., at-grade, in situ, and offsite), treatment method (i.e., chemical, physical, thermal, and biological), and treatment process (e.g., in situ vitrification, land farming)

  - waste and site characteristics correlated with the technologies.

The information gathered from the FS review has been assembled in this report. The report also contains a suite of matrices and tables summarizing the findings. Also contained in this report is an overview of how the RAAS methodology is integrated into the RI/EA/FS process.

The effort represented by this report is an initial review of selected FSs. The final phase of the FS review effort will occur in Fiscal Year 1990, and it will involve selected DOE and EPA FSs that are available for examination. Emphasis will be placed on ensuring that all FSs associated with DOE facilities are included in the final document.

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CONTENTS

FIGURES

TABLE

ACRONYMS

ACL	alternate contaminant level
AMM	asbestos-mining materials
AO	Administrative Order
AOW	asbestos-ore waste
ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
Cr	chromium
CWA	Clean Water Act
DER	Department of Environmental Resources
DOE	U.S. Department of Energy
DOE-ESH	DOE's Office of Environment, Safety, and Health
D.O.T.	U.S. Department of Transportation
DQOs	data quality objectives
DWS	drinking water standards
EA	Endangerment Assessment
EPA	U.S. Environmental Protection Agency
FHC	Frontier Hard Chrome site
FS	Feasibility Study
FS-1	Phase I FS
FS-2	Phase II FS
FS-3	Phase III FS
GAC	granular activated carbon (process)
GMC-CFD	General Motors Corporation, Central Foundry Division
HCl	hydrochloric acid

HRS	Hazard Ranking System
KOH	potassium hydroxide
M	million
MCL	Maximum Contaminant Level
MEPAS	Multimedia Environmental Pollutant Assessment System
N/A	not addressed
NCP	National Contingency Plan
NPDES	National Pollution Dispersion Elimination System
NPL	National Priorities List
NYCRR	New York Coastal and River Regulations
NYDEC	New York Department of Energy Conservation
O&M	operations and maintenance (costs)
PA	Preliminary Assessment
PA/SI	Preliminary Assessment/Site Inspection
PCBs	polychlorinated biphenyls
PCE	perchloroethylene
PEG	polyethylene glycols
PEL	Permissible Exposure Limit
PLM	polarized light microscopy
PNAs	polynuclear aromatic hydrocarbons
PNL	Pacific Northwest Laboratory
RA	Remedial Action
RAAS	Remedial Action Assessment System
RAPS	Remedial Action Priority System
RBC	rotating biological contactor
RCRA	Resource Conservation and Recovery Act of 1976

RI	Remedial Investigation
RI-1	Phase I RI
RI-2	Phase II RI
RMCL	Recommended Maximum Contaminant Level
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SBR	steady-state batch reactor
SDWA	Safe Drinking Water Act
SPEDS	State Permitting Discharge System
TCE	trichloroethylene
TSCA	Toxic Substances Control Act of 1976 and 1987
UV	ultraviolet
WMU	waste management unit
WQC	water quality criteria

1.0 INTRODUCTION[a]

With the passage of the Resource Conservation and Recovery Act (RCRA) of 1976, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and the Superfund Amendments and Reauthorization Act (SARA) of 1986, Congress and the public have mandated much closer scrutiny of the management of chemically hazardous and radioactive mixed wastes. Legislative language, regulatory intent, and prudent technical judgment, as illustrated by the National Contingency Plan (NCP), call for using scientifically based studies to assess current conditions and to evaluate and select cost-effective strategies for mitigating unacceptable situations.

The NCP requires that a Remedial Investigation (RI) and a Feasibility Study (FS) be conducted at each site targeted for remedial response action. The goal of the RI is to obtain the site data needed so that the potential impacts on public health or welfare or on the environment can be evaluated and so that the remedial alternatives can be identified and selected. The goal of the FS is to identify and evaluate alternative remedial actions (including a no-action alternative) in terms of their cost, effectiveness, and engineering feasibility. The RI emphasizes data collection and site characterization, and the FS emphasizes data analysis and the evaluation of alternative remedial actions (RAs). The NCP also requires the analysis of impacts on public health and welfare and on the environment; this analysis is the endangerment assessment (EA). The overall objective of the EA is to provide a determination of the magnitude and probability of actual or potential harm to public health and welfare or to the environment by the threatened or actual release of a hazardous substance (including hazardous waste). In summary, the RI, EA, and FS processes require assessment of the contamination at a site, of the potential impacts on public health or the environment from that contamination, and of alternative RAs that could address potential impacts to the environment.

In general, the RI, EA, and FS processes have proved to be time-consuming and expensive (OTA 1988). For a site to be added to the National

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(a) Portions of this section are based on a paper by Hartz and Whelan (1988).

Priorities List (NPL) by reaching a "C"- (for completed) level Record of Decision (ROD) has typically taken far longer than 4 years for sites in the Pacific Northwest (Idaho, Montana, Oregon, and Washington) (Porter 1987). Only one site (the Tofdahl Drum Site near Brush Prairie, Washington) has received a "C"-level ROD in less than 2 years. Generally, it takes 2 years to reach an "I"- (interim-) level ROD and at least 4 years to reach an "O"- (operable-) level ROD. As a result, the U.S. Environmental Protection Agency (EPA) would like to shorten the RI/EA/FS process (Porter 1987). Clearly, if this goal is to be attained, methods that can implement the guidance provided by CERCLA/SARA are needed to help reduce resource and time requirements.

The U.S. Department of Energy (DOE) has taken the first step in developing such methods by having the Pacific Northwest Laboratory (PNL) develop the Multimedia Environmental Pollutant Assessment System (MEPAS). MEPAS is a user-friendly, computer-based system that is designed to assess environmental problems based on limited site data, by performing a physics-based assessment of transport, exposure, and health effects. The next logical step in improving the assessment process is to develop other tools to be used in specifically addressing environmental degradation, evaluating and mitigating environmental problems, and addressing EPA and DOE concerns related to the RI, EA, and especially FS processes.

The purpose of the research effort described in this report is to develop a standardized and comprehensive system, the Remedial Action Assessment System (RAAS), to evaluate the full spectrum of possible RAs at a hazardous waste site. The system will include a data base of all technologies that have been identified as potentially applicable to waste remediation. Development of the system will provide the necessary tools, guidance, and assistance to ensure consistent and technically defensible FS activities.

Because many environmental issues at DOE sites fall under the jurisdiction of CERCLA, SARA, and/or RCRA, EPA and DOE are working together to fulfill the intent of the RI/EA/FS process. Although EPA has provided general guidance for conducting RIs (EPA 1985a), EAs (EPA 1985b, 1988), and FSs (EPA 1985c, 1988), detailed procedures are not readily available to implement these guidelines; consequently, analyses tend to be inconsistent from site to site, and the quantity and quality of documentation vary. To implement the RI/EA/FS process more consistently, promptly, and cost-effectively, a systematic methodology is required to 1) focus on and prioritize the environmental issues (e.g., to determine whether groundwater contamination or atmospheric suspension of contaminated surface soil is the main problem) and 2) screen RAs to ensure that the appropriate environmental issues are addressed and that only the most appropriate remedial alternatives are highlighted for final consideration. MEPAS has been developed to serve the first purpose and RAAS will serve the second.

This systematic, integrated methodology ties a source-to-receptor analysis with performance characteristics (e.g., effectiveness, reliability, confidence, implementability, and cost) of the RA process, and thus ensures that 1) consistent sets of data and information are collected at each waste unit and at each site; 2) documentation is standardized to ensure traceability of input and results of the assessment, because traceability enhances credibility; 3) fewer senior technical staff are required; 4) substantial time can be saved because of the standardization; 5) implementation costs associated with labor can be reduced substantially; 6) staff are used more efficiently; 7) analyses are consistent from site to site across the United States; 8) the approach for licensing and compliance negotiations is more consistent; 9) internal and external surveys/audits are made more meaningful; 10) an effective vehicle is developed for internal and external peer reviews; 11) appropriate problems and the reasons behind the problems are identified; and 12) an objective analysis for providing insight to the most effective technologies can be developed.

OBJECTIVE AND SCOPE

The objective of the current effort is to initiate the development of the RAAS methodology, by initiating the development of a data base that correlates waste and site characteristics with selected treatment processes.

The selected approach for developing the data base is focused, providing the most information for the lowest cost. A baseline of treatment technologies should be identified that are acceptable (i.e., proven methodologies) to

DOE and EPA for remediating waste sites. The selection of these technologies should be based on site and waste characteristics at actual sites requiring cleanup. This approach identifies site and waste characteristics and develops a data base outlining specific technologies for remediation. This approach is focused and cost effective for three reasons: 1) it is based on proven technologies, 2) it is based on data that are currently available, and 3) it identifies where there are gaps in the data concerning current technologies for remediating particular waste streams and sites.

The initial suite of treatment technologies should be based on those identified in CERCLA-related FSs and RODs (Records of Decision) at major DOE Operation Offices and pertinent EPA Superfund sites. This will provide a well-known and manageable baseline and should include most of the currently important remedial technologies. When new technologies are identified, they can easily be added into the system.

Baes and Marland (1989) have evaluated cleanup levels for selected remedial actions at EPA CERCLA sites, based on the RODs. Although their document contains pertinent information, their study had a different focus from the present work:

- They focused on cleanup standards rather than the remedial alternatives associated with the waste sites. The RAAS effort focuses on the remedial alternatives associated with the sites.
- They looked at only 42 of 218 RODs, all for U.S. Department of Defense Navy sites. The RAAS effort will look at DOE and EPA FSs as well as RODs.
- They provided only a cursory review of the type of cleanup remedy suggested for the site. The RAAS effort will focus on all suggested remedies in the FS and will correlate these technologies with waste and site characteristics and with source- and migration-control strategies.

Having this baseline of treatment technologies allows us to use scientifically and cost effectively all of the DOE and EPA analyses that were associated with previous remedial alternative assessments. Several benefits are associated with this effort:

- A focused effort to identify appropriate and acceptable (i.e., acceptable to DOE and EPA) treatment technologies will result in a cost-effective use of resources. A baseline of acceptable treatment technologies will be established.

- Technologies will be identified as either source- or migration-control approaches. These technologies will be correlated with waste and site characteristics. In addition, treatment modes (i.e., at-grade, in situ, and offsite), methods (i.e., chemical, physical, biological, and thermal), and processes (e.g., incineration) will be identified.

- Technologies that are currently recommended for addressing particular waste streams and site characteristics will be collated. A baseline of acceptable technologies will be established. If a similar approach is suggested at a particular DOE facility, documentation supporting the DOE facility position on this approach will have been identified and be available.

- For DOE-site waste streams and site characteristics that are not addressed by current FSs and RODs, data gaps will inherently be identified. This could help focus research efforts and allocation of funds.

- The results from this initial effort could help in the RI/FS compression process.

STRUCTURE OF THE REPORT

The information gathered from the FS review has been assembled in this report. The report also contains a suite of matrices and tables summarizing the findings.

The remainder of this report is divided into 11 chapters. Chapter 2.0 presents an overview of how the RAAS methodology is integrated into the RI/EA/FS process and illustrates how the RAAS methodology can be used to mimic portions of the process. Chapter 3.0 briefly reviews the format in which FSs are summarized. Chapters 4.0 through 11.0 present the FS reviews for eight CERCLA or SARA sites. Finally, Chapter 12.0 presents the references cited throughout the document.

2.0 OVERVIEW OF THE RAAS METHODOLOGY AS INTEGRATED INTO THE RI/EA/FS PROCESS[a]

This chapter presents an overview of how the RAAS methodology is integrated into the RI/EA/FS process. The overview is divided into the following sections:

- RAAS and MEPAS in the RI/EA/FS Process -- This section explains how the RAAS and MEPAS methodologies help mimic portions of the RI/EA/FS process.
- MEPAS Methodology -- This section briefly describes the MEPAS methodology.
- RAAS Methodology -- This section describes the RAAS methodology and the components that it comprises.
- Integration of RAAS and MEPAS -- This section explains how the RAAS and MEPAS methodologies interact as part of the RI/EA/FS process.
- Summary -- This section briefly summarizes the chapter.

RAAS AND MEPAS IN THE RI/EA/FS PROCESS

The MEPAS and RAAS methodologies are not intended to conflict with or provide alternative guidance to EPA's RI/EA/FS process. On the contrary, these methodologies emulate or mimic portions of the RI/EA/FS process. Because they do, they are tools that can provide a more consistent and cost-effective approach for assessing a CERCLA/SARA site.

To remediate an inactive hazardous waste site under CERCLA or SARA using MEPAS and RAAS, the process is as follows (Figure 2.1):

1. Following a site "discovery," a Preliminary Assessment/Site Inspection (PA/SI) is performed. Typical activities associated with the PA/SI process include 1) reviewing historical records of the site, 2) developing data files, 3) visiting the site and taking "grab" samples, as appropriate, and 4) documenting the environmental setting and nearby populations. The Hazard Ranking System (HRS) is applied to the site; those sites scoring above 28.5 on a scale of 0 to 100 are proposed for addition to the NPL and enter the RI/EA/FS process.

(a) Portions of this section are based on a paper by Hartz and Whelan (1988).

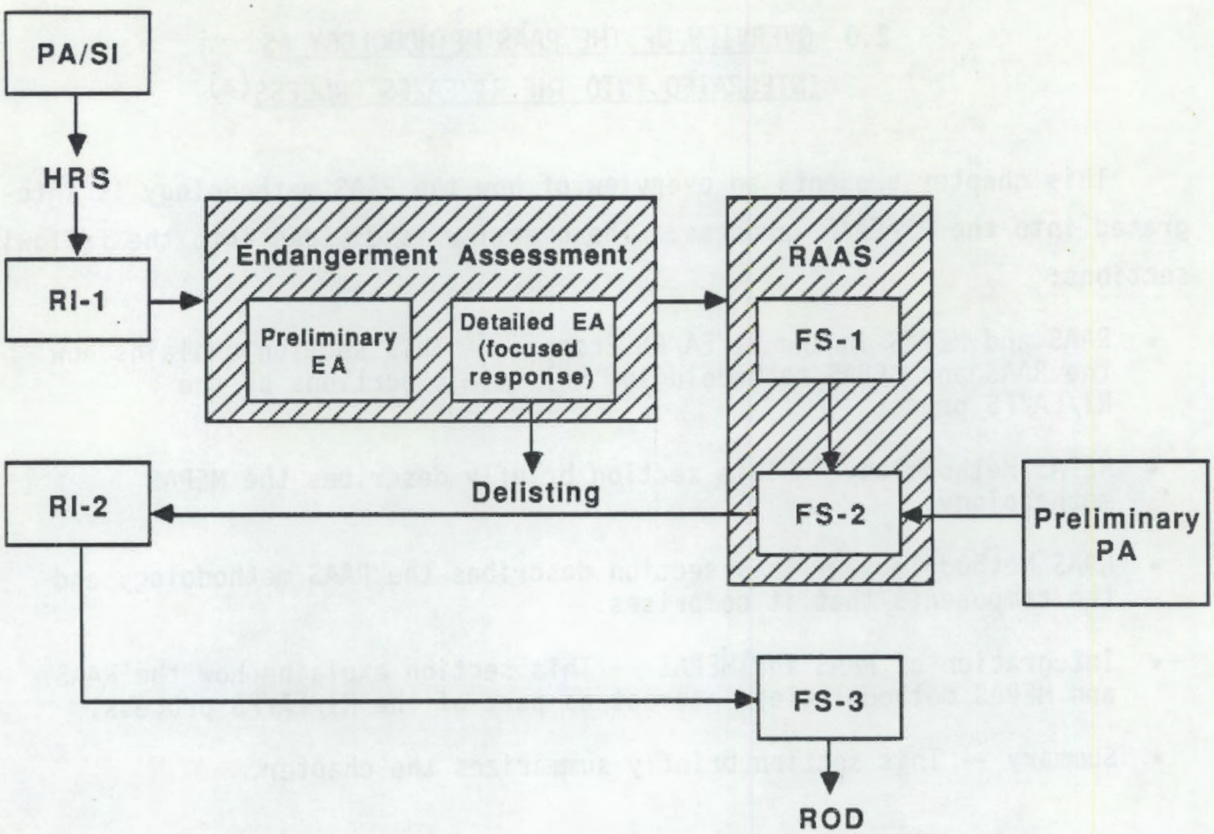

FIGURE 2.1. MEPAS and RAAS Methodologies as Integrated into the RI/EA/FS Process

2. At the outset of the RI/EA/FS process, the following efforts are initiated: 1) a site-scoping study, in which site data are collected and reviewed, potential Applicable or Relevant and Appropriate Requirements (ARARs; i.e., contaminant levels or health standards) are identified, likely remedial responses are identified, and data quality objectives are identified; and 2) development of work plans that address technology, quality assurance and quality control, project management, sampling and analysis, data management, health and safety, and community relations. A Phase I RI (RI-1) is performed to define the nature and extent of the contamination by initiating field data collection at the site, to determine cleanup goals, and to refine data quality objectives.

3. EAs may be performed at CERCLA sites 1) before issuance of an Administrative Order for removal actions, 2) as part of the RI/FS process, 3) before issuance of an Administrative Order or consent decree of a responsible party for RI/FS or cleanup (i.e., for remedial actions), 4) before issuance of an Administrative Order to a federal facility for cleanup, or 5) before any judicial action is taken. A two-step procedure (involving preliminary and then

detailed EAs; see Figure 2.1) minimizes the effort and maximizes the focus of the assessment. First, a preliminary EA focuses on the potential issues/problems at the waste site by implementing the MEPAS or other appropriate methodology. Second, based on the assessment, a more focused and detailed EA using more quantitative preliminary assessment tools may determine the disposition of the site (i.e., either removal from the NPL or continuation in the RI/FS process). Conducting an EA corresponds, for all practical purposes, to what is done for the no-action alternative in the FS process. All information and data collected for the EA conducted by MEPAS are equally useful and applicable to the more detailed assessment, so that the information collected can be used cost-effectively.

4. In addition to the no-action alternative, the Phase I FS (FS-1) identifies as many as 100-150 alternative treatment technologies, performs preliminary screening of treatment technologies, and organizes these technologies into alternative RAs. For the RAs, the Phase II FS (FS-2) establishes screening criteria (e.g., effectiveness, implementability, and cost), and then screens RAs and identifies what treatability studies are needed. A preliminary assessment using the MEPAS or other appropriate methodology incorporates selected risk to the surrounding population in the screening process by evaluating the waste streams associated with each alternative RA. The RAAS methodology performs tasks associated with FS-1 and FS-2 while making use of the MEPAS methodology for the preliminary assessment; the primary screening criterion is the reduction of risk provided by each RA.

5. A Phase II RI (RI-2) is performed to complete the site characterization and to conduct treatability studies.

6. A Phase III FS (FS-3) is performed to critically review each RA and prioritize the RAs on the basis of the criteria established by the FS-2, probably using preliminary assessment tools that are more quantitative than MEPAS. The results of the FS-3 analysis are submitted for the ROD.

The RAAS methodology is intended to perform the activities under Phases I and II of the FS (FS-1 and FS-2, respectively) in accordance with SARA guidance. These phases include identifying treatment technologies, linking these technologies into RAs, and initially screening these RAs to reduce the number of alternatives on a final list to be considered during Phase III of the FS (FS-3). The benefits of using RAAS include reductions in how long the process takes, its cost, and the need for senior technical skills; consistent results; and full evaluation of all possible RAs.

MEPAS METHODOLOGY

The MEPAS methodology is an expanded version of the Remedial Action Priority System (RAPS) and is currently documented both as part of the RAPS methodology (Whelan et al. 1985, 1986, 1987a,b, 1988, 1989) and under its own name (Droppo and Buck 1988; Hoopes et al. 1988). MEPAS is an objective, computer-based, physics-based system that provides a means of quantifying the relative risks caused by contaminants released into the environment. The MEPAS methodology provides DOE with a management tool for assessing active and inactive hazardous and radioactive mixed-waste disposal sites in a scientific and objective manner despite limited site information. MEPAS is currently being used for DOE's Environmental Survey, which is assessing environmental issues associated with DOE facilities.

The MEPAS methodology uses empirically, analytically, and semianalytically based mathematical algorithms and a coupled-pathways analysis to predict the potential for contaminants to migrate from a waste site to important environmental receptors. Subsurface (groundwater), overland, surface-water (e.g., rivers, wetlands, and lakes), and atmospheric pathways are considered. Using the predictions of contaminant transport, simplified exposure assessments are performed for important receptors. The relative risks associated with the sites are then calculated (Whelan et al. 1986, 1987a,b).

Based on input data that are readily available, MEPAS considers 1) specific site information and constituent characteristics associated with the pathways; 2) chemical and radioactive wastes; 3) the potential direction of contaminant movement; 4) contaminant retention (e.g., environmental mobility, dispersion, and decay/degradation), where applicable; 5) contaminant toxicities; 6) population distributions; 7) various routes or types of exposure (e.g., inhalation, ingestion, dermal contact, and external dose); 8) time until a population is exposed or exposure begins (i.e., time of contaminant arrival); and 9) duration of exposure (i.e., the length of time that a population is continually exposed to a contaminant). The time of contaminant arrival and the duration of exposure are critical considerations in site prioritization; the sooner a population is exposed, the greater the urgency of site characterization and possible remediation. Likewise, the longer a population is exposed to a contaminant, the greater the potential severity of that exposure. Consideration of both of these factors has been absent from more simplified assessment methodologies (Whelan et al. 1986, 1987a,b).

Structurally, the MEPAS methodology involves a set of codes that describe the migration and fate of contaminants through each transport pathway. These transport-pathway codes are systematically integrated with an exposure-assessment component that considers the type, time, and duration of exposure and the location and size of the population exposed. Figure 2.2 is a simplified diagram outlining the various pathways and their interactions as considered by MEPAS (Whelan et al. 1986, 1987a,b).

To implement MEPAS at a site, the user designates appropriate transport pathways by identifying the path [i.e., routes(s)] taken by contaminants from the waste site through the various media. The user is then prompted to supply site and constituent (i.e., contaminant) information. Based on these data, MEPAs simulates the migration and fate of the contaminants from the source through the designated transport pathways to important environmental receptors. The route by which the population is exposed is integrated into the analysis, and the consequent risk to the population is computed for the site.

The relative risk that is computed reflects the results of the multimedia transport calculations, the exposure assessment, and the effects of exposure on a population of concern. It directly considers population distributions, contaminant levels that reflect persistence and mobility at important receptors, contaminant toxicity, routes and levels of exposure, duration of exposure, and the length of time until a population is exposed. It is also based on scientifically accepted relationships between dose and health effects. The computed relative risk is used for quantitatively comparing the potential migration, fate, and effects of hazardous substances.

The shaded boxes in Figure 2.2 illustrate an example application of the MEPAS methodology. Leachate leaves the waste site and enters the groundwater pathway, travels through the partially saturated zone, enters and travels through the saturated zone, leaves the groundwater pathway and enters the surface-water pathway, and migrates through a nearby river. At

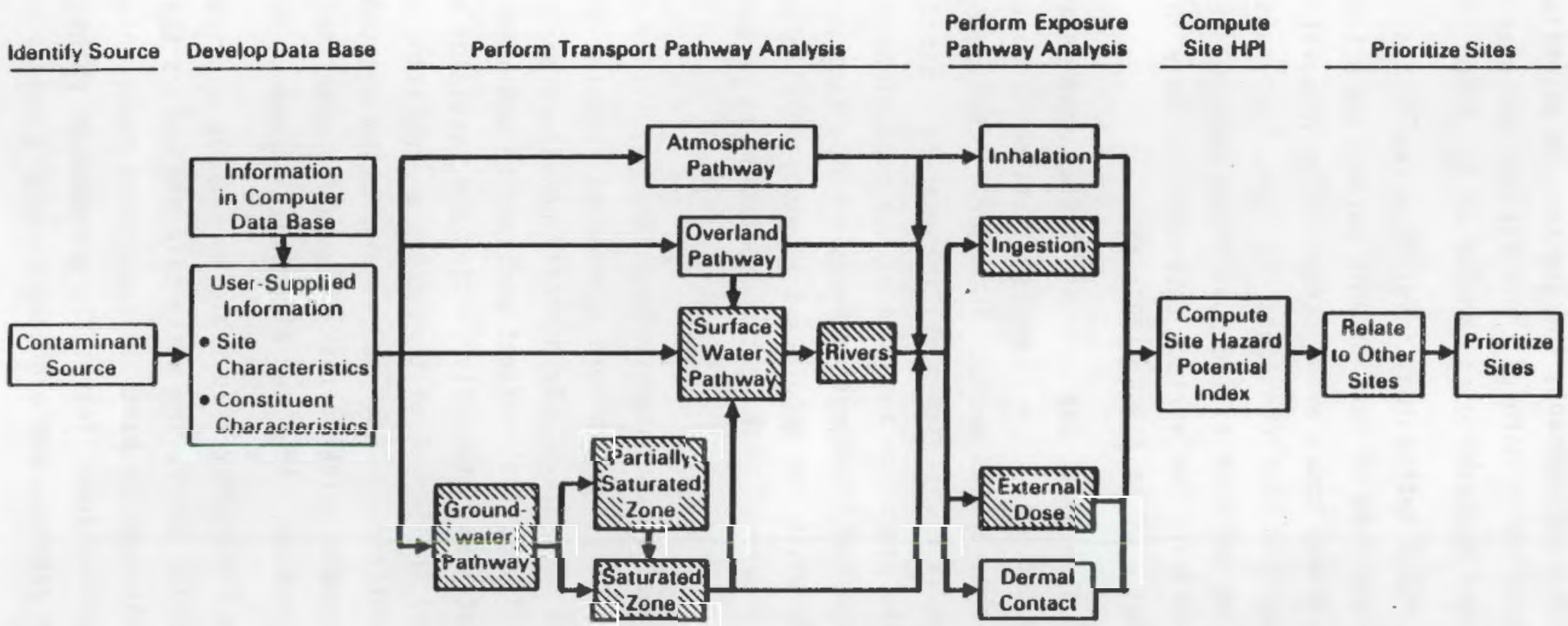

FIGURE 2.2. Simplified Diagram Outlining the Interactions Between the Transport Pathways and Exposure-Assessment Components of the MEPAS Methodology (shaded boxes indicate a potential contaminant transport and exposure route using the MEPAS methodology). (After Whelan et al. 1986, 1987a)

designated usage locations, the population is exposed externally to contaminants of concern and, in addition, ingests a portion of the contaminated river water. A relative risk is computed on the basis of exposure to the population. If MEPAS is being used with the RAAS methodology, the risks associated with a particular RA would be compared to the risks calculated for other RAs to help prioritize the RAs. Example applications of the MEPAS methodology have been presented by Whelan et al. (1987a).

RAAS METHODOLOGY

The RAAS methodology (Hartz and Whelan 1988) is a quantitative system for the initial comparative evaluation and screening of remedial alternatives. RAAS should be further developed to allow it to assist in the complete evaluation of all possible treatment technologies. Historically, some criticism has been directed at the selection of remedial alternatives. Before the enactment of SARA, those sites receiving "C"-level ROOs predominantly emphasized containment features (e.g., capping). Implementation of the features of SARA are changing this emphasis. Although the containment option is one that is identified in the FS-1, under SARA those technologies that reduce volume or toxicity or, preferably, that destroy the waste are given priority. In line with this philosophy and as stated within the SARA guidance, a range of options must be maintained as remedial alternatives are identified and screened. This stipulation of a range of options means that various isolation and containment schemes should be considered.

In addition, the final group of remedial alternatives considered should include more intensive types of technology. Such technologies concentrate and immobilize the conservative (non-degrading) hazardous wastes (e.g., heavy metals) and destroy the nonconservative wastes, such as organic chemicals and anions, virtually completely.

Because so many options must be considered, even though it is generally desired that the RI/FS process should take less time, those performing the work are burdened with an expanded work scope. The investigators responsible for performing the FS must track more remedial alternatives through to the final selection phase (FS-3). If the identification of treatment technologies, the linking of these technologies into remedial alternatives, and the initial screening of these alternatives are performed manually, it will almost certainly take even longer to perform the RI/FS work under the SARA guidance than under the more traditional approach. The three work elements just identified (identification, linking, and initial screening) are precisely those that RAAS is intended to perform. These work elements are the major objectives of Phases I and II of the FS. The simplified flow diagram of the RI/FS in Figure 2.1 shows those portions that can be performed by MEPAS and RAAS.

In its basic form, RAAS will consist of a data base that describes each treatment technology, a set of procedures that will couple the treatment technologies into remedial alternatives, and a set of criteria that will be used to screen each remedial alternative. When combined with MEPAS, RAAS will not only develop the no-action alternative (i.e., the EA), but will also evaluate the relative reduction in risk associated with each remedial alternative. This integrated methodology will reduce the manual effort necessary to perform FS-1 and FS-2.

The RAAS data base will include information that details each treatment technology. The data base can be organized as an array of individual (unit) process characteristics. A simplified array is presented in Table 2.1. To

TABLE 2.1. Array of Unit-Process Characteristics

Treatment Modes	Treatment Methods	Treatment Objectives	Process Performance Characteristics	Costs
In situ	Biological	Destruction	Effectiveness	Capital
At-grade	Chemical	Encapsulation	Reliability	Maintenance
Offsite	Physical	Containment	Confidence	Operating
	Thermal	Disposal	Implementability	

be effective, the data base will require much greater detail for each unit process. At a minimum, the following information must be included for each unit process:

a. waste categories for which the treatment technology is appropriate

b. the name and a brief description of the treatment process

c. application constraints, specifically the application mode (in situ, at-grade, offsite)

d. all necessary pretreatments (e.g., organic constituents should be removed before application of ion exchange)

e. appropriate design models and performance response as a function of loading for known hazardous wastes

f. identification of all secondary effluents that will require further remediation

g. capital costs based on scale

h. operations and maintenance costs based on scale

i. implementation constraints or characteristics.

The data base is expected to be organized as shown in Figure 2.3. This organization will facilitate the omission of certain irrelevant or unacceptable groups of technologies, if desired. As an example, for institutional reasons, an investigator may not wish to consider any biological processes. This segment of the data base could then be blocked off during the search mode.

Processes will be established within RAAS that will link treatment technologies into remedial alternatives. These links will incorporate required pretreatments and secondary treatments. In addition, secondary effluent characteristics may require the application of treatment technologies. Therefore, the linking process will be iterative until all waste streams, both primary and secondary, meet ARARs. For example, some processes will probably not be able to perform well enough to meet the ARARs. Therefore, additional treatments may be required. For instance, biological treatment may require subsequent air stripping to meet the ARARs for a hazardous solvent waste.

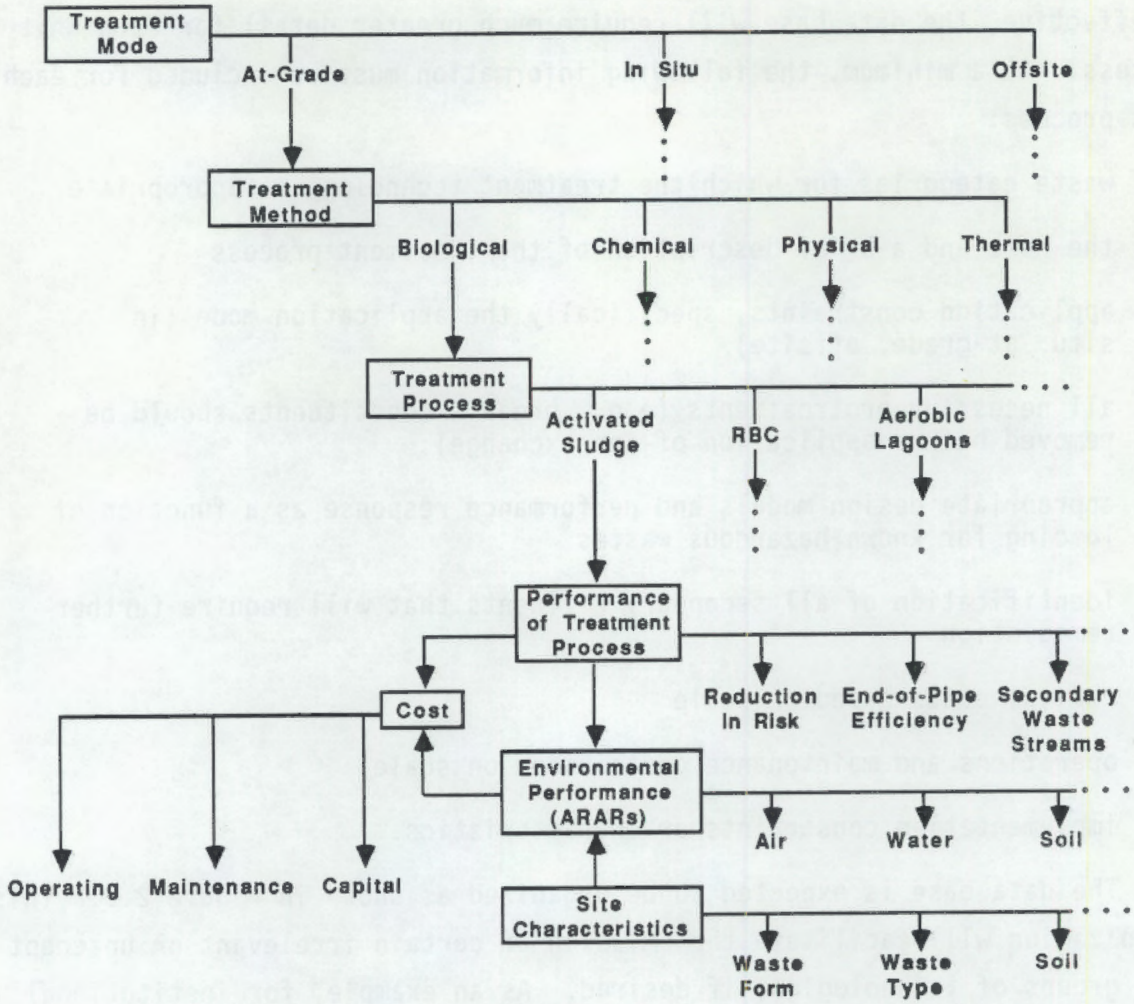

FIGURE 2.3. Simple Schematic Illustrating Application of RAAS

The CERCLA and SARA guidance provides three criteria for initially screening the remedial alternatives: effectiveness, implementability, and cost. The effectiveness criterion refers to those measures of performance that evaluate the ability of the process to reduce or eliminate toxicity. A measure of effectiveness that includes reducing toxicity is risk reduction. The purpose of MEPAS is to estimate health risk; therefore, MEPAS could be used with RAAS to evaluate effectiveness for environmental performance assessment. Thus, the real measure of effectiveness of a remedial alternative is whether the risk to human health is sufficiently reduced or eliminated.

The implementability criterion refers to the evaluation of procedures necessary to protect public health during implementation of an RA. For example, barriers, covers, and special protective gear may be required during source excavation. Reduced worker productivity and costs associated with the necessary safeguards should be considered, as should any intermittent increase in risk to human health. No additional risks, even if they are temporary, should be considered acceptable. Under these conditions, the costs associated with the implementation of a remedial alternative can be comparatively evaluated. Whether all safeguards are effected or not, evaluation of implementability on the basis of cost allows direct quantitative comparison.

The third criterion is cost. Both capital and operations and maintenance costs can be discounted to present worth. Cost algorithms would be associated with each treatment technology in the data base. These algorithms would describe capital, operating, and maintenance costs as a function of scale. Total life-cycle costs can be extrapolated to present worth on a relatively straightforward basis.

Together, these three criteria become the methodology for evaluating a remedial alternative. The questions to be answered are "How much is risk reduced?" and "How much does it cost?"

In summary, the RAAS methodology, coupled with the existing MEPAS or other appropriate methodology, represents the first source-to-receptor-to-remedial-action-alternative screening system that would provide a cost-effective, consistent, objective, and scientifically defensible framework for assessing hazardous waste sites. Implementation of these methodologies at operable units will provide valuable data for the decision-making process.

INTEGRATION OF RAAS AND MEPAS

Traditionally, site characterization, endangerment assessment, and selection of RAs, the three components of the RI/FS process, are performed independently, producing a less-than-optimal solution and consuming significant resources and time. Much of the data input required by the MEPAS methodology is also required to properly evaluate the RA possibilities.

Examples include waste type, waste characteristics, and transporting media. Elements currently missing from MEPAS include 1) a data base of treatment unit processes, 2) components to link these processes into remedial alternatives, and 3) components to evaluate and prioritize each RA in terms of its effective environmental performance as well as its treatment performance. Once the remedial alternatives have been analyzed, each would be evaluated by MEPAS with regard to its environmental performance (e.g., comparison with the no-action alternative). Figure 2.4 is a flow diagram illustrating the systematic, fully integrated FS process. The following is a brief explanation of the diagram in Figure 2.4:

- Input Data Determination--Data input to this integrated RI/FS methodology (i.e., the completed RAAS) include waste characteristics, waste form, waste inventory, transport media characteristics, and demography. The same information is supplied to MEPAS for evaluating the no-action alternative and to the unit-process evaluation.

- Identification of Unit Process--Researchers at PNL have identified the spectrum of these processes, including their treatment method, mode, objective, and performance characteristics.

- Remedial Action--Remedial action refers to the linkage of several unit processes to treat a waste (e.g., precipitation of heavy metals, followed by application of activated carbon, air stripping, and ion exchange). Secondary waste streams are produced by intermediate unit processes (e.g., heavy metals from precipitation) and are screened against ARARs. If the waste stream fails to meet the ARARs, it either re-enters the system or is disposed of properly; if it does meet the ARARs, it represents a component of the primary waste stream that can be released back into the environment.

- Environmental Performance Evaluation--Remedial alternatives are selected for each transport pathway. In conjunction with analysis of the no-action alternative, an initial screening is performed to eliminate all inappropriate remedial action alternatives.

- Process Performance Characteristics--A PA process performed for the remaining RAs considers effectiveness, implementability, and cost.

- Quantitative PA Methodology--The evaluation of process performance characteristics is combined with a MEPAS analysis of the effluent of the waste streams to determine the risk to the surrounding population.

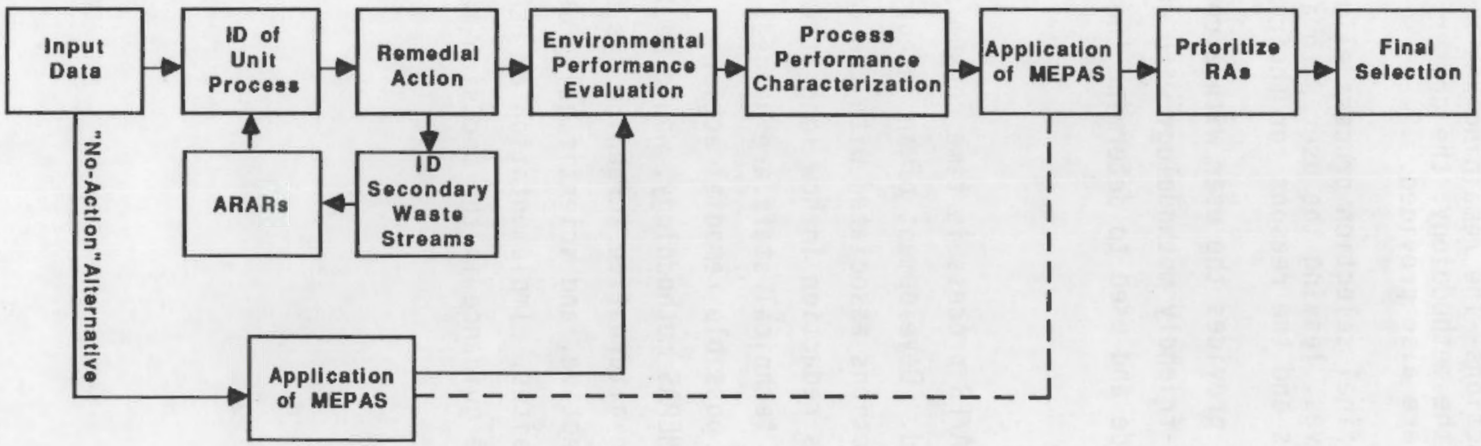

FIGURE 2.4. Integration of RAAS and MEPAS

- Prioritize Remedial Actions--The remaining RAs are prioritized after application of the methodology; the criteria used for making the ranking decision are also provided.

- Final Selection--The final selection process eliminates all undesirable alternatives, leaving the user with a suite of the most desirable alternatives and the reasons for their selection.

The approach outlined provides the user with a cost-effective, consistent, integrated, and user-friendly methodology with which a more focused final assessment can be made and used to determine the most appropriate RA.

SUMMARY

Implementing the RI/EA/FS process is time consuming and expensive when current approaches are used. Development of an integrated and standardized methodology to perform functions associated with the EA and FS components would have such benefits as reduction in how long it takes, how much it costs, and how many senior technical staff are needed; consistent results; and full evaluation of all possible remedial actions. The RAAS methodology, coupled with the existing MEPAS methodology, would be the first source-to-receptor-to-remedial-action-alternative screening system to provide a cost-effective, consistent, objective, and scientifically defensible framework for assessing hazardous waste sites. Implementation of MEPAS and RAAS at waste sites will provide valuable guidance in the decision-making process.

3.0 FEASIBILITY STUDY REVIEW FORMAT

This chapter includes a brief discussion of the format used in reviewing the FSs for this report. The purpose of these reviews is to obtain an appreciation for and identify those remedial alternatives that are currently being suggested as acceptable options for cleaning up waste sites. The reviews provided in the chapters that follow document the thinking process of the investigators who performed the FSs for EPA. The reviews are not meant to examine the FSs with respect to completeness or correctness. The alternatives suggested in these FSs either have already been or are currently going through a review cycle that includes a technical peer review and a public hearing.

The tone of the reviews and many of their words may be those of the authors of the FSs. Also, there may be contradictions between various reviews and FSs, because the authors of the different FSs may disagree about the effectiveness and implementability of a particular unit process. Such discrepancies have been retained to ensure that the reader recognizes that differences of opinion do exist in the technical community. Finally, the level of detail varies greatly between different FSs. The level of detail provided in the reviews reflects that of the original FSs.

The FS review format is divided into four distinct sections, as follows:

- Background Information on Site -- This section provides historical background for the waste site.
- Overview of Suggested Treatment Technologies -- This section identifies those unit processes initially considered for the cleanup action at the site.
- Environmental and Contaminant Information -- This section documents the primary constituents of interest, which determined the type of remedial alternatives being considered for cleaning up the waste site.
- Summary of Suggested Remedial Alternatives -- This section presents the remedial alternatives that were considered during the final review process and identifies the alternative that was finally suggested for cleaning up the site.

BACKGROUND INFORMATION ON SITE

This section contains pertinent information on the site that is being reviewed. The site's name, its location, different environmental matrices being considered for remediation, appropriate references, and a biographical sketch are provided. The following information was sought for the review:

SITE NAME: Identifies the common site name.

EPA REGION: Designates the EPA Region that has jurisdiction over the site.

STATE: Identifies the state in which the waste site is located.

REFERENCES: Documents the reports that formed the basis of the FS review.

ENVIRONMENTAL MATRIX: Reviews the environmental matrices (e.g., soil, groundwater, surface water, air, fish or animals) that contain the contaminants of concern and those matrices that are addressed by the alternative RAs. The intent of this discussion is to provide the reader with an appreciation of the different types of media (i.e., environmental matrices) that are being considered for cleanup and of the constituents that most affect which alternatives are suggested for use in the cleanup action.

CURRENT STATUS: Identifies the current status of the site as it is known to the reviewer. This tells the reader whether a remedial action has been implemented and whether the implementation was successful.

HISTORICAL SKETCH: Outlines the history of the site. The intent of this discussion is to provide the reader with a quick understanding of the extent, magnitude, and type of problems at the site.

OVERVIEW OF SUGGESTED TREATMENT TECHNOLOGIES

This section reviews the lists of unit processes that were initially considered in the preliminary FS. If the unit process was approved for further consideration, or if it was removed from further consideration, the reasons were noted. The intent of this review is to provide the reader with an understanding as to which unit processes are being considered for use in cleanup actions and the reasons why they were approved or removed from further consideration.

Each unit process has been categorized according to its treatment technology, or more specifically, according to the treatment method and objective. Each unit process can be categorized as involving one of four treatment methods: biological, chemical, thermal, or physical. As their names suggest, these treatment methods have their basis in either biological activity to remediate the waste (i.e., biological methods), chemical reactions to transform the waste (i.e., chemical methods), heat to alter the waste (i.e., thermal methods), or physical activities to contain or move the waste or to prevent exposure of surrounding receptors to the waste (i.e., physical methods). The four treatment methods are illustrated in Figure 3.1.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment
Destruction
Disposal
Encapsulation

Chemical

Containment
Destruction
Disposal
Encapsulation

Thermal

Containment
Destruction
Disposal
Encapsulation

Physical

Containment
Institutional Containment
Destruction
Disposal
Encapsulation
Excavation/Removal
Physical Handling/Processing
No-Action Alternative

FIGURE 3.1. Overview of Suggested Treatment Technologies

Typical biological unit processes include land farming, rotating biological contractors, air-activated sludge, trickling filter, and aerobic and anaerobic lagoons/ponds. For more information on biological treatment, refer to Freeman (1989), McArdle et al. (1988), Stewart et al. (1987),[a] Sims et al. (1984a, 1984b, 1986), Nyer (1985), and PNL (1983).

Typical chemical unit processes include chemical oxidation and reduction, chemical precipitation, ozonation, fixation, KOHPEG, NaPEG, PCBX, Acruex, and LARC. For more information about chemical methods, refer to Freeman (1989), McArdle et al. (1988), Stewart et al. (1987),[a] Bhatt et al. (1986), Nyer (1985), and Peirce and Vesilind (1981).

Typical thermal processes include in situ vitrification, liquid injection incineration, use of rotary kilns, fluidized-bed thermal oxidation, wet oxidation, and pyrolysis processes. For more information about thermal processes, refer to Freeman (1989), OGE (1988), Stewart et al. (1987),[a] and Martin and Johnson (1987).

Finally, typical physical processes include filtration and separation, solvent extraction, evaporation, permeable beds, slurry walls, grout curtains, pumping, groundwater reinjection, sheet piling, air stripping, landfilling, capping, liners, screening, shredding, magnetic sorting, fencing, and revegetation. For more information about physical processes, refer to Freeman (1989), McArdle et al. (1988), Stewart et al. (1987),[a] Martin and Johnson (1987), Bhatt et al. (1986), and Peirce and Vesilind (1981).

Eight treatment objectives have been defined in this review process and are illustrated in Figure 3.1. Note that this list is not necessarily all-encompassing.

- Containment -- Containment refers to isolation of the waste to prevent migration without altering the waste itself. Examples of containment strategies include the use of grout curtains, clay caps, and membrane liners.

(a) Stewart, T. L., E. J. Ethridge, K. E. Hartz, J. Jo, D. McCarthy, S. J. Mitchell, K. H. Oma, R. J. Robertus, C. L. Timmerman, and R. L. Treat. 1987. Waste Treatment Technology Needs for Remediating Northwest Hazardous and Radioactive Mixed-Waste Sites. Prepared for the U.S. Department of Energy by Pacific Northwest Laboratory. (Draft)

- Destruction -- Destruction refers to the degradation, mineralization, or decay of waste to make a harmless product. Methods with the objective of destruction include incineration and microbial degradation.

- Disposal -- Disposal refers to placement of the waste under controlled, engineered conditions. Examples of disposal methods include onsite and offsite landfilling and containerization of wastes.

- Encapsulation -- Encapsulation is a process involving the complete coating or enclosure of a toxic particle or waste agglomerate with another substance (Freeman 1989). Examples of encapsulation include stabilization and solidification.

- Institutional Containment -- Institutional containment refers to barriers that are put in place to prevent exposure of surrounding sensitive receptors to the waste site by keeping possible receptors from the waste, rather than by preventing migration. Examples include fences, guards, and ordinances, laws, statutes, and regulations.

- Excavation/Removal -- Excavation/removal refers to physical activities associated with relocation of the waste. Examples include dredging, excavation, and removal.

- Physical Handling/Processing -- Physical handling/processing refers to those activities employed to physically alter the size, composition, volume, or shape of the waste. Examples of such activities include screening, shredding, and magnetic sorting.

- No-Action Alternative -- The no-action alternative represents the baseline case to which the cost, risk reduction, implementability, and short- and long-term effectiveness of all other remedial treatments are compared.

All unit processes may not fit exactly into these eight categories. Depending on a reviewer's perspective, a particular unit process could be associated with more than one objective.

ENVIRONMENTAL ANO CONTAMINANT INFORMATION

This section documents the primary constituents of interest, those which determined the type of remedial alternatives being considered for cleaning up the waste site. Figure 3.2 shows what environmental and contaminant information was requested by the site reviewer. Sequential numbers (starting with 1.1) are associated with the information requested in Figure 3.2 in case

1.1 ENVIRONMENTAL MATRIX:

1.2 STATUS:

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL

FIGURE 3.2. Environmental and Contaminant Information

several different types of environmental issues are relevant to the site. For example, different remedial solutions may be suggested for contaminated surface soil and for contaminated groundwater. For each new environmental issue (corresponding to a different environmental matrix), a separate suite of remedial alternatives might be designated. The following categories are identified in Figure 3.2:

- Environmental Matrix -- The environmental matrix refers to the matrix that is being remediated at the site. Different environmental matrices include surface soil, subsurface soil in the vadose zone, groundwater, vadose-zone moisture, surface water, surface-water sediments, air, crops, and fish or animals. The environmental matrix is important because different remedial options might be suggested for different matrices.

- Status -- Status refers to the status of the given environmental matrix, which may be different from the status of another matrix on the site. For example, contaminated surface soil may have already been remediated at the site, but the groundwater may still be contaminated and may still require remediation.

- Contaminant Information -- This category provides the reader with a list of primary constituents that determine the type of remedial alternatives being considered for cleaning up the waste site. Usually those constituents with the highest inventory or the greatest potential health impact dominate the analysis. However, secondary constituents may also be important (e.g., heavy metals in a predominantly organic waste). Under this heading, the reviewer lists the constituent name, its waste form (e.g., liquid, solid, vapor, sorbed to soil), the waste type (e.g., organic, inorganic, or radionuclide), and the particular cleanup goal or ARAR.

SUMMARY OF SUGGESTED REMEDIAL ALTERNATIVES

This section of the review presents the remedial alternatives that were considered during the final review process and identifies the alternative that was finally suggested for cleaning up the site. Figure 3.3 presents the format used for recording the remedial alternative information. (The sequential numbering from Figure 3.2 continues.) Two categories are presented in Figure 3.3: Unit Processes and Treatment Trains. Either or both headings may be filled out; which is done depends on the strategy followed by the investigators in implementing the FS. Some FSs reviewed only unit processes as suggested remedial alternatives, other FSs reviewed only treatment trains, and some FSs included both. A brief discussion of each of the components that make up Figure 3.3 follows:

- Process/Treatment Train Name -- A descriptive name identifying the unit process or treatment train.
- Description -- A brief description of the components associated with the unit process or treatment train.
- Treatment Method -- Identifies whether the remedial alternative is biological, chemical, physical, or thermal method, or a combination of these methods.
- Treatment Objective -- Identifies the objective of the treatment method (e.g., destruction, encapsulation, containment).
- Treatment Mode -- Identifies whether the remedial alternative is treated in situ, at grade, offsite, or in some combination of these.
- Source or Migration Control -- Identifies whether the treatment objective addresses the waste at its source, attempts to control the waste after it has left the source and is migrating in the environment, or does both.
- Accepted/Rejected -- Notes whether this unit process or treatment train has been selected as the remedial action.
- Reasoning -- Briefly explains why the unit process or treatment train was selected or rejected as the remedial action.

1.4 REMEDIAL ALTERNATIVE INFORMATION

UNIT PROCESSES:	TREATMENT TRAINS:
a. PROCESS NAME:	a. Treatment Train Name:
Description:	Description:
Treatment Method:	Treatment Method:
Treatment Objective:	Treatment Objective:
Treatment Mode:	Treatment Mode:
Source or Migration Control:	Source or Migration Control:
Process Performance Characteristics:	Treatment Train Performance Characteristics:
Effectiveness -- Reliability -- Confidence -- Implementability -- Risk Reduction -- Cost --	Effectiveness -- Reliability -- Confidence -- Implementability -- Risk Reduction -- Cost --
Accepted/Rejected:	Accepted/Rejected:
Reasoning:	Reasoning:

FIGURE 3.3. Summary of Suggested Remedial Alternatives

The process/treatment train performance characteristics are briefly described as follows:

- Effectiveness -- Short-term effectiveness concerns those characteristics that protect or do not protect human health and the environment during the period of remedial construction and implementation until the final response objectives have been met. Long-term effectiveness involves characteristics that protect human health and the environment after response objectives have been met.

- Reliability -- Reliability concerns those characteristics that describe the dependability of the remedial alternative at meeting the response objectives. For instance, a given remedial alternative may be very effective when it is implemented, but if it is continually breaking down, it is not very reliable at fulfilling the response objectives.

- Confidence -- Confidence describes the level of comfort the original investigator had with implementation of this particular alternative. Because this category may be subjective, it may not be addressed in every review.

- Implementability -- Implementability concerns the technical and administrative feasibility of alternatives and the availability of the resources required for implementing them.

- Risk Reduction -- Risk reduction concerns, either qualitatively or quantitatively, the amount that the alternative reduced risk relative to the no-action alternative. It is an evaluation of the anticipated performance of the treatment process with respect to risk, toxicity, or overall protection to the surrounding sensitive receptors (specifically, the local population and workers).

- Cost -- The cost category concerns the anticipated capital, operation, and maintenance costs associated with implementing the remedial alternative.

4.0 MOWBRAY ENGINEERING SITE

SITE NAME: Mowbray

EPA REGION: 4

STATE: Alabama

REFERENCES: CDM (1986)

ENVIRONMENTAL MATRIX: Contaminated soils and waste oils

CURRENT STATUS: The RI/FS and ROD were completed 11/86. Onsite stabilization/solidification with site drainage diversion and site restoration was the remedial alternative that was ultimately implemented at the site. Currently (9/89) EPA is in the process of delisting this site.

HISTORICAL SKETCH: The Mowbray site consists of the main facility (a building and parking area) and approximately three acres of adjacent swamp into which polychlorinated biphenyls (PCBs), in particular Aroclor[a] 1260, and oil-contaminated water drained for over 20 years. The Mowbray Company disposed of waste transformer oil by discharging it onto the ground behind the plant; PCB-contaminated oils drained from the Mowbray facility through a city storm sewer to the nearby swamp. The PCB contamination was at its highest level in soil on the Mowbray property and in the swamp and concentrated in the upper ten feet of soil. Following discovery of this contamination, the Mowbray Company installed underground storage tanks to hold the PCB-contaminated oils.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment: None

Destruction: None

Disposal: None

Encapsulation: None

Chemical

Containment: None

(a) Aroclor is a trade name of Monsanto Company, Saint Louis, Missouri.

Destruction: None

Disposal: None

Encapsulation: None

Physical

Containment:

Site-Drainage Diversion -- **Approved** for consideration because it is a well-established and technically feasible method for preventing erosion of contaminated soils by surface runoff.

Site Restoration -- **Approved** for consideration because this technology has been proven to be an effective and reliable approach for stabilizing residual contamination, preventing erosion of residual contamination, and reducing the risk to people via dermal contact or inadvertent soil ingestion.

Surface Capping -- **Removed** from consideration because the overall effectiveness of capping is rated low; the capping process would occur in a swamp area that can be expected to be flooded every 100 years, which means that the cap's effectiveness for retaining contaminated soils onsite and preventing contaminated leachate from leaving the site is reduced.

Institutional Containment: None

Destruction: None

Disposal:

Offsite Disposal -- **Approved** for consideration because transportation and disposal of hazardous wastes to an approved chemical waste-management facility can be effectively accomplished, provided proper equipment, handling, and safety measures are employed.

Encapsulation:

Onsite Stabilization/Solidification -- **Approved** for consideration because it is technically feasible and implementable and because it would reduce risk to the surrounding population due to surface-water and groundwater contamination via overland runoff and percolation.

Onsite Containment/Encapsulation -- **Approved** for consideration because containment using impermeable liners has been practiced at several waste sites and is considered technically feasible; this process would also limit the release of contaminants into the surface water, groundwater, and air, thereby reducing the risk to the surrounding population.

Excavation/Removal:

Excavation -- **Approved** for consideration because it would remove the contamination from the area.

Onsite Solvent Extraction -- **Removed** from further consideration because there are no long-term data for the effectiveness and reliability of this process in the field; also, the low PCB concentrations mean that several soil washings may be necessary, resulting in a contaminated waste-solvent by-product.

Physical Handling/Processing: None

No-Action Alternative:

No-Action Alternative -- **Approved** for consideration because it is a standard procedure.

Thermal

Containment: None

Destruction:

Offsite Incineration -- **Approved** for consideration because it is considered a technically reliable and effective method for destroying PCBs in contaminated soils.

Onsite Incineration -- **Approved** for consideration because it is considered a technically reliable and effective method for destroying PCBs in contaminated soils.

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: PCB-contaminated and waste-oil-contaminated soils

1.2 STATUS: at least through RI/FS with public comment (through 1984)

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Polychlorinated biphenyls	sediment	organic	86, 880 μg/g[a] 2.4, 5.0 μg/g[b]

(a) Future- and current-use scenarios based on average exposure conditions.
(b) Future- and current-use scenarios based on maximum exposure conditions.

1.4 REMEDIAL ALTERNATIVE INFORMATION

TREATMENT TRAINS:

a. TREATMENT TRAIN NAME: No-Action Alternative

Description: Under the no-action alternative, soils would remain contaminated with toxic substances regulated by local, state, and federal laws.

Treatment Method: None

Treatment Objective: None

Treatment Mode: N/A

Source or Migration Control: None

Treatment Train Performance Characteristics:

Effectiveness -- None

Reliability -- N/A

Confidence -- N/A

Implementability -- N/A

Risk Reduction -- No risk reduction would occur. Under average exposure conditions involving direct contact with PCB-contaminated soils, no significant risk is likely to occur based on a 10^{-6} excess cancer risk. Under a maximum exposure condition involving five times as much contact, the result would be an "excess cancer risk slightly above that considered acceptable by EPA."

Cost -- None

Accepted/Rejected: **Rejected**

Reasoning: This alternative would not meet public health and environmental objectives.

b. TREATMENT TRAIN NAME: Site Drainage Diversion/Excavation/Site Remediation

Description: This alternative involves the excavation and removal of the underground storage tanks and treatment or disposal of contaminated waste oils, as well as site drainage diversion and restoration to eliminate continued overland transport of contaminated soils.

Treatment Method: Physical

Treatment Objective: Removal of waste-oil tanks and drainage diversion

Treatment Mode: At-grade

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Effective and reliable for the prevention of soil erosion. This alternative does not attain any specified cleanup goal, but it does help to prevent the spreading of the contamination.

Reliability -- This method is considered to be reliable only as a preventive measure.

Confidence -- This alternative does not attain any specified cleanup goal, but it does help to prevent the spreading of the contamination. The contaminated area lies within the 100-year flood plain.

Implementability -- The estimated time required to implement this alternative is three months. Removal underground storage tanks would require Level C protection, and site drainage diversion and restoration would require Level D protection. If this alternative is implemented, a coordinated effort with regard to state drainage regulations, the U.S. Department of Transportation's Hazardous Transport Rules, TSCA, RCRA, Federal Water Quality Criteria, Clean Air Act, and ADEM regulations would be involved.

Risk Reduction -- Reduces risk of public exposure by erosion pathways; however, contaminants are left onsite. This represents only a temporary solution.

Cost -- The cost of this treatment is estimated as $0.14 M, and it will take three months to implement.

Accepted/Rejected: **Accepted** (Note that all of the alternatives except the no-action alternative were accepted by the ROD)

Reasoning: None given

c. TREATMENT TRAIN NAME: Site Drainage Diversion/Excavation/Offsite Disposal/Site Restoration

Description: This option involves excavating the soil and taking it to an approved offsite landfill.

Treatment Method: Physical

Treatment Objective: Removal and disposal; temporary solution

Treatment Mode: Offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative removes contamination at the site and would be highly effective at meeting cleanup goals.

Reliability -- Although this represents a permanent solution at the Mowbray site, it creates a temporary solution and potential problem at the offsite landfill. Offsite disposal, however, is a proven and reliable short-term technology.

Confidence -- High confidence for implementing technology and meeting cleanup goals.

Implementability -- The technology is easy to implement, although the contaminated soil would be transported through neighboring towns, creating the potential for accidental exposure. If this alternative is implemented a coordinated effort with regard to state drainage regulations, the U.S. Department of Transportation's Hazardous Transport Rules, TSCA, RCRA, Federal Water Quality Criteria, Clean Air Act, and ADEM regulations would be involved.

Risk Reduction -- This alternative would meet cleanup goals. The contaminated soil would be transported through neighboring towns, creating the potential for accidental exposure. It is estimated that this would result in a small risk to the population.

Cost -- The cost is estimated at \$0.23 M for a 50-μg/g cleanup goal to \$8.6 M for a 10-μg/g cleanup goal.

Accepted/Rejected: **Accepted** (Note that all of the alternatives except the no-action alternative were accepted by the ROD)

Reasoning: None specifically given

d. TREATMENT TRAIN NAME: Offsite Incineration

Description: Soils would be excavated and taken to a mobile or permanent incineration facility; an infrared-type incinerator would be preferred.

Treatment Method: Thermal

Treatment Objective: Destruction

Treatment Mode: Offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Incineration results in permanent destruction of PCBs.

Reliability -- The reliability of a mobile incinerator is rated less than that of a permanent incinerator.

Confidence -- Destruction of PCBs by incineration has been proven to be effective and reliable.

Implementability -- There may be difficulties in scheduling a mobile incinerator or in obtaining incineration rights, given local opposition to a permanent incinerator at another hazardous waste site.

Risk Reduction -- This option is considered to be a low-risk alternative.

Cost -- The cost is estimated to range from $0.21 M for a cleanup goal of 50 μg/g to $51 M for a cleanup goal of 10 μg/g. Two different incineration facilities are associated with these estimates.

Accepted/Rejected: **Accepted** (Note that all of the alternatives except the no-action alternative were accepted by the ROD)

Reasoning: None given

e. TREATMENT TRAIN NAME: Onsite Stabilization/Solidification with Site Drainage Diversion and Site Restoration

Description: Under this alternative, the soil would be excavated, mixed with cement-like substances, and replaced in the site.

Treatment Method: Physical

Treatment Objective: Stabilization

Treatment Mode: In situ

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative would store contaminants permanently onsite; it is less effective than treatment or disposal.

Reliability -- Treatability tests would have to be implemented to ensure that contaminants did not leach from the solidified matrix.

Confidence -- Future failure of the cement bond could cause the release of contaminants.

Implementability -- This methodology is relatively easy to implement. Obtaining a permit for onsite storage is the most difficult implementation problem. A long-term monitoring program would have to be established to ensure that no contaminants are leaching from the site.

Risk Reduction -- Reduced environmental effects are envisioned, but no detailed information on the risk reduction is provided. There is a small possibility of contaminants leaching out and causing exposure to surrounding populations.

Cost -- The cost is estimated to range from $0.36 M for a cleanup goal of 50 μg/g to $2.3 M for a cleanup goal of 10 μg/g.

Accepted/Rejected: **Accepted** (Note that all of the alternatives except the no-action alternative were accepted by the ROD)

Reasoning: None given

f. TREATMENT TRAIN NAME: Onsite Containment/Encapsulation with Site Drainage Diversion and Site Restoration

Description: This alternative consists of constructing a site drainage diversion, excavating the contaminated soil, encapsulating the excavated waste in a clay or plastic liner with cap, and restoring the site.

Treatment Method: Physical

Treatment Objective: Encapsulation and contaminant immobility

Treatment Mode: In situ

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative would store contaminants permanently onsite; it is less effective than treatment or disposal.

Reliability -- To ensure reliability of this alternative, a monitoring schedule must be maintained and structural integrity of synthetic liners and surface cap must be verified frequently. Operation and maintenance activities are required.

Confidence -- This alternative is less reliable than permanent destruction or storage.

Implementability -- Implementation and permitting for onsite storage of contaminated wastes in a swamp where a 100-year flood reaches might be difficult. A long-term monitoring program would have to be established to ensure that no contaminants are leaching from the site.

Risk Reduction -- Reduced environmental effects are envisioned, but no detailed information on the risk reduction is provided. There is a possibility of contaminants leaching out and causing exposure to surrounding populations.

Cost -- The cost is estimated to range from \$0.36 M for a cleanup goal of 50 μg/g to \$1.7 M for a cleanup goal of 10 μg/g.

Accepted/Rejected: **Accepted** (Note that all of the alternatives except the no-action alternative were accepted by the ROD)

Reasoning: None given

g. TREATMENT TRAIN NAME: Onsite Incineration

Description: Soils would be excavated and taken to an onsite mobile incineration facility; an infrared-type incinerator would be preferred.

Treatment Method: Thermal

Treatment Objective: Destruction

Treatment Mode: Onsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Incineration results in permanent destruction of PCBs.

Reliability -- The reliability of a mobile incinerator is rated less than that of a permanent incinerator.

Confidence -- Destruction of PCBs by incineration has been proven to be effective and reliable.

Implementability -- Local opposition to incineration may make permitting for this alternative difficult.

Risk Reduction -- This option is considered to be a low-risk alternative.

Cost -- The cost is estimated to range from $0.2 M for a cleanup goal of 50 $\mu g/g$ to $10 M for a cleanup goal of 10 $\mu g/g$. Two different incineration facilities are associated with these estimates.

Accepted/Rejected: **Accepted** (Note that all of the alternatives except the no-action alternative were accepted by the ROD)

Reasoning: None given

5.0 HUDSON RIVER SITE

SITE NAME: Hudson River

EPA REGION: 2

STATE: New York

REFERENCES: NUS (1984)

ENVIRONMENTAL MATRIX: Contaminated river sediments and remnant soil deposits

CURRENT STATUS: FS completed through 1984. Currently (9/89) work on the remedial design is being completed. The original remedial alternative selected (i.e., remnant soil containment using a soil cover) has been modified to include a synthetic liner and bentonite clay cover beneath the soil cover.

HISTORICAL SKETCH: The Hudson River, New York, was contaminated with polychlorinated biphenyls (PCBs) from two General Electric capacitor manufacturing plants in Fort Edward and Hudson Falls. Much of the contaminated material had accumulated behind the Fort Edward Dam and was released when the dam was removed, forming hot spots of PCB-contaminated sediments for 30 miles downstream. Segments of the river have consequently been closed to commercial and recreational activities. PCBs have been detected in several public drinking water supply intakes, as well as in ambient air near remnant sites.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment: None

Destruction:

Biodegradation -- Removed from consideration, because degradation by microbial activity is dependent on the degree of chlorination and the position of the chlorine atom on the biphenyl molecule. Biodegradation has not proven itself effective for use on the highly chlorinated biphenyls.

Disposal: None

Encapsulation: None

Chemical

Containment: None

Destruction:

Acruex -- **Removed** from consideration as it is difficult to implement and not permitted by EPA for use on PCB-contaminated wastes.

Hydrothermal -- **Removed** from consideration because work on this process is still in the early development stage and, therefore, it would not be available for use in the near future.

KOHPEG -- **Approved** for consideration although testing has not been completed for this process.

NaPEG -- **Removed** from consideration; although this process is similar to the KOHPEG process, it is not as reactive and is more sensitive to impurities.

PCBX -- **Removed** from consideration because it has not been approved by EPA for use on PCB-contaminated sediments and poses difficulties for onsite implementation due to its solvent-extraction requirement.

Goodyear -- **Removed** for consideration because this process is nonmobile and difficult to use in conjunction with contaminated sediments.

LARC -- **Removed** from consideration; no reason is given, but it may be because its use on river sediments is restricted by ultraviolet-light-absorbent materials present in the water, the requirement of a constant hydrogen source, and the process being unproven (but patented).

Photodecomposition -- **Removed** from consideration; this may be because tests on contaminated soils indicate that no significant reduction of PCBs occurred after irradiation of soils.

Disposal: None

Encapsulation: None

Physical

Containment:

Control River Flows -- **Removed** from consideration because dam construction costs were prohibitive.

In-River Containment -- **Removed** from consideration because it provides no advantages over dredging.

Remnant Soil Containment Using a Soil Cover -- **Approved** for consideration.

Institutional Containment:

Restrict Access to Remnant Soils -- **Approved** for consideration.

Destruction: None

Disposal:

Bioharvesting -- **Removed** from consideration as this method has been estimated to take 100 to 10,000 years to complete.

In-River Activated Carbon Adsorption -- **Removed** from consideration because the concept has not been fully developed and applied to a river system.

Removal/Disposal in Landfill -- **Approved** for consideration because this alternative is available, routine, and nonexperimental and applies to long-term storage of PCB-laden soils and sediments. This procedure might also be considered as encapsulation.

Encapsulation: None

Excavation/Removal:

Dredging of Sediments -- **Approved** for consideration because it is a standard alternative.

Removal of Remnant Soils -- **Approved** for consideration for a number of reasons (e.g., removal of potential human contact, reduction in volatilization rates of PCB).

Physical Handling/Processing: None

No-Action Alternative:

No-Action Alternative -- **Approved** for consideration because it is a standard procedure.

Thermal

Containment: None

Destruction:

Plasma Arc -- **Removed** from consideration because this process is unproven on a field scale.

Pyromagnetics Incinerator -- **Removed** from consideration because the existing unit is too small for the large volumes of sediments and soils anticipated, and this process represents an unproven technology.

Rotary Kiln Incineration -- **Approved** for consideration as this technology is a reliable and proven technology for destruction of PCB-laden soils and sediments.

Thagard HTFW -- **Removed** from consideration because this unit is currently not mobile and has high operating costs.

Wet Air Oxidation -- **Approved** for consideration as it represents a promising technology.

Molten Salt Incinerator -- **Removed** from consideration, apparently because it was unavailable.

Controlled Air Incineration -- **Removed** from consideration because its state of development renders this process unsuitable for use on contaminated sediments.

Fluidized Bed Incineration -- **Removed** from consideration, apparently because it has not moved past the test trial burn stage.

Ozonation -- **Removed** from consideration because this process is in the development stage.

Ultraviolet/Ozone -- **Removed** from consideration because this process is in the pilot-plant state for wastewater and cannot handle wastes in which the ultraviolet light cannot penetrate the contaminated material.

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Contaminated river sediments

1.2 STATUS: at least through RI/FS with public comment (through 1984)

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Polychlorinated biphenyls	sediments	organic	N/A

1.4 REMEDIAL ALTERNATIVE INFORMATION

UNIT PROCESSES:

a. PROCESS NAME: KOHPEG

Description: Potassium hydroxide (KOH) and polyethylene glycols (PEG) react with and destroy PCBs, producing reaction products of aryl polyglycols and biphenyls. Dredged sediments would be placed in a lagoon for dewatering to a suitable water-content level. The water would be decanted, tested, and treated prior to discharge. KOHPEG would be sprayed over the area, followed by rototilling.

Treatment Method: Chemical

Treatment Objective: Destruction

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- Essentially 100% cleanup could occur, as long as the KOHPEG contacts all contaminated sediments.

Reliability -- Process still in laboratory phase of development

Confidence -- Unknown at this time

Implementability -- Laboratory analysis indicates that the destruction of PCBs may be very effective, but the process could take months to complete.

Risk Reduction -- Degradation products represent only a mild eye irritant. No long-term biological tests have been performed.

Cost -- Process considered to be extremely costly (estimated costs are apparently unavailable).

Accepted/Rejected: **Rejected**

Reasoning: The process is promising but as yet unproven on a field scale; costs are considered to be extremely high; process could take months to complete; and how the process will perform under varied conditions is unknown. No cost-effectiveness score was available.

b. PROCESS NAME: Various dredging scenarios with/without water treatment.

Description: No-action alternative for river sediments with routine channel maintenance; full or partial dredging where water supply is treated/untreated.

Treatment Method: Physical

Treatment Objective: Removal and disposal

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- Transport rates for PCBs are estimated to remain from 62 to 100% of original rate.

Reliability -- Standard mechanical and hydraulic dredging equipment has been in use for years and is currently used in the study area for routine channel maintenance.

Confidence -- The dredging method is currently in use and has a proven track record.

Implementability -- Applicable to contaminated river bottom sediments. Because all necessary equipment is currently available and already in use on the river, the technical implementability is high. Dredging will take several years.

Risk Reduction -- The risk to the surrounding environment and population would not be significantly higher than it already is.

Cost -- Depends on option chosen ($3.4 M -$5.3 M).

Accepted/Rejected: **Accepted**

Reasoning: The matrix evaluation resulted in the identification of a no-action alternative as the most cost-effective option. The limited improvement that might be expected does not offset the decreasing environmental and health impacts of the current PCB problem. Cost-effectiveness score of 7.9.

c. PROCESS NAME: Removal/Disposal in Landfill

Description: This process includes the siting, design, construction, operation, closure, and post-closure monitoring and maintenance of a single, multicelled, controlled-access, dredged, PCB-laden sediment landfill. The design provides an encapsulated, stable, dewatered, monitored, and secured containment area that meets all regulatory requirements commonly in use for PCB landfills. After each season of dredging, the landfill will be capped with a clay cover.

Treatment Method: Physical

Treatment Objective: Disposal and encapsulation

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- The alternative is well suited based on location and specific siting and design criteria. This technology is therefore as effective as standard designed landfill encapsulation systems. The degree of isolation appears to be high to very high.

Reliability -- The technology is generally available, routine, and nonexperimental.

Confidence -- The alternative has a very low probability of failure and a very low probability of risk, and is therefore a low-risk alternative.

Implementability -- The containment area occupies approximately 63 acres, large enough to hold all sediments. Roughing and storage and surge ponds, a water treatment plant, a pump station, a leachate collection system, a stormwater drain system, access roads, and a chemical feed system are the components of this alternative.

Risk Reduction -- This alternative would meet current appropriate regulatory requirements, environmental standards, and public policies under current enforcement policies.

Cost -- The cost is estimated at $1.9 M.

Accepted/Rejected: **Rejected**

Reasoning: This alternative appeared to be acceptable and had a cost-effectiveness score of 7.1, which was second only to the no-action alternative.

d. PROCESS NAME: Wet-Air Oxidation

Description: Wet-air oxidation uses a cocatalyst and moderate temperatures to achieve >99% destruction of chlorinated biphenyls. Wet-air oxidation is a commercially proven technology for the destruction of organics in waste water and sludges; it is expected, however, that higher temperatures and pressures will be required to destroy the more environmentally persistent chlorinated organics. Dredged sediments would be routed to a storage basin to attain an optimal solids and organic content. The slurry would be pumped to a continuously stirred tank reactor to oxidize the organics.

Treatment Method: Chemical

Treatment Objective: Destruction

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- If properly implemented, this procedure should completely destroy the PCBs.

Reliability -- This procedure has not been implemented on a field scale.

Confidence -- This procedure has not been implemented on a field scale.

Implementability -- Catalyzed wet-air oxidation is applicable to the destruction of chlorinated organics, but pilot studies on PCB materials have not been performed; work and testing have been on a laboratory scale only.

Risk Reduction -- A relatively high risk (probably due to potential failure) is associated with this alternative, although no reasons are given.

Cost -- The cost is estimated at $109 M.

Accepted/Rejected: **Rejected**

Reasoning: The risk and effect of failure were high, and the cost was exceedingly high. In addition, the methodology is not a proven, full-scale alternative for PCB-laden sediments.

e. PROCESS NAME: Incineration -- Rotary Kiln

Description: This alternative includes dewatering of the influent, feeding of solids into the incineration unit, incineration, disposal of the residue, and air-pollution control. The residue expected would be sterile and clean. This process could be used for either contaminated sediments or remnant deposits. It is being proposed that the incineration units be built onsite.

Treatment Method: Thermal

Treatment Objective: Destruction

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- The incineration process should completely destroy the PCBs.

Reliability -- The technology is considered to be common and not liable to failure, especially considering that more than one unit is proposed.

Confidence -- This technology has been used for years and is considered to be a standard technology.

Implementability -- No mobile incinerators were available at the time, so incineration was eliminated as a viable alternative. The length of time associated with completing the operation is estimated as two dredging seasons.

Risk Reduction -- This option is considered to be a low-risk alternative.

Cost -- The cost of shipping contaminated soils and sediments to one of two fixed-incineration plants (in Arkansas or Texas) was considered too high. Mobile incineration was not available at the time, although the Denney Farm mobile incineration tests were about to begin in Missouri in the first quarter of 1985. The estimated cost associated with this alternative was not provided.

Accepted/Rejected: **Rejected**

Reasoning: The shipping costs and transportation logistics for offsite incineration removed this process from consideration. For onsite incineration, the cost-effectiveness score was 7.1, which was second only to the no-action alternative.

2.1 ENVIRONMENTAL MATRIX: Contaminated Remnant Soils

2.2 STATUS: at least through RI/FS with public comment (through 1984)

2.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Polychlorinated biphenyls	soils	organic	N/A

2.4 REMEDIAL ALTERNATIVE INFORMATION

a. PROCESS NAME: Restricting Access

Description: Measures would be implemented to deter access by people, vehicles, and wildlife to the remnant soil deposits. These measures would include fencing the landward edge of remedial areas and seeding remnant sites.

Treatment Method: Physical

Treatment Objective: Full/partial restriction of access of general population to contaminated soils.

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- These methods are not necessarily effective if people ignore warning signs, if construction techniques are incorrect, or if vandalism takes place.

Reliability -- Fences and signs are easily removed and can be easily vandalized.

Confidence -- Low-to-medium probability of failure is associated with these methods, because problems may arise from human ignorance or error, such as ignoring warning signs or using incorrect construction techniques. The probability of these types of problems is highly variable.

Implementability -- Restricted-access methods are proven and well-established. One construction season will be required to install fences and seed remnant deposits.

Risk Reduction -- These measures do not restrict movement of PCBs in the environment.

Cost -- The cost is estimated as $1.1 M.

Accepted/Rejected: **Rejected**

Reasoning: Although there will be restricted access to direct contact of contaminated soils, there will be little, if any, reduction of PCBs in the environment. The cost-effectiveness score for this alternative was 5.6.

b. PROCESS NAME: Remnant Soil Containment Using a Soil Cover

Description: This alternative involves the placement of a 2-ft-thick layer of soil over the existing remnant deposits, seeding the soil, and protecting the associated river banks with riprap.

Treatment Method: Physical

Treatment Objective: Containment

Treatment Mode: In situ

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- Use of an impermeable cover and bank reinforcement to contain hazardous wastes has proven adequate in the past.

Reliability -- Proper equipment and procedures must be maintained during placement of the cover, and bank reinforcement material must be placed and sized properly to prevent scour and erosion.

Confidence -- If all conditions are met, there is a relatively low probability of failure.

Implementability -- Proper equipment and procedures must be maintained during placement of the cover, and bank reinforcement material must be placed and sized properly to prevent scour and erosion. Approximately two construction seasons would be required to implement this alternative.

Risk Reduction -- Direct public access to PCBs is prevented by the soil cover, with the exception of any possible vaporization through the soil cover. PCBs could still enter the environment through the groundwater pathway; the importance of this transport pathway would be reduced if the soil cover is properly engineered.

Cost -- The cost is estimated at $1.1 M.

Accepted/Rejected: **Accepted**

Reasoning: The entry of PCBs to the river and lower portions of the estuary will be reduced, public access to the PCBs will be prevented, and there is minimal impact to the surrounding communities.

c. PROCESS NAME: Partial/Complete Removal of Remnant Soils

Description: This alternative addresses removal of materials with levels of contamination that may be either low (complete removal) or high (partial removal). The contaminated materials would have to be hauled away to an approved disposal site, detoxified, or incinerated. This alternative could involve extensive amounts of sampling over a large area.

Treatment Method: Physical

Treatment Objective: Removal

Treatment Mode: Offsite

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- This method is very effective for preventing direct-contact contamination, because there would be little contamination remaining. This alternative would probably would not have a significant impact on the contaminant levels in the river.

Reliability -- This method is proven to be very reliable.

Confidence -- This method is a proven technology.

Implementability -- Excavation and removal of contaminated soils is a proven technique for remediation of uncontrolled hazardous-waste sites. The contaminated materials would have to be hauled away to an approved disposal site, detoxified, or incinerated. This alternative could involve extensive amounts of sampling over a large area. In addition, this alternative would require the clearing, grubbing, and construction of haul roads; excavation, hauling, and disposal of contaminated sediments; and regrading and revegetation of disturbed areas.

Risk Reduction -- The impacts to the surrounding environment would be minimal following excavation and removal, except for those instances where contaminated sites were missed. The excavation and removal procedures could create a secondary health concern because of construction dust being entrained into the atmosphere. This alternative would probably not have a significant impact on contaminant levels in the river.

Cost -- The costs are estimated at $1.9 M.

Accepted/Rejected: **Rejected**

Reasoning: The method was rejected because of potential construction health impacts, extensive sampling requirements, and potentially insignificant effects on the contamination levels in the river. The cost-effectiveness score for this alternative ranged from 6.1 to 7.5.

d. PROCESS NAME: KOHPEG -- This process has been described in Part 1.4.a.

6.0 WHITEHOUSE OIL PITS SITE

SITE NAME: Whitehouse Oil Pits

EPA REGION: 4

STATE: Florida

REFERENCES: EE (1985)

ENVIRONMENTAL MATRIX: Disposal area (original source) with contaminated soils, groundwater, and surface water; air pollution; and contaminated sediments

CURRENT STATUS: FS completed 6/85. Currently (9/89) a treatability study is being performed between the slurry wall remedial alternative and a bioremediation alternative that had been removed from consideration during the initial review. Note that the slurry wall alternative had not been chosen as the suggested cleanup option.

HISTORICAL SKETCH: The Whitehouse Oil Pits are located about eight miles west of Jacksonville, Florida. The site was opened in 1958 as a disposal area for waste oil and acid sludges and includes seven oil pits on five acres of a seven-acre site. The pits were abandoned in 1968, and the dike around the pit was later breached, with the contents spilling onto adjacent property and into McGirts Creek. In 1976, another spill occurred, and the pits were dewatered, the sludges stabilized, and the pits covered and seeded. Analyses at the site indicated that soil and groundwater were contaminated. The constituents of interest include polynuclear aromatic hydrocarbons (PNAs) and halomethanes; some heavy metals were also present although they were not included in the analysis.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment:

Pump and Biologically Treat -- **Removed** from further consideration because it was felt by the reviewers that PCBs were not biodegradable; the processes were felt to be too sensitive to the heavy metal content at the site; and it was felt that the processes might potentially generate hazardous sludge. The five process systems considered included activated sludge, anaerobic and aerobic systems, facultative lagoons, supported growth, biological reactors, and treatment in a publicly owned treatment works.

Destruction:

In Situ Bioreclamation with Microbes -- **Removed** from consideration because its perceived long-term effectiveness is unknown, it cannot effectively handle chlorinated organics and heavy metals, and concentrations of organics in the groundwater are considered to be too low for effective microbial degradation.

Disposal: None

Encapsulation: None

Chemical

Containment:

Solution Mining -- **Removed** from consideration because not all waste products will partition into solvent, solvent becomes a contaminant itself, and groundwater injection would increase the hydraulic gradient, thereby aggravating the problem.

Neutralization/Detoxification/Immobilization (Stabilization) -- **Removed** from consideration because stabilization techniques are difficult to apply in situ given the inhomogeneity of the site and the heterogeneous waste mixture. No single agent can neutralize acidic conditions, precipitate heavy metals, and immobilize or detoxify organic contaminants all at once without becoming a contaminant itself.

Pump and Chemically Treat with Chlorination -- **Removed** from consideration because it does not remove heavy metals or organic contaminants.

Pump and Chemically Treat with Photolysis -- **Removed** from consideration because it does not remove heavy metals, and it is perceived not to remove organic contaminants.

Pump and Chemically Treat with Oxidation -- **Removed** from consideration because it does not remove heavy metals, and because PCBs are not readily oxidized.

Pump and Chemically Treat with Precipitation and Neutralization -- **Approved** for consideration because heavy metals could be precipitated.

Destruction: None

Disposal: None

Encapsulation: None

Physical

Containment:

Permeable Beds -- **Removed** from consideration because this in situ technology is basically a concept and not a well-documented and proven technology. In addition, permeable beds would need to be replaced when they become saturated and access is difficult, the treatment beds can plug or pond, there is very little operational control over the system, and the heterogeneity of the waste dictates the use of a flexible system.

Slurry Walls -- **Approved** for consideration because a properly designed and installed slurry wall will provide effective groundwater control.

Grout Curtains -- **Removed** from consideration because they are significantly more expensive than slurry walls.

Sheet Piling -- **Removed** from consideration because they tend to be more expensive than slurry walls and because it is sometimes difficult to obtain an adequate seal in coarse sandy soils.

Pump and Oil/Water Separation -- **Approved** for further consideration; no reason given.

Pump and Activated Carbon Adsorption -- **Approved** for consideration because it is a standard and proven technology for removing a wide range of organic and inorganic materials.

Pump and Ion Exchange -- **Removed** from consideration because the regenerated exchange resin contains high concentrations of contaminants and creates a disposal problem, the majority of organic contaminants cannot be removed by this method, and the method is not cost-effective.

Pump and Reverse Osmosis -- **Removed** from consideration because the technical feasibility of using this particular waste water is unproven, and it is deemed that this method is unreliable for this waste water.

Pump and Wet-Air Oxidation -- **Removed** from consideration because this method does not remove heavy metals and it is only suitable for higher-strength waste streams.

Pump and Ultrafiltration -- **Removed** from consideration because the effluent contains high concentrations of contaminants and creates a disposal problem, the majority of organic contaminants cannot be removed by this method, and the method is not cost-effective and is unproven.

Air Stripping -- **Approved** for consideration because it has been used effectively for stripping volatile organics.

Onsite Surface Water Controls -- **Approved** for consideration because these are standard and approved techniques in conjunction with other remedial alternatives. These techniques include surface seals (e.g., clay caps, portland cement, sprayed bituminous membrane, synthetic membrane, neoprene), diversion/collection structures, and regrading and revegetation.

Institutional Containment: None

Destruction: None

Disposal:

Disposal Area Excavation and Offsite Disposal in a Secured Landfill -- **Approved** for consideration because the option is technically feasible.

Disposal Area Excavation and Onsite Disposal in a Secured Landfill/ Vault with Groundwater Treatment -- **Approved** for consideration because the option is technically feasible.

Equalization -- **Approved** for consideration because it is used to effectively balance the quantity and quality of waste water prior to subsequent downstream treatment; it also aids in carbon adsorption and precipitation.

Coagulation/Flocculation/Sedimentation -- **Approved** for consideration because it removes particulate matter, solid particles, flocculated impurities, and precipitates, and improves metal removal.

Encapsulation: None

Excavation/Removal: None

Physical Handling/Processing: None

No-Action Alternative:

No-Action Alternative -- **Removed** from consideration because it was not felt to be an acceptable alternative.

Thermal

Containment: None

Destruction:

Disposal Area Excavation and Onsite/Offsite Thermal Destruction:

1. Fluidized Bed -- **Removed** from consideration; incompatible with excavated materials.

2. Liquid Injection -- **Removed** from consideration; incompatible with excavated materials.

3. Wet-Air Oxidation -- **Removed** from consideration; incompatible with excavated materials.

4. Molten Salt Process -- **Removed** from consideration; incompatible with waste that has a high inorganic content.

5. Co-incineration -- **Removed** from consideration because no existing facility will accept large volumes of an impure waste with a low heating value.

6. Pyrolysis -- **Removed** from consideration; incompatible with waste that has a high inorganic and/or moisture content.

7. Rotary Kiln -- **Approved** for consideration because it is technically feasible.

8. Multiple Hearth Furnace -- **Approved** for consideration because it is technically feasible.

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Groundwater, Contaminated Sediments and Soils

1.2 STATUS: at least through the June 1985 RI/FS

1.3 CONTAMINANT INFORMATION:

#	MAJOR CONSTITUENTS	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Fluoranthene	soil/water	organic	FDER/WQC[a]
2	Phenanthrene	soil/water	organic	FDER/WQC
3	Pyrene	soil/water	organic	FDER/WQC
4	Hexavalent chromium	soil/water	inorganic.	FDER/WQC
5	Arsenic	soil/water	inorganic	FDER/WQC
6	Lead	soil/water	inorganic	FDER/WQC
7	Phenol	soil/water	inorganic	FDER/WQC
8	Benzene	soil/water	organic	FDER/WQC

(a) Groundwater and sludge contamination not to exceed federal Primary Drinking Water Standards; surface-water contamination not to exceed state water quality standards; and contaminated soil/sediment not to exceed background levels or minimal health-risk levels.

1.4 REMEDIAL ALTERNATIVE INFORMATION

UNIT PROCESSES:

a. PROCESS NAME: No-Action Alternative

Description: No additional remedial activities would be conducted but long-term groundwater quality would be monitored for most of the EPA priority pollutants. Pesticides and PCBs will not be included in analysis because of their low solubility in water.

Treatment Method: Physical

Treatment Objective: Monitoring

Treatment Mode: In situ

Source or Migration Control: N/A

Process Performance Characteristics:

Effectiveness -- Moderate to high surface-water impact will continue, because of continued migration of soluble portions of waste oil and sludges into the flood plain of McGirts Creek. Moderate groundwater impact would continue because of the continued migration of shallow-depth contaminated groundwater into underlying aquitard. Moderate to high soil/sediment impact would continue because existing soil contamination would remain, adding to continued leachate generation.

Reliability -- N/A

Confidence -- N/A

Implementability -- N/A

Risk Reduction -- None

Cost -- Costs are associated with construction, maintenance, and sampling of monitoring wells, and costs associated with laboratory analyses. Present-worth costs are estimated as $0.3 M.

Accepted/Rejected: **Rejected**

Reasoning: This alternative does not meet remedial response objectives, because migration of contaminants offsite will continue and result in exposure to surrounding populations.

2.1 ENVIRONMENTAL MATRIX: Contaminated Soils at the Source, Contaminated Sediments in McGirts Creek, and Groundwater

2.2 STATUS: at least through RI/FS through June 1985

2.3 CONTAMINANT INFORMATION:

#	MAJOR CONSTITUENTS	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Fluoranthene	soil/water	organic	FDER/WQC[a]
2	Phenanthrene	soil/water	organic	FDER/WQC
3	Pyrene	soil/water	organic	FDER/WQC
4	Hexavalent chromium	soil/water	inorganic	FDER/WQC
5	Arsenic	soil/water	inorganic	FDER/WQC
6	Lead	soil/water	inorganic	FDER/WQC
7	Phenol	soil/water	inorganic	FDER/WQC
8	Benzene	soil/water	organic	FDER/WQC

(a) Groundwater and sludge qualities not to exceed federal Primary Drinking Water Standards; surface-water quality not to exceed state water quality standards; and contaminated soil/sediment not to exceed background levels or minimal health-risk levels.

2.4 REMEDIAL ALTERNATIVE INFORMATION

TREATMENT TRAINS:

a. TREATMENT TRAIN NAME: Pit (partial)/Site (complete) Excavation and Offsite/Onsite Landfill/Vault Disposal with Groundwater Treatment (groundwater treatment train is discussed separately)

Description: Source contaminants in seven pits would be excavated to a depth of 15 feet, or the entire site excavated to 40 feet; the oily sludge material in the lower 10 feet would be solidified or dewatered; all excavated and solidified/dewatered material would be disposed of in an onsite/offsite secured landfill or onsite vault; contaminated sediments would be dredged from McGirts Creek and disposed of; cap and vegetative cover would be installed over entire site; pumping wells would be installed to extract contaminated groundwater; an onsite treatment facility for contaminated groundwater would be installed; and treated effluent would be discharged to McGirts Creek.

Treatment Method: Physical (excavation and other treatments), followed by chemical (groundwater treatment)

Treatment Objective: Disposal of contaminated soil/sediment and groundwater.

Treatment Mode: At-grade and/or offsite.

Source or Migration Control: Source for soils/sediments and migration for groundwater.

Treatment Train Performance Characteristics:

Effectiveness -- Medium to high level of cleanup achievable.

Reliability -- Excavation work and disposal in landfill/vault are very reliable; groundwater treatment facility should be highly effective after optimization of design.

Confidence -- High degree of confidence for achieving goals; relies on widely-used technologies.

Implementability -- Dewatering of site required prior to excavation. For onsite landfill, logistics of landfill construction are complex. Tree removal will be required. An NPDES discharge permit will be required for treated groundwater; onsite landfilling would require state approval; and the groundwater treatment facility and landfill would require a RCRA permit.

Risk Reduction -- Meets remedial response objectives completely and reduces public-health threat to acceptable levels, but with high risk to remedial workers during excavation. Slight effect on air during excavation; moderate effect on surface water due to NPDES-permitted discharge of contaminants; minimal adverse effect on groundwater because contaminated water will be removed and treated; and slight adverse effect from soils and sediments because they will be removed and capped.

Cost -- Operating and maintenance requirements for landfill, cap, and groundwater treatment will be substantial. Estimated present-worth cost is $12.6 M - $224.8 M.

Accepted/Rejected: **Rejected**

Reasoning: Implementation of these alternatives would take more than two years. In addition, other alternatives are more cost-effective.

b. TREATMENT TRAIN NAME: Sludge/Pit Excavation, Onsite/Offsite Incineration, with Onsite/Offsite Disposal and Groundwater Treatment (groundwater treatment train is discussed separately)

Description: Source contaminants in the seven pits would be excavated to a total depth of 15 feet; the oily sludge (from the lower 10 feet) or all contaminated material would be incinerated; all ash would be disposed of in an approved, secured landfill; contaminated sediments would be dredged from McGirts Creek and disposed of in landfill; the site would be regraded and a cap installed; pumping wells would be installed to extract contaminated groundwater; an onsite treatment facility would be installed to treat groundwater; and treated effluent would be discharged to McGirts Creek.

Treatment Method: Physical (excavation and others) followed by thermal (incineration) followed by chemical (groundwater treatment).

Treatment Objective: Disposal of contaminated soil/sediment and groundwater.

Treatment Mode: At-grade and/or offsite

Source or Migration Control: Source for soils/sediments and migration for groundwater.

Treatment Train Performance Characteristics:

Effectiveness -- High level of cleanup achievable.

Reliability -- High reliability for contaminant destruction; skilled operating labor required. Excavation work and disposal in landfill are very reliable; groundwater treatment facility should be highly effective after optimization of design.

Confidence -- High degree of confidence for achieving goals; relies on widely used technologies.

Implementability -- Dewatering of site required prior to excavation. Logistics of onsite landfill construction are complex. Tree removal will be required. An NPDES discharge permit will be required for treated groundwater; onsite landfilling would require state approval, a state air discharge permit would be required for the incinerator, and the groundwater treatment facility and landfill would require a RCRA permit.

Risk Reduction -- Meets remedial response objectives completely and reduces public-health threat to acceptable levels, but with high risk to remedial workers during excavation. Moderate effect on air because of the possibility of products of incomplete combustion; moderate effect on surface water due to NPDES-permitted discharge of contaminants; minimal adverse effect on groundwater because contaminated water will be removed and treated; and slight adverse effect from soils and sediments because they will be removed and capped.

Cost -- Operating and maintenance requirements for the incineration system and groundwater treatment will be substantial. Estimated present-worth cost is $71.4 M - $137.6 M.

Accepted/Rejected: **Rejected**

Reasoning: Implementation of these alternatives would take more than two years. In addition, other alternatives are more cost-effective.

c. TREATMENT TRAIN NAME: Slurry Wall around Entire Site, Site Cap, Dredge Sediments, with/without Groundwater Treatment (groundwater treatment train is discussed separately).

Description: A soil-bentonite slurry wall would be constructed around the entire site (3000 ft long and to a depth of 40 ft); groundwater would be extracted and treated with sludges going to offsite landfill (for one option); contaminated sediments would be removed from McGirts Creek and disposed of onsite under a clay cap; surface would be regraded; and the area would be capped with a low-permeability material.

Treatment Method: Physical (excavation and others) and chemical (groundwater treatment; for one option)

Treatment Objective: Disposal of contaminated soil/sediment and treatment of groundwater.

Treatment Mode: In situ, at-grade, and offsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- A high achievable level of cleanup is anticipated.

Reliability -- Slurry wall and clay cap should be fairly to highly effective; the slurry wall should require little maintenance; and the clay cap should require moderate to high maintenance. The treatment facility should be highly effective following design optimization.

Confidence -- This approach relies on well-established technologies. Investigators were confident that this remedial action will correct public health and environmental concerns associated with the site.

Implementability -- Site conditions pose minor constraints on construction activities; dewatering is necessary for slurry wall construction; tree removal will be required. Long-term monitoring of the contaminant system will be required. Slurry wall and waste compatibility and suitability must be determined. An NPDES discharge permit will be required for treated groundwater; onsite disposal would require state approval, and the groundwater treatment facility would require a RCRA permit.

Risk Reduction -- No atmospheric environmental effects; slight surface-water environmental effects; no groundwater environmental effects; and slight sediment/soil environmental effects. This remedial alternative meets the remedial response objectives by reducing public-health threat to acceptable limits. There is also a low risk to remedial workers.

Cost -- Estimated present-worth cost is $2.5 M - $3.0 M.

Accepted/Rejected: **Accepted** (includes groundwater treatment option)

Reasoning: This remedial alternative was accepted because it fully meets the response objectives and acceptable levels of risk at the lowest cost. The system has proven reliable in the past and is based on well-established technologies. In addition, risk to remedial workers is minimized. The estimated time associated with implementing this alternative is between one and two years.

d. TREATMENT TRAIN NAME: Slurry Wall around Pits, Soil Excavation, Site Cap, Dredged Sediments, with/without Groundwater Treatment (groundwater treatment train is discussed separately)

Description: A clay-bentonite slurry wall would be constructed around pits only; groundwater from entire site (one option only) would be extracted and treated; contaminated soils would be removed from the non-pit areas; contaminated sediments would be removed from McGirts Creek and disposed of onsite under a clay cap; the entire site would be regraded and capped with a low-permeability liner.

Treatment Method: Physical (excavation and others) and chemical (groundwater treatment; for one option)

Treatment Objective: Disposal of contaminated soil/sediment and treatment of groundwater (one option).

Treatment Mode: In situ, at-grade, and offsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- A high achievable level of cleanup is anticipated.

Reliability -- Clay cap should be fairly to highly effective and should require moderate to high maintenance. The slurry wall's reliability should be lower because of its proximity to the waste pits, but it should require low upkeep. The treatment facility should be highly effective following design optimization.

Confidence -- This approach relies on well-established technologies. Slurry wall placement in contaminated zone increases the potential for failure. Long-term monitoring will be required to check effectiveness of system.

Implementability -- Site conditions impose several constraints on construction activities because construction of the slurry wall will be in a contaminated area. Tree removal will be required. In addition, dewatering will be required during slurry wall construction. Slurry wall and waste compatibility and suitability must be determined. An NPDES discharge permit will be required for treated groundwater; onsite disposal would require state approval, and the groundwater treatment facility would require a RCRA permit.

Risk Reduction -- Minimal atmospheric environmental effects, possible release of particulates and organic vapors during excavation; moderate surface-water environmental effects due to possible overland runoff to the creek during excavation; no groundwater environmental effects; and slight sediment/soil environmental effects. The remedial alternative with groundwater treatment totally meets the remedial response objectives by reducing public-health threat to acceptable limits, but there is a moderate risk to remedial workers. The remedial alternative without groundwater treatment does not meet the remedial response objectives, because it does not reduce public-health threat to acceptable limits; there is also a moderate risk to remedial workers.

Cost -- The estimated cost of these alternatives lies in the range \$2.1 M - \$2.7 M.

Accepted/ Rejected: **Rejected**

Reasoning: Although the groundwater treatment option is less expensive than the option accepted (i.e., \$2.7 M versus \$3.0 M), slurry wall placement in the contaminated zone increases the potential for wall failure; in addition, there is a moderate risk to remedial workers. The non-groundwater option does not fully meet the remedial response objectives of reducing the threat to public health to acceptable limits. The estimated time for completion of this alternative is between one and two years.

e. TREATMENT TRAIN NAME: Slurry Wall around Pits/Entire Site, Surface Cap without Groundwater Treatment

Description: A clay-bentonite slurry wall would be constructed around pits and contaminated soils removed from non-pit area, or a clay-bentonite slurry wall would be constructed around entire site, contaminated sediments would be removed from McGirts Creek and disposed of onsite under a clay cap, and the site would be regraded and capped with a low-permeability liner.

Treatment Method: Physical

Treatment Objective: Disposal of contaminated soil/sediment

Treatment Mode: In situ and at-grade

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- A moderate achievable level of cleanup is anticipated.

Reliability -- Clay cap should be fairly to highly effective and should require moderate to high maintenance. The slurry wall's reliability should be lower for the pit-only option because of its proximity to the waste pits but it should require low upkeep.

Confidence -- This approach relies on well-established technologies. Slurry wall placement in contaminated zone increases the potential for failure. Long-term monitoring will be required to check effectiveness of system.

Implementability -- Site conditions impose several constraints on construction activities because, for one option, construction of the slurry wall will be in a contaminated area. Tree removal will be required. In addition, dewatering will be required during slurry wall construction. Slurry wall and waste compatibility and suitability must be determined. An NPDES discharge permit will be required for treated groundwater; onsite disposal would require state approval, and the groundwater treatment facility would require a RCRA permit.

Risk Reduction -- No atmospheric environmental effects; zero to slight surface-water environmental effects; slight groundwater environmental effects, because the cap should minimize leachate generation through the site; and slight sediment/soil environmental effects because the contamination will remain. This alternative partially meets the remedial response objectives; it does not reduce public-health threats to acceptable limits; and there is a moderate risk to remedial workers (for the pit-only option) during installation of the slurry wall in the contaminated pit region.

Cost -- The estimated costs of these alternatives are in the range $2.0 M - $2.3 M.

Accepted/Rejected: **Rejected**

Reasoning: Although these treatment options are less expensive than the option accepted (i.e., $2.0 M versus $3.0 M), slurry wall placement in the contaminated zone (for the pit-only option) increases the potential for wall failure; in addition, there is a moderate risk to remedial workers. Finally, these options do not fully meet the remedial response objectives of reducing the threat to public health to acceptable limits. The estimated time of completion for this alternative is less than one year.

f. TREATMENT TRAIN NAME: Groundwater Treatment

Description: Groundwater would be extracted via pumping and moved to an equalization basin; or to a "mixing tank" where precipitation and flocculation agents are added; or to a flocculation tank; or to a sedimentation tank where sludge will be removed and sent to an offsite landfill; or to a place where air-stripping will be conducted, with the volatile organics going through activated carbon, then being released to the air and the heavy metals being acidified and sent through carbon adsorption and then neutralization.

Treatment Method: Physical and chemical

Treatment Objective: Treatment and disposal

Treatment Mode: At-grade

Source or Migration Control: Migration

Treatment Train Performance Characteristics:

Effectiveness -- Effective removal technology for particles, emulsified oil and grease, organics, and heavy metals.

Reliability -- Not discussed

Confidence -- Not discussed

Implementability -- Not discussed

Risk Reduction -- Meets approved NPDES discharge permit stipulations and provides acceptable levels of risk to surrounding populations.

Cost -- See other treatment trains for more detail.

Accepted/Rejected: **Accepted**

Reasoning: This is an effective removal technology for particles, emulsified oil and grease, organics, and heavy metals. It meets the stipulations of the approved NPDES discharge permit and provides acceptable levels of risk to surrounding populations.

7.0 McCARTY'S/PACIFIC HIDE AND FUR SITE

SITE NAME: McCarty's/Pacific Hide and Fur Site

EPA REGION: 10

STATE: Idaho

REFERENCES: RETEC (1987)

ENVIRONMENTAL MATRIX: PCB-contaminated soils

CURRENT STATUS: Currently (9/89) EPA is in the process of retaining a contractor to begin the remediation tasks at the site.

HISTORICAL SKETCH: During the course of operations at the site, transformers were salvaged and some capacitors containing PCBs were discarded onsite in a gravel pit. Intermixed silt and scrap, contaminated by PCBs, were the only contaminated media identified on this site. The intermixed silt and scrap consisted of as much as 50% metal, including small and large pieces. No contamination by any chemicals on the priority pollutant list was discovered in the groundwater.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment: None

Destruction:

Indigenous and Conventional Microorganisms -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Bio-Clean Process -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Sybron Bi-Chem 1006 Process -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Composting -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Disposal: None

Encapsulation: None

Chemical

Containment: None

Destruction:

Supercritical Water Oxidation -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

Supercritical Extraction -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

Hydrothermal Dechlorination -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

KOHPEG Process -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

LARC Process -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

UV Light with Methanol/Petroleum Ether -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

NaPEG Process -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Sodium Naphthalide -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

PBX Process -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

UV Light with Thermal Treatment -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Radiolytic Dechlorination -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Thionation -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Disposal: None

Encapsulation:

Fixation -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

Physical

Containment:

Capping -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

Institutional Containment: None

Destruction: None

Disposal:

Landfilling -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

Encapsulation: None

Excavation/Removal:

Excavation/Removal -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

Aqueous Surfactants (Extraction/Solvent Flushing) -- **Removed** from further consideration because the process was commercially unavailable for implementation.

Soilex Process (Extraction/Solvent Flushing) -- **Removed** from further consideration because the process was commercially unavailable for implementation.

Acruex Process (Extraction/Solvent Flushing) -- **Removed** from further consideration because the process was commercially unavailable for implementation.

O.H. Materials Process (Extraction/Solvent Flushing) -- **Removed** from further consideration because the process was commercially unavailable for implementation.

Physical Handling/Processing:

Screening -- **Approved** for consideration because screening was considered to be an effective process for separating most large-sized particles from smaller ones.

Shredding -- **Approved** for consideration because shredding is considered to be an effective process for reducing the size of objects.

Magnetic Sorting -- **Approved** for consideration because it is an effective process for removing ferrous metal objects from a process stream, thereby potentially reducing the volume of material needed to be treated.

No-Action Alternative:

No-Action Alternative -- **Approved** for consideration because it is standard procedure.

Thermal

Containment: None

Destruction:

Rotary Kiln (Incineration) -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

Cement Kiln (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

Fluidized Bed (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids.

Multiple Hearth (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Molten Salt (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Liquid Injection (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Catalytic Combustion (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Circulating Bed (Incineration) -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

Pyrolysis Advanced Electric Reactor (Incineration) -- **Removed** from further consideration because the process was commercially unavailable for implementation.

Plasma Arc (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Radio Frequency Heating (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Thermal Desorption Fuel-Indirect Heating System (Incineration) -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Shirco Infrared System (Incineration) -- **Approved** for consideration because the process was considered to be a proven treatment for PCB-contaminated soils/solids and was commercially available for implementation.

In Situ Vitrification -- **Removed** from further consideration because the process was not considered to be a proven treatment for PCB-contaminated soils/solids, and because it was commercially unavailable for implementation.

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Contaminated Soils and Metal Scrap

1.2 STATUS: FS completed November 1987

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Polychlorinated Biphenyls	sediment	organic	WQC,DWS,TSCA[a]

(a) WQC are Water Quality Criteria; DWS are Drinking Water Standards; and TSCA denotes allowable contaminant levels of 50 μg/g under the Toxic Substances Control Act of 1976.

1.4 REMEDIAL ALTERNATIVE INFORMATION

TREATMENT TRAINS:

a. TREATMENT TRAIN NAME: No-Action Alternative

Description: Over-sized scrap would be removed and salvaged; site grading would be undertaken to consolidate contaminated material on the site; a seeded, thin cover of soil would be placed over the site; and annual groundwater monitoring would be conducted.

Treatment Method: Physical

Treatment Objective: Monitoring

Treatment Mode: In situ

Source or Migration Control: N/A

Treatment Train Performance Characteristics:

Effectiveness -- N/A

Reliability -- N/A

Confidence -- N/A

Implementability -- N/A

Risk Reduction -- None

Cost -- Costs associated with this alternative are estimated as $0.16 M in initial costs and $6600 in annual cost.

Accepted/Rejected: **Rejected**

Reasoning: This alternative does not improve protection of the public of exposure to contaminants, does not meet ARARs, and does not reduce contaminant toxicity, mobility, or volume.

b. TREATMENT TRAIN NAME: Onsite Containment

Description: Under this alternative, some excavation of the pit area would occur, a 3-ft thick clay liner would be placed at the bottom of the pit, metal scrap would be sorted/screened from the contaminated soil for salvaging or landfilling, a clay cap would be placed on the waste site, the site would be restored to its original contours, and monitoring wells would be emplaced to ensure contamination has not migrated from the site.

Treatment Method: Physical

Treatment Objective: Containment

Treatment Mode: In situ

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Effective for preventing surface water infiltration, control of erosion, and isolation of contaminants from surface. Effective to reduce migration of contaminants as a result of infiltration of water, especially substances like PCBs.

Reliability -- Layered-cover systems to avoid cracking, drying, and wind erosion are reliable if they are designed to suit site-specific conditions. The effective, usable life of the cap is estimated at 100 years.

Confidence -- Average to above average confidence in meeting all criteria. The alternative does not remove PCB-contaminated material above the 50-μg/g level, although it is a proven approach for remediation of waste sites.

Implementability -- This alternative requires long-term maintenance and site controls. It requires long-term monitoring. Implementation of this alternative will take less than one year. Inspections will have to be performed regularly to ensure the integrity of the site.

Risk Reduction -- It could provide significant reduction in long-term potential for direct contact, and this alternative was judged to be at the median in protecting the public health.

Cost -- The costs associated with this alternative are estimated to be $1.1 M in initial cost and $4600 in annual cost.

Accepted/Rejected: **Accepted**

Reasoning: This alternative was judged to be the most successful in achieving all of the effectiveness and implementability goals in the most cost-effective manner. It provided a reduction in risk of long-term exposure through all transport pathways. This is a proven technology for long-term prevention of migration of PCB-contaminated soils.

c. TREATMENT TRAIN NAME: Fixation

Description: This alternative involves a pilot-scale test, excavation of contaminated soils and metal scrap, magnetic separation followed by particle shredding to reduce sizes, fixation by mixing the contaminated soil with kiln dust or fly ash, which is then placed back in the excavation pit to solidify. The surface of the site would be restored to its original condition, and long-term groundwater monitoring would occur.

Treatment Method: Physical (all but fixation) and chemical (fixation).

Treatment Objective: Containment

Treatment Mode: In situ

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Fixation has been used effectively for inorganics. With addition of proprietary additives, this process might be effective for fixating PCB-contaminated soils.

Reliability -- This process has been extensively tested under the supervision of EPA and the Florida Department of Environmental Resources on soils containing PCBs and metals. Both agencies approve the process as being reliable.

Confidence -- The process is commercially available, but it has been used at only one site. Average confidence in meeting all criteria. The alternative does not remove PCB-contaminated material above the 50-$\mu g/g$ level, although it is a proven approach for remediation of waste sites.

Implementability -- Fixation has the potential for short-term adverse effects as a result of material handling and processing requirements. Because the technology is relatively new, it has been judged to be below the median with regard to feasibility. This alternative requires long-term maintenance and site controls. It also requires long-term monitoring. Implementation of this alternative will take less than one year, but regular inspections will have to be performed to ensure the integrity of the site.

Water is required for this process and a hook-up to an existing water main or the construction of a water-producing well will be required.

Risk Reduction -- It could provide significant reduction in long-term potential for direct contact, and this alternative was judged to be at the median in protecting the public health.

Cost -- The cost associated with this alternative is estimated as $2.8 M in initial cost and $3500 for annual costs.

Accepted/Rejected: **Rejected**

Reasoning: This alternative was rejected because it is a relatively new technology, because it was judged below the median for feasibility given the extent of demonstration testing and the identification/construction of a water supply required, and because its costs are significantly higher than those associated with onsite containment.

d. TREATMENT TRAIN NAME: Offsite Disposal

Description: This alternative would involve excavation of the contaminated soil and metal scrap, screening of the material through a 6-in. screen, magnetic sorting to separate out the metal scrap, transport of the contaminated soil to an offsite, commercially approved landfill, and restoration of the land to its original grade.

Treatment Method: Physical

Treatment Objective: Removal and disposal

Treatment Mode: Offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Fully approved, commercially available landfill sites are considered to be effective treatment for PCB-contaminated soils. This alternative is considered to be extremely effective at eliminating the toxicity, volume, and mobility of the PCBs, because the contamination would be removed from the site.

Reliability -- There is a potential risk to those populations surrounding the landfill site for exposure to PCBs if the landfill system fails. Landfills designed with double liners and leachate-collection systems are considered reliable and comply with TSCA regulations, but they are judged to be likely to fail, and, for that reason, this alternative is judged to be below the median with regard to reliability.

Confidence -- EPA-approved landfills have been successful for soil contamination; long-term maintenance and monitoring are required.

Implementability -- This alternative is composed of technologies that are well proven, readily available, and implementable. The nearest approved landfill sites will only accept waste that is less than 6 in. in size. All scrap metal not recovered would have to be disposed of at a separate facility. It is estimated that this alternative would take six months to implement.

Risk Reduction -- Because the contaminated soil is removed from the site, there would not be long-term exposure to the contamination. An elevated risk to the general population and worker exposure would occur during the excavation and transportation of the material from the site. This alternative is judged to provide median protection of public health.

Cost -- The costs associated with this alternative are estimated as $4.0 M in initial cost, with no additional annual cost.

Accepted/Rejected: **Rejected**

Reasoning: Although the contamination is removed from the original site, there is a potential for increased exposure to surrounding populations during implementation of the alternative (i.e., excavation and transport) and eventual failure of the commercially approved landfill. In addition, the implementation cost associated with this alternative is significantly higher than that associated with onsite containment.

e. TREATMENT TRAIN NAME: Onsite Incineration

Description: This alternative involves excavation of all contaminated soil and metal scrap, reduction of the size of the metal scrap to fit into the incinerator (involving separation, magnetic sorting, and shredding), onsite incineration, fixation of the secondary waste stream (i.e., the ash), onsite disposal of ash as a nonhazardous substance (assuming the metal content was low enough or nonleachable so that delisting requirements are met), and site restoration.

Treatment Method: Thermal

Treatment Objective: Destruction

Treatment Mode: At-grade

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative is generally very effective at destroying PCBs. However, secondary waste streams are produced.

The ash would have to be fixed, potentially resulting in a larger volume to be disposed of (if metal content is a problem) than the volume that was fed to the incinerator. In addition, products of incomplete combustion (e.g., dioxin) might be released if the incinerator malfunctions. Higher levels of hydrochloric acid might also result from the burning if elevated levels of chlorine are present.

Reliability -- Onsite incineration is a proven technology that is considered to be quite reliable.

Confidence -- Products of incomplete combustion are possible, resulting in potential exposure and elevated risk to the surrounding population. If implemented properly, the incineration alternative has proven to be extremely effective at destroying PCBs to acceptable limits.

Implementability -- A test burn would be required. Also, state air-emission permits and local acceptance of this alternative would have to be obtained. This is a proven technology that has been successfully implemented on organic materials at other sites. The technology is labor intensive and requires skilled operators. Implementability is considered to be more involved than that for other technologies and, therefore, is judged to be below the median. It is estimated that upon approval it would take approximately one year to begin operation.

Risk Reduction -- There is an increased risk to the population through the atmospheric pathway during the excavation phase. Also, products of incomplete combustion may be released to the atmosphere during malfunctions, resulting in increased risks to the population.

Cost -- The cost associated with this alternative is estimated as $8.4 M initially, with no additional annual cost.

Accepted/Rejected: **Rejected**

Reasoning: This alternative has particle-size limitations; fixation of the ash may be required, resulting in a potential secondary waste stream; increased short-term risks are likely due to excavation and subsequent exposure to contaminated particles; implementability is below the median because skilled labor is required; and it is the most expensive alternative.

8.0 COALINGA ASBESTOS WASTE SITE

SITE NAME: Coalinga

EPA REGION: 9

STATE: California

REFERENCES: ATEC (1988)

ENVIRONMENTAL MATRIX: Asbestos and chromium-laden soils and building materials

CURRENT STATUS: FS published in 12/88. As of 9/89, the administrative record has been completed and is available for public inspection.

HISTORICAL SKETCH: A survey of the Coalinga Site found chrysotile asbestos ore ranging from less than 1% by weight to 50% by weight; other heavy metals were also found, including chromium and nickel. From 1955 to 1980, the site was active in the milling, manufacture, and/or transportation of asbestos-mining materials (AMM). As a result of these activities, residual asbestos-ore waste (AOW) has been found throughout the site, including in the soil and building materials.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment: None

Destruction: None

Disposal: None

Encapsulation: None

Chemical

Containment: None

Destruction: None

Disposal: None

Encapsulation:

Chemical Fixation by Plant Processing -- **Approved** for consideration because it was felt to be highly effective in reducing contaminant mobility; although it was approved for consideration, it was not included in any of the remedial alternatives.

Chemical Fixation by Pressure Grouting -- **Removed** from consideration because it was not felt to be technically feasible or effective in treating surface zones of waste.

Chemical Fixation by Deep In Situ Soil Mixing -- **Removed** from consideration because this technology was not felt to be technically feasible, because it is more applicable to wastes that extend to large depths. This technique is also relatively new.

Chemical Fixation by Area Mixing -- **Removed** from consideration because this procedure is more appropriate for fixing just the outermost layer of a waste pile than for fixing an entire mass.

<u>Physical</u>

Containment:

Capping of Onsite Asbestos-Ore Waste and Asbestos-Mining Waste -- **Approved for** consideration because capping of onsite asbestos-ore waste (AOW) and asbestos-mining waste (AMW), whether the cap is composed of asphalt, soil, soil-cement, or clay, or is multilayered, is felt to be highly effective in preventing airborne transport of and direct contact with source contaminants. The soil cap was felt to be the best and was, therefore, the recommended capping type.

Stockpiled Containers -- **Removed** from consideration because the integrity of the containers is compromised by exposure to the elements and because capital and maintenance costs of containerization are high relative to other technologies (e.g., soil capping).

Institutional Containment:

Fencing of the Site -- **Approved** for consideration because it should be effective in preventing direct contact with onsite contamination and because the relative capital and operation and maintenance costs are low.

Destruction: None

Disposal:

Onsite Disposal of Asbestos-Ore Waste and Asbestos-Mining Waste -- **Approved** for consideration because of its moderate cost, long-term effectiveness, and technical feasibility.

Offsite Disposal of Asbestos-Ore Waste and Asbestos-Mining Waste -- **Approved** for consideration because of its known implementability, effectiveness, and cost.

Encapsulation: None

Excavation/Removal: See Disposal.

Physical Handling/Processing:

Reprocessing of Onsite Waste Material -- **Removed** from consideration because of high costs and health and safety concerns; this treatment is also considered to be ineffective.

No-Action Alternative:

No-Action Alternative -- **Approved** for consideration because this is standard procedure.

Thermal

Containment: None

Destruction:

Thermal Vitrification -- **Removed** from consideration because in situ vitrification and plant-processing vitrification are considered relatively new treatment technologies.

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Soil and Building Material

1.2 STATUS: Through December 1988.

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Asbestos	soil material(b)	inorganic	PEL,PLM(a)
2	Nickel	soil material	inorganic	N/A(c)
3	Chromium	soil material	inorganic	N/A

(a) Permissible Exposure Limit (PEL) for asbestos at 0.2 PCM fibers per cubic centimeter (for occupational exposure); are designated with asbestos when more than percent one asbestos [using Polarized Light Microscopy (PLM)] is found.
(b) Material includes building material other than soil.
(c) Not addressed.

1.4 REMEDIAL ALTERNATIVE INFORMATION

TREATMENT TRAINS:

a. TREATMENT TRAIN NAME: No-Action Alternative

Description: The site would be left as is, and no additional remedial actions would take place.

Treatment Method: None

Treatment Objective: None

Treatment Mode: N/A

Source or Migration Control: None

Treatment Train Performance Characteristics:

Effectiveness -- None

Reliability -- N/A

Confidence -- N/A

Implementability -- N/A

Risk Reduction -- No risk reduction would occur. The risk to human health and the environment would not be mitigated, and the no-action alternative would not comply with cleanup standards.

Cost -- None

Accepted/Rejected: **Rejected**

Reasoning: The risk to human health and the environment would not be mitigated, and the no-action alternative would not comply with cleanup standards. The remedial alternative score was 21. [Note: The lower the number, the better the score.]

b. TREATMENT TRAIN NAME: Removal of Wastes with Disposal at Abandoned Mine Sites

Description: This alternative involves removing contaminated areas within the site, transporting the material offsite to an abandoned mine in the surrounding hills, and decontaminating the building structures.

Treatment Method: Physical

Treatment Objective: Removal and disposal

Treatment Mode: Offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This approach would meet ARARs (i.e., cleanup standards) with community approval.

Reliability -- This method is based on fairly reliable techniques.

Confidence -- The remedial alternative could be implemented but at a high cost.

Implementability -- This alternative would include efforts associated with extending and/or repairing roads and utilities to the chosen mine site. The length of time to implement this alternative is estimated at one to two years.

Risk Reduction -- Potential exposure to surrounding residents and workers would occur during the building-decontamination and contaminated-soil-excavation phases; in addition, exposures to residents would occur during the transportation phase.

Cost -- The cost associated with this alternative is estimated to range from $7 M to $9 M.

Accepted/Rejected: **Rejected**

Reasoning: This remedial alternative received the second highest remedial alternative score, 19. [Note: The lower the number, the better the score.] Because of its high cost and extended duration for implementation and additional liabilities, this alternative was rejected.

c. TREATMENT TRAIN NAME: Covering Waste with One Foot of Asbestos-Free Soil

Description: This alternative would involve removal of the waste mining materials to an offsite disposal facility, covering the site areas that tested positive for AOW with a 1-ft layer of asbestos-free soil, and decontaminating the remaining building structures.

Treatment Method: Physical

Treatment Objective: Containment

Treatment Mode: In situ

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative would meet ARARs and is an acceptable practice for landfill burial of asbestos waste.

Reliability -- Short-term and long-term effectiveness for eliminating exposure to surrounding people is rated as fair.

Confidence -- This alternative is the acceptable practice for landfill burial of asbestos waste.

Implementability -- This alternative would require a five-year revisit for leaving wastes on site. Community acceptance is not likely to be obtained during a public hearing period given the acreage involved. Under these conditions, deed restrictions for future land use would be placed on a large portion of Coalinga, thus limiting development. It is estimated that this alternative could be implemented in four months.

Risk Reduction -- The short-term risks to human health and the environment would be moderately high. The cleanup of buildings and covering of the highly contaminated areas could potentially cause exposure. Long-term protection of human health and the environment would be less than with most of the other alternatives because the asbestos-ore waste would be under only one foot of clean soil and exposure through direct contact could occur.

Cost -- The estimated cost associated with this alternative is $0.6 M - $0.8 M.

Accepted/Rejected: **Rejected**

Reasoning: The short-term risks to human health and the environment would be moderately high. Long-term protection of human health and the environment would be less than with most of the other alternatives because the asbestos-ore waste would be under only one foot of clean soil and exposure through direct contact could occur. Finally, the institutional controls required by this alternative would be inconsistent with future land use and would seriously impact future development in Coalinga. The remedial alternative score was 16. [Note: The lower the number, the better the score.]

d. TREATMENT TRAIN NAME: Removal of Waste to an Offsite Landfill

Description: This alternative would involve decontaminating the structures, collecting the AOW and other mining materials, and loading and transporting the material to an approved offsite landfill.

Treatment Method: Physical

Treatment Objective: Disposal

Treatment Mode: Offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative meets ARARs and is an acceptable practice for asbestos disposal.

Reliability -- The tone of the FS implied that this method of disposal would be reliable, although nothing was specifically noted.

Confidence -- Landfilling has been a common practice for disposing of hazardous waste, although none of the negative aspects associated with the practice were discussed.

Implementability -- This alternative would meet the criterion of acceptance by the community.

Risk Reduction -- Long-term protection of human health is judged to be moderately high; although short-term protection is judged to be moderately low, exposure would occur only during the onsite operations.

Cost -- The estimated cost associated with this alternative is $5.5 M.

Accepted/Rejected: **Rejected**

Reasoning: The remedial alternative score was 13. This was the lowest score, and the fifth alternative (i.e., Construction of an Onsite Waste

Management Unit) received the second lowest score. [Note: The lower the number, the better the score.] From a technical standpoint, the alternatives are very similar. However, this alternative costs more than double the fifth alternative, without providing any additional human-health or environmental protection. Based on this reasoning, Alternative e was chosen over this alternative.

e. TREATMENT TRAIN NAME: Construction of an Onsite Waste Management Unit

Description: This alternative involves decontamination of the buildings; construction of an onsite Waste Management Unit (WMU); collection, consolidation, and onsite burial of the AOW and other mining materials; and capping of the WMU in accordance with the State Code of Regulations.

Treatment Method: Physical

Treatment Objective: Disposal

Treatment Mode: In situ

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- This alternative was felt to be technically acceptable from an environmental standpoint.

Reliability -- The tone of the FS implied that this method of disposal would be reliable, although nothing was noted specifically.

Confidence -- Landfilling has been a common practice for disposing of hazardous waste, although none of the negative aspects associated with the practice were discussed.

Implementability -- The permitting and review processes could be lengthy. The site would require monitoring and land-use restrictions over a limited area would be likely. The primary drawback for this alternative is the permanent land-use restriction for a small portion of the site.

Risk Reduction -- Long-term protection of human health is judged to be moderately high; short-term protection is judged to be moderately low but exposure would occur only during the onsite operations.

Cost -- The estimated cost associated with this alternative is \$1.5 M - \$2.5 M.

Accepted/Rejected: **Accepted**

Reasoning: This alternative received the second lowest score (14), while the fourth alternative (i.e., Removal of Waste to an Offsite Landfill) received the lowest score. [Note: The lower the number, the better the score.] From a technical standpoint, the alternatives are very similar. This alternative costs less than one-half as much as Alternative d, and Alternative d does not provide any additional human-health or environmental protection. The primary drawback for this alternative is the permanent land restriction for a small portion of the site. Based on this reasoning, Alternative e was chosen.

9.0 GMC-CFD MASSENA FACILITY SITE

SITE NAME: GMC-CFD Massena Facility

EPA Region: 2

STATE: New York

REFERENCES: Swed et al. 1989

ENVIRONMENTAL MATRIX: Disposal area with PCB-(Aroclor 1248) contaminated soils, groundwater, sludges, industrial wastes, and river sediments.

CURRENT STATUS: At public hearing awaiting ROD.

HISTORICAL SKETCH: The General Motors Corporation, Central Foundry Division (GMC-CFD), has operated an aluminum-casting plant in Massena, New York, since 1959. Hydraulic fluids containing PCBs were purchased for use in die-casting machines from 1968 until 1973. Sludges containing PCBs from waste-water systems were periodically disposed of in onsite disposal pits. Two inactive waste-water lagoons are also located at the facility.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment:

Soil/Waste/Sediment Treatment -- **Approved** for consideration. Batch processing (SBR) in aboveground reactors is a likely biological treatment scenario. Bench and pilot testing would be required before implementation.

Destruction:

Groundwater Treatment -- **Approved** for consideration. The presence of toxins in groundwater and low organic content could inhibit biological treatment. Use of the existing onsite water-treatment facility is feasible.

Disposal: None

Encapsulation: None

Chemical

Containment:

Soil/Waste/Sediment Treatment -- **Approved** for consideration. Treatability studies would be necessary to demonstrate effectiveness on site wastes.

Soil/Waste/Sediment Extraction Treatment -- **Removed** from further consideration because it has not been widely demonstrated at full scale.

Destruction: None

Disposal: None

Encapsulation:

Solidification/Stabilization of Soils/Solids -- **Removed** from further consideration because there has been no definitive guidance from EPA concerning the allowable "leachability" of contaminants from a solidified material.

Physical

Containment:

Sprayed-On Caps -- **Removed** from consideration because of the high costs and maintenance requirements.

Soil Caps -- **Approved** for consideration because soil caps can be constructed using conventional equipment and techniques.

Synthetic Membranes -- **Removed** from consideration because of the high costs and maintenance requirements.

Composite Covers -- **Approved** for consideration because composite covers provide the most flexible options, with fewer maintenance requirements.

Slurry Walls -- **Approved** for consideration because this treatment has been the most widely implemented form of hydraulic containment.

Sheet Piles -- **Removed** from consideration because this treatment has not been implemented at the depths required at the GMC-CFD site.

Injected Screens -- **Removed** from consideration because this treatment has not been implemented at the depths required at the GMC-CFD site.

Grout Curtains -- **Removed** from consideration because this treatment has not been implemented at the depths required at the GMC-CFD site.

Pumping Wells -- **Approved** for consideration. Spacing and sizing of the pumping wells would be determined by the extent of the plume to be controlled and by aquifer properties.

Subsurface Drains -- **Removed** from consideration. A well system would be preferable to a drain system because subsurface drains are generally limited to operation in shallow depths.

Carbon Absorption -- **Approved** for consideration but treatment could be limited by dissolved constituents present in groundwater.

Air Stripping -- **Removed** from further consideration. The efficiency of the air-stripping process is mainly dependent on the air-to-water ratio, the contact time, temperature, and the physical and chemical properties (volatility) of the constituent of interest.

Institutional Containment: None

Destruction: None

Disposal:

Soil/Waste/Sediment Offsite Disposal -- **Approved** for further consideration but limited by the availability of offsite facilities.

Soil/Waste/Sediment Onsite Disposal -- **Approved** for further consideration. However, any proposed use of land-disposal technologies would be subject to RCRA regulations, which require a permanent solution.

Groundwater Discharge to Surface Water -- **Approved** for further consideration. This treatment can be applicable to both treated and untreated groundwater, provided both the quality and quantity meet the allowable discharge requirements for surface waters.

Groundwater Discharge to Publicly Owned Treatment Works -- **Removed** from consideration because there are no facilities nearby.

Groundwater Reinjection -- **Removed** from consideration because of the low permeability of the soils.

Encapsulation: None

Excavation/Removal:

Soil and Solids Excavation -- **Approved** for consideration because it can be accomplished using conventional technology.

Mechanical Sediment Dredging -- **Approved** for consideration because it can be accomplished using conventional technology.

Hydraulic Sediment Dredging -- **Removed** from consideration because of the large volume of water that must be handled.

Physical Handling/Processing:

Physical Separation -- **Approved** for consideration because it can be implemented using conventional technology.

No-Action Alternative:

No-Action Alternative -- **Approved** for consideration because it is a standard procedure.

Thermal

Containment: None

Destruction:

Soil/Waste/Sediment Treatment -- **Approved** for consideration. The implementability of an offsite option would be limited by available capacity and location. Onsite implementation would be limited by permitting requirements.

Disposal:

Soil/Waste/Sediment Extraction Treatment -- **Removed** from consideration because performance data are limited. Treatability testing would be required.

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Contaminated soils, sludges, industrial wastes, and river sediments.

1.2 STATUS: draft RI/FS out for public comment (as of April 1989)

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Polychlorinated biphenyls	soil/waste, surface and groundwater, sediments	organic	TSCA[a] NYCRR[b] NYCRR N/A

(a) The Toxic Substances Control Act (TSCA) of 1976 and 1987.
(b) New York Coastal and River Regulations (NYCRR).

1.4 REMEDIAL ALTERNATIVE INFORMATION

UNIT PROCESS:

a. PROCESS NAME: No-Action Alternative

Description: No onsite remedial actions would be performed. Defined onsite waste-disposal areas would remain in their present conditions. Long-term groundwater monitoring would be implemented. Chemical analyses for PCBs, acid-extractable chemicals, metals, and several inorganics would be conducted semiannually.

Treatment Method: Physical

Treatment Objective: Monitoring

Treatment Mode: In situ

Source or Migration Control: N/A

Process Performance Characteristics:

Effectiveness -- This alternative will not remove the source or reduce the volume of contamination. Short-term potential exposures to workers during implementation would be minimal. The potential for future long-term leaching or migration to groundwaters and/or surface waters would not be reduced.

Reliability -- N/A

Confidence -- N/A

Implementability -- This alternative can be implemented using proven equipment and construction materials for monitoring well installation. Site and use restrictions will be required in preventing access to contaminated materials. Monitoring wells can be effectively operated over a 30-year period to assess potential constituent releases. Monitoring wells can be maintained and replaced if necessary over a 30-year period. Long-term groundwater monitoring program will depend on EPA and NYDEC approval.

Risk Reduction -- None

Cost -- Indirect capital costs would be associated with engineering and there would be annual monitoring costs for groundwater sampling and analysis. Present-worth costs are estimated as $1.26 M.

Accepted/Rejected: **Accepted**

Reasoning: Specific exposures to site contaminants have not been identified, and GMC-CFD will maintain institutional control over the land-based operable units at the facility.

b. PROCESS NAME: Site Capping

Description: Industrial wastes and highly contaminated areas would be capped to minimize infiltration, thus keeping water from contacting unsaturated contaminated material and producing leachate. Shallow off-site soils from the adjacent St. Regis Mohawk Reservation land and from GMC-CFD land adjacent to the Raquette River would be excavated to action levels of 1 ppm and 10 ppm, respectively. This material would be consolidated within the east disposal area.

Treatment Method: Physical

Treatment Objective: Offsite soils would be excavated and consolidated with onsite contaminated soils, and then graded. Option b1 includes a soil cover over the entire area, even where only marginally contaminated. Option b2 involves a composite cover that would be installed over just the highly contaminated area.

Treatment Mode: At-grade

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- This treatment will prevent the direct contact route of exposure in the long term. Liquid migration and mobility through the contaminated material will be reduced. Site capping will not reduce the volume or remove the source of contamination from major disposal areas. It would be effective for diverting site drainage to sedimentation basins, but will not reduce the toxicity or volume of the constituents of concern. The composite cover in Option b2 would reduce liquid migration and mobility through the contaminated material more than the soil cover (Option b1) would.

Reliability -- Conventional technology has been applied at numerous sites.

Confidence -- It is necessary to provide assurance that the materials would have the appropriate engineering characteristics and adequate availability.

Implementability -- Site capping can be implemented using proven equipment and technologies. Long-term groundwater monitoring of the site and periodic inspection of the cover for settlement, ponding of liquid, and erosion will be required. Implementability is dependent on the local availability of proper soil and drainage materials. Administratively, implementability would depend on coordination with governmental agencies. Approval from the EPA and NYDEC may be difficult, given that the toxicity of the site is not reduced.

Risk Reduction -- No change in toxicity or volume of constituents, although mobility would be reduced.

Cost -- Direct capital costs would be associated with site preparation and work. Excavation of Raquette River and offsite soils could potentially affect the estimate significantly. Obtaining clay to meet the specifications also affects the estimate. There would be indirect costs for engineering and annual monitoring of groundwater sampling and analysis. Present-worth costs are estimated as \$6.2 M for the soil cover and \$10 M for the composite cover.

Accepted/Rejected: **Accepted**

Reasoning: This alternative was considered an effective means of reducing contaminant mobility and direct contact with contaminants because the cost of excavation and management of the large volumes of soil and waste in some operable units may be prohibitive.

c. PROCESS NAME: In Situ Containment of River Sediments

Description: This treatment has two options - c1 involves a graded filter, c2 involves a graded filter and a sheet pile wall. With either option, the contaminated sediment would remain in place. Option c1 uses a silt curtain to capture sediment extending approximately 1,000 feet along the river shore encircling the zone of contaminated sediment. Option c2 is basically the same as c1, except Option c2 also includes a sheet pile wall, which would protect the graded filter against the potential erosive force of the river.

Treatment Method: Physical

Treatment Objective: The transport of PCB-contaminated river sediments to the environment would be limited.

Treatment Mode: In situ

Source or Migration Control: Migration

Process Performance Characteristics:

Effectiveness -- Option c1 offers a short-term protection of the environment from downstream siltation caused by disturbed sediment. Placement of the graded filter over the contaminated material will minimize the suspension of sediment in both the short and the long terms. Isolating the contaminated sediment will reduce the probability of its uptake by aquatic organisms. In situ containment will not reduce either the toxicity or the volume of the contaminated river sediments. Option c2 offers short-term protection, enhanced over that provided by Option c1 by use of a sheet pile wall for primary containment of the sediment disturbed during construction. Long-term protection will be increased by the extra protection against erosion provided by the sheet pile wall. As in Option c1, placement of the graded filter over the contaminated material will minimize suspension of sediment in both the short and the long terms. Isolating the contaminated sediment will reduce the probability of its uptake by aquatic organisms. In situ containment will not reduce either the toxicity or the volume of the contaminated river sediments.

Reliability -- N/A

Confidence -- Both options make use of well-developed construction techniques.

Implementability -- Both options are based on proven construction methods. Little maintenance will be required, as long as flow in the river does not exceed that of the maximum flood considered in designing. Implementability will require permits from appropriate regulatory agencies for the placement of a graded filter in the St. Lawrence Seaway. No permits will be required for either transportation or disposal of contaminated sediments.

Risk Reduction -- Toxicity would be reduced only to the extent of natural reduction. Volume would be unchanged. Mobility can be limited.

Cost -- Direct capital costs would be associated with placing the graded filter. Costs of the riprap could potentially vary significantly. There would be long-term costs for periodic inspections. Indirect costs include those for engineering and permits. Present-worth costs are estimated at $3.62 M for the sediment containment and $4.51 M for the sediment containment with sheet piles.

Accepted/Rejected: Option c1: **Accepted**; Option c2: **Rejected.**

Reasoning: Option c1 is an effective means of reducing contaminant mobility if sediment removal cannot be implemented. The sheet pile wall included with Option c2 provides little additional protection, but creates additional implementation concerns and costs over those of Option c1.

d. PROCESS NAME: Solids and Soils Excavation and Offsite Management

Description: This treatment involves excavation of onsite solid materials to an action level of 25 ppm and offsite soils to an action level of 1 ppm. Clean backfill will be added to the excavated areas and graded. A long-term groundwater monitoring program would be implemented in Option d1 (Secure Chemical Landfill); material would be loaded into trucks and shipped to an approved receiving facility, such as the Chemical Waste Management Site in Model City, New York. For Option d2 (Thermal Treatment Facility), soils would be temporarily stockpiled on location. Preprocessing will be required to remove oversized items. Material would later be loaded in 55-gallon drums and shipped to an approved receiving facility.

Treatment Method: Physical

Treatment Objective: Excavation of solid materials from several operable units and disposal of materials at an offsite facility.

Treatment Mode: Offsite

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- An offsite landfill would be effective in removing the source and reducing the volume of contamination onsite. Short-term protection will be maintained by personal protective equipment and construction methods that minimize contaminant disturbance. The offsite incineration option provides for long-term reduction in waste characteristics (toxicity and volume).

Reliability -- Both options are very reliable.

Confidence -- Both options are proven technologies.

Implementability -- Option d1 - The nearest permitted landfill is located in Model City, New York. The capacity of the landfill will be an issue for the anticipated disposal of 747,000 cubic yards of contaminated material. There is currently sufficient capacity; however, final negotiations would need to be settled before implementation. Materials hauled offsite would have to be replaced with large volumes of backfill. U.S. Department of Transportation (D.O.T.) approval must be obtained for over-the-road hauling of wastes. Increased liability could result from offsite disposal of untreated wastes. Option d2 - Again, materials hauled offsite would have to be replaced with large volumes of backfill. D.O.T. approval must be obtained for over-the-road hauling of wastes. The nearest offsite incinerator is located in Arkansas, at a haul distance of approximately 1,200 miles. The large volume of material that would have to be hauled offsite makes this impractical. If containerization would be needed for hauling the wastes, Option d2 is less practical.

Risk Reduction -- Toxicity and volume of contaminated soils are not reduced. Mobility is greatly reduced.

Cost -- Present-worth cost estimate is $322 M for Option d1 and $2.68 billion for Option d2.

Accepted/Rejected: **Rejected**

Reasoning: Compared to onsite management alternatives, these options are not economically attractive.

e. PROCESS NAME: Dredging and Offsite Management of River Sediments

Description: A silt curtain would be installed for control of sediment that might be disturbed by construction activities. A sheet pile wall would be installed to provide a stilling basin for dredging operations. A sediment-dewatering basin will be constructed on shore. The river sediments will be mechanically dredged with a clam-shell bucket. After the material is moved onshore and dewatered, the dewatered material would be moved offsite for disposal. In Option e1 (Secure Chemical Landfill), material will be loaded into trucks and shipped to an approved receiving facility, such as the Chemical Waste Management Site in Model City, New York. In Option e2 (Thermal Treatment Facility), material would be incinerated at an approved facility, such as the Rollins incinerator in Deer Park, Texas.

Treatment Method: Physical

Treatment Objective: Dredging and dewatering the contaminated St. Lawrence River sediments, and offsite management of the dewatered material by landfilling or incineration.

Treatment Mode: Offsite

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- Short-term protection during dredging will be provided by use of both a silt curtain and a sheet pile wall to isolate the contaminated material from the rest of the environment. Long-term protection will be provided by removal and treatment of the sediment. In Option e1, with respect to short-term protection, over-the-road hauling to an offsite facility may result in exposure to contaminated material. However, long-term protection is provided. Contaminated material, once stored above the saturation zone, will be less susceptible to contact with and movement through the groundwater. For Option e2, short-term effectiveness is related to exposure during offsite transport. The long-term effectiveness of incineration is reflected in the reduction of toxicity, volume, and mobility.

Reliability -- Mechanical dredging is a proven technology for excavation of river sediment. Technical feasibility of sediment control, sheet pile walls, and excavation has been demonstrated in locations along the St. Lawrence Seaway. Technical feasibility of implementing Option e2 is proven.

Confidence -- Methods that will be used include standard earth-moving technology.

Implementability -- Administrative feasibility is probable because approval from few agencies will be required; treatment, storage, and disposal services are not component elements of this alternative; and equipment and technical specialists are probably available in the work area. The administrative feasibility of Option el depends to a significant degree on available space in a permitted landfill when it is required. If use of an out-of-state landfill is necessary, changing regulatory constraints in the receiving state could create problems. Increased liability could result from offsite disposal of untreated wastes. For Option e2, administrative feasibility has been demonstrated in several similar projects. A possible hindrance to the timely execution of this option may be the lead time required to locate a permitted incinerator with the available capacity. If use of an out-of-state landfill is necessary, changing regulatory constraints in the receiving state could create problems.

Risk Reduction -- Toxicity and volume of contaminated soils are not reduced. Mobility is greatly reduced.

Cost -- Present-worth cost estimates are $14.9 M for Option el and $112 M for Option e2. No long-term monitoring costs are associated with these alternatives.

Accepted/Rejected: **Rejected**

Reasoning: The institutional drawbacks to offsite disposal make Option el less desirable than onsite alternatives, even though the volumes and costs are less prohibitive for the offsite management of soils and wastes. Onsite thermal alternatives are more cost-effective than Option e2.

f. PROCESS NAME: Onsite Disposal of Contaminated Materials

Description: A landfill with a double composite liner would be designed and constructed. Within the landfill, a dewatering basin would be constructed. Contaminated soil, lagoon sludges, and river sediments would be excavated and hauled to the landfill. Excavated areas would be filled with clean backfill, graded, and revegetated. Landfill and leachate treatment and a groundwater monitoring program would be maintained.

Treatment Method: Physical

Treatment Objective: Dispose of contaminated solids in an onsite, double-lined landfill.

Treatment Mode: Onsite

Source or Migration Control: Source

Process Performance Characteristics:

Effectiveness -- Long-term effectiveness will be determined by both the maintenance provided to the disposal unit and the effectiveness of the liner system in minimizing migration from the site. A program of surface maintenance, groundwater monitoring, and leachate treatment will be effective in a warning system that will indicate when further action is required to protect human health and the environment from exposure to PCB-contaminated materials.

Reliability -- Protection during implementation will be related to construction techniques that reduce the mobility of the contaminated material.

Confidence -- The construction techniques used in landfill construction have been proven in the field under a wide variety of operating conditions.

Implementability -- Administrative feasibility is probable.

Risk Reduction -- This option does not provide a permanent solution, but it does reduce the mobility of the material and protect the environment. Land disposal is less desirable than treatment in which the volume or toxicity of contaminated material is reduced.

Cost -- Present-worth cost estimate for an onsite landfill is $45.6 M. Clay meeting RCRA requirements may or may not be readily available, which could affect the estimate.

Accepted/Rejected: **Accepted**

Reasoning: This alternative is retained because it is an effective means of reducing the mobility of PCBs from soils and waste.

2.1 ENVIRONMENTAL MATRIX: Contaminated soils, groundwater, sludges, industrial wastes, and river sediments.

2.2 STATUS: draft RI/FS out for public comment (as of April 1989)

2.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Polychlorinated biphenyls	soil/waste, surface and groundwater, sediments	organic	TSCA[a] NYCRR[b] NYCRR N/A

(a) Toxic Substances Control Act (TSCA) of 1976 and 1987.
(b) New York Coastal and River Regulations (NYCRR).

2.4 REMEDIAL ALTERNATIVE INFORMATION

a. TREATMENT TRAIN: Slurry wall around industrial landfill and onsite with highly contaminated soils, with groundwater treatment.

Description: A slurry wall would be installed to an average depth of approximately 40 feet to reduce the amount of contaminated groundwater flowing offsite from beneath the operable unit. A hydraulic control system would consist of 16 four-inch diameter wells spaced 100 ft apart and extending into the confined sand layer. Groundwater would be removed and treated in the existing onsite waste-water treatment plant. The existing system would be upgraded to include an equalization basin, a clarifier for primary settling, and a sand filter. Treated water would be discharged to the St. Lawrence River under the existing GMC-CFD SPEDS permit. Ten piezometers would be installed both within and outside the slurry wall to assess the hydraulic gradient. Long-term monitoring of water levels and groundwater quality would be required to assess the integrity of the slurry walls. Long-term monitoring would be the same as in Part 1.4.a.

Treatment Method: Physical and chemical

Treatment Objective: Containment of groundwater flow in the vicinity of the industrial landfill and the highly contaminated soils onsite.

Treatment Mode: In situ and offsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- Designed to minimized the long-term offsite release of contaminated groundwater in the vicinity of the industrial landfill and north disposal area. Short-term protection of site workers will be maintained by personal protective equipment and construction methods that minimize contaminant disturbance. The mobility of contaminated groundwater will be minimized, but the toxicity and volume of the source of contaminants will not be reduced. The slurry wall design can be keyed into a lower-permeability confining layer to reduce the amount of groundwater leaving the site. A gradient-control system must be maintained to provide long-term effectiveness.

Reliability -- Construction practices are standard.

Confidence -- The expected slurry wall depth of 40 feet can be constructed using proven technology.

Implementability -- The hydraulic and migration pathway pinches out to the south of both operable units and grades to low-permeability formations, which reduces the need for wall construction to the south of the units. Groundwater extraction wells will be needed to maintain inward gradients. This alternative is administratively feasible with respect to obtaining approvals from appropriate agencies. Long-term monitoring of the site will be required. The compatibility of the backfill mixture with site contaminants, the type of wells to be used in the gradient-control system, and the design of a gradient-control system (using a groundwater model to further define the hydrogeologic system) must all be resolved prior to implementation.

Risk Reduction -- Contaminant mobility is decreased. Volume and toxicity of contamination are unchanged.

Cost -- Direct capital costs are associated with installing the slurry wall and well drilling (highly variable between contractors). Potential costs for repair of the slurry wall are not included, because its long-term performance is unknown. The carbon requirement in the carbon filtration system could vary if the pumping rate and the contaminant-removal rate vary from those predicted. Present-worth cost estimate is $7.61 M.

Accepted/Rejected: Accepted

Reasoning: An effective and implementable means of reducing the mobility of constituents via groundwater.

b. TREATMENT TRAIN: Recovery wells with groundwater treatment

Description: Fifteen recovery wells would be installed in the industrial landfill and ten in the north disposal/lagoon area. Pumping would directly remove the contaminant mass in the groundwater and would accelerate the natural flushing of contaminants adsorbed on the soil in the aquifer using relatively clean groundwater migrating from areas outside the operable unit. Groundwater would be discharged to a centralized collection header, which would feed directly into the wastewater treatment plant. The existing system (aeration basin, clarifier, sand filtration, storage lagoon, and carbon absorption) would be upgraded to include an equalization basin, a clarifier for primary settling, and a sand filter. The treated water is to be discharged to the St. Lawrence River under existing GMC-CFD SPEDS permit.

Treatment Method: Physical and chemical

Treatment Objective: Install recovery wells for the removal and treatment of contaminated groundwater.

Treatment Mode: In situ and offsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- Treatment is designed to minimize offsite release of contaminated groundwater in the vicinity of the industrial landfill and north disposal area and to minimize the long-term release of groundwater in these units. It would reduce the mobility of contaminated groundwater and, over the long term, will reduce the volume of contaminants in the groundwater. The treatment of groundwater will also reduce the mobility and toxicity of constituents via groundwater and waste-water discharge.

Reliability -- Technologies of groundwater recovery and treatment are feasible.

Confidence -- A pump test would have to be completed before a final design can be completed. The ability of the existing waste-water system to meet effluent limitations will need to be confirmed through treatability testing.

Implementability -- Long-term operation of the pumping wells will be required (assuming a 30-year minimum). Collected groundwater can be treated using the existing plant waste-water treatment system. A groundwater model must be developed for the site, to aid in the final system design. Treatment and discharge of groundwater using the existing waste-water treatment system would need to be approved by appropriate agencies.

Risk Reduction -- Toxicity, mobility, and volume of contaminants in groundwater are reduced. Contaminated soil would not be reduced or removed.

Cost -- The present-worth cost estimate is $3.78 M, assuming this option was solely selected. Different costs would apply if this option would be combined with other options. Hydraulic characteristics of the aquifer may vary from those used in the estimate, the number of wells required may differ from the estimated number, and the carbon requirement in the carbon filtration system could vary if the pumping rate and contaminant removal rate differ from the predicted rates.

Accepted/Rejected: **Accepted**

Reasoning: Less protection is provided than in the groundwater containment alternative but costs are correspondingly lower.

c. TREATMENT TRAIN: Solids Excavation and Onsite Treatment

Description: Onsite contaminated solid materials would be excavated to the action level of 25 ppm, soils near the Raquette River would be taken to an action level of 10 ppm, and offsite soil would be taken to an action level of 1 ppm. The soil would be stockpiled near the treatment facility. Treated soils and sludges will be backfilled in the excavated areas. Bulk debris will be removed by preprocessing. Backfilled areas would be graded and restored to support vegetation. A long-term monitoring program would be implemented (see part 1.4.a). In Option c1 (Thermal Treatment), a federally permitted, portable rotary kiln incinerator would be located on site. For Option c2 (Chemical Treatment), a KOHPEG process would be used to treat the PCB-contaminated soils and other solids. Process waste waters would be either diverted to the existing waste-water treatment plant or managed via a stand-alone treatment system. Discharges would be subject to SPEDS permitting. Option c3 (Biological Treatment) involves treatment of contaminated soils in aboveground batch reactors. Upon completion of treatment, soils will be removed from the treatment vessels and dewatered, then backfilled onsite, after testing to determine treatment performance effectiveness.

Treatment Method: Physical and destructive

Treatment Objective: Excavation of solid materials from several operable units and treatment of the materials at an onsite treatment system.

Treatment Mode: In situ and onsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- This treatment will effectively remove source contamination from major disposal areas and reduce potential for future exposure to source contaminants as well as reducing leaching or migration to groundwater and surface waters. Short-term protection of site workers will be maintained by personal protective equipment and construction methods that minimize contaminant disturbance. The treatment will reduce the toxicity and mobility of constituents of concern in both the short and the long terms. It will also reduce the volume of contaminated materials.

Reliability -- Option c1 - Rotary kiln incineration will provide proven destruction of PCBs and other less significant organic constituents in the waste materials. The process is somewhat less sensitive to feed variations than chemical or biological options. Option c2 - The KOHPEG process has generally been effective at reducing PCB levels to less than 2 ppm at full scale. The process would not specifically destroy volatile organics or phenols identified in waste materials, but these constituents may be removed indirectly by volatilization at elevated reaction temperatures or by separation into an aqueous phase during soil-washing steps. Option c3 - Both short- and long-term protection are unproven on a field scale. Site-specific tests must be run to determine treatability by biological activity.

Confidence -- Option c1 can be implemented using proven equipment and technologies. Option c2 required full-scale equipment that is currently being fabricated for a first-time application. Equipment used to date has principally been at a pilot scale. Field trials may be required to demonstrate the implementability of higher-throughput equipment. For Option c3, technical feasibility of treating PCB-contaminated soil on a field scale cannot be fully evaluated with existing information. No precedent for the administrative feasibility of this option exists.

Implementability -- Treatment requires major commitments of equipment and personnel because of the large volumes involved. It will require removal of an interim cover on the industrial landfill. Large volumes of relatively uncontaminated overburden must be removed from the industrial landfill for the underlying highly contaminated wastes to be recovered. Highly contaminated wastes occur at depths of up to 30 feet, and possibly deeper, requiring deep excavation techniques at the industrial landfill.

Risk Reduction -- Toxicity and mobility would be reduced under Options c1 and c2. Volume could also be reduced, depending on the thermal content of contaminated soils. Option c3 would not reduce the toxicity, volume, or mobility of the constituents.

Cost -- The present-worth cost estimates for Options c1 and c2 are $339 M and $295 M, respectively. An order-of-magnitude cost estimate for Option c3 is tentative because its treatment effectiveness on site-specific wastes has not been determined. There have been no full-scale applications of this technology on PCB wastes at a site of this magnitude to date. An onsite pilot program is under way at a cost of $1 M over the course of one year.

Accepted/Rejected: **Accepted**

Reasoning: Option c1 provides the highest level of reduction in toxicity and volume of the onsite alternatives. Option c2 is an effective means of reducing toxicity and volume, but its implementability is less certain. For Option c3, field-scale studies are planned, although the effectiveness has not been demonstrated and the implementablility is uncertain.

d. TREATMENT TRAIN: Dredge and Treat Onsite

Description: Sediments from the St. Lawrence River would be mechanically dredged and dewatered. A silt curtain would be installed to capture sediment to the extent allowable. A sheet pile wall could be placed along the river side of the boundary of contaminated sediment. A sediment dewatering basin would be constructed on the shore in the vicinity of the sediment remediation effort. A pumping station and force main would be used to transfer leachate and to decant waters from the basin. For more information on Options d1, d2, and d3, refer to Option c.

Treatment Method: Physical and destructive

Treatment Objective: Dredge and dewater, then treat the dewatered St. Lawrence River sediments in an onsite system.

Treatment Mode: In situ and onsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- Short-term protection during the dredging portion of this alternative will be provided by use of both a silt curtain and sheet pile wall to isolate the contaminated material from the environment. Long-term protection will be provided by removal and treatment of the sediment.

Reliability -- Mechanical dredging is a proven technology for excavation of river sediment.

Confidence -- The technical feasibility of sediment control, sheet pile walls, and excavation has been demonstrated in locations along the St. Lawrence Seaway.

Implementability -- Administrative feasibility is probable, given that approval from few agencies will be required; that treatment, storage, and disposal services are not components of this alternative; and that equipment and technical specialists are probably available in the work area.

Risk Reduction -- Toxicity and mobility would be reduced under Options d1 and d2. Volume could also be reduced, depending on the thermal content of contaminated soils. Option d3 would not reduce the toxicity, volume, or mobility of the constituents.

Cost -- The present-worth cost estimates for options d1 and d2 are $18.1 M and $16.1 M, respectively. An order-of-magnitude cost estimate for Option d3 is tentative because the effectiveness of the treatment on site-specific wastes has not been determined. There have been no full-scale applications of this technology on PCB wastes at a site of this magnitude to date. An onsite pilot program is underway at a cost of $1 M over the course of one year.

Accepted/Rejected: Options d1 and d2: **Accepted**; Option d3: **Rejected**

Reasoning: Option d1 provides the highest level of reduction in toxicity and volume of the onsite alternatives. Option d2 is an effective means of reducing toxicity and volume, but its implementability is less certain. Option d3 is uncertain. Evaluations will be made on soil and waste material.

e. TREATMENT TRAIN: In Situ Treatment

Description: In Option e1 (Land-Based Materials), a treatability program would be conducted onsite on contaminated soils to assess site geochemistry, so that a nutrient mix applicable to site conditions could be designed and soil grain size can be assessed. A system of groundwater recovery wells, injection wells, and subsurface drains would be designed. Groundwater quality would be monitored to guide adjustment of the treatment program and to determine the effectiveness of the remediation. For Option e2 (River Sediments), there would be two phases. In Phase I, factors affecting the extent of PCB dechlorination will be examined. In Phase II, pilot-scale laboratory testing will be conducted. Results will be used to model the course of PCB dechlorination in sediments and to make estimates about the fate of PCBs in the river sediments.

Treatment Method: Physical and chemical

Treatment Objective: Option e1 - Treatment cycle that involves recovery of groundwater, analyses, treatment with nutrients, subsurface injection, and monitoring. Option e2 - Examines the environmental controls on PCB dechlorination in contaminated sediments in the St. Lawrence River below the outfall of the GMC-CFD facility.

Treatment Mode: In situ and offsite

Source or Migration Control: Source and migration control

Treatment Train Performance Characteristics:

Effectiveness -- Option e1: Short-term protection is based on the construction and treatment techniques; little or no excavation of contaminated material will be required. Long-term protection will be provided by a reduction in contaminant toxicity and mobility. Completion of an in situ treatment program may leave nonhazardous constituents in the soil. Option e2: Neither short- nor long-term protection will be provided. Results developed would be used to assess these issues with respect to in situ treatment of river sediments.

Reliability -- Option e1: Technical feasibility of constructing, operating, and maintaining an in situ treatment alternative is unknown. No bioremediation projects have been completed on a scale comparable to this site. Option e2: Sampling techniques and sediment coring are proven technologies.

Confidence -- N/A

Implementability -- Administratively, the feasibility is unknown. No permitting process has been defined by either the State of New York or EPA.

Risk Reduction -- Option e1 reduces toxicity, mobility, and volume of PCBs in river sediments.

Cost -- No full-scale in situ biological treatment projects have been performed to date. The cost of an initial testing program is estimated at $0.36 M for a three-year program.

Accepted/Rejected: Option e1: **Rejected**; Option e2: **Accepted.**

Reasoning: The effectiveness of Option e1 has not been demonstrated and its implementability under site conditions at GMC-CFD is probably not feasible. The proposed study of in situ anaerobic dechlorination may yield data that would demonstrate that effective reductions in toxicity can be achieved without sediment removal.

10.0 FRONTIER HARD CHROME SITE

SITE NAME: Frontier Hard Chrome Site

EPA Region: 10

STATE: Washington

REFERENCES: BNW (1987)

ENVIRONMENTAL MATRIX: Chrome-plating facility with contaminated soils, groundwater, and surface water, and with air pollution.

CURRENT STATUS: ROD 1988; ROD revised 1988, and currently under reconsideration.

HISTORICAL SKETCH: The Frontier Hard Chrome site (FHC) was the location of chrome-plating operations from 1958 to 1983. In 1975, metals from these industries were discovered to be toxic to biota in the City of Vancouver's secondary waste-water treatment plant. In 1982, several wells around FHC were found to contain concentrations of hexavalent chromium above the EPA drinking water standard. FHC discontinued its industrial chrome-plating operations in 1983, and the site was placed on the NPL under CERCLA.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment: None

Destruction: None

Disposal: None

Encapsulation: None

Chemical

Containment:

Soil Washing and Leaching (in situ) -- **Removed** from consideration. Solution mining on the site would have to be done by putting the flushing solutions in contact with the contamination zone through the aquifer and would not be effective overall. Reduction by a ferrous sulfate solution would affect only the outer clay surfaces and would introduce another contaminant to the aquifer.

Soil Washing and Leaching (onsite/offsite) -- **Approved** for further consideration. A pretreatment method to oxidize the trivalent chromium to the hexavalent form may be effective in mobilizing the chromium from the clay. Acids and bases, oxidizing agents, and distillation/carbon adsorption solutions have all been found to be effective. A water solution is not effective for washing contaminated soil and that option has been removed from further consideration.

Inorganic Water Treatment -- **Approved** for consideration because a number of technologies are available to effectively remove the contaminants at FHC. These technologies include neutralization, precipitation, reduction (for Cr), reverse osmosis, ion exchange, filtration, sedimentation, and distillation.

Organic Water Treatment -- **Approved** for consideration because several technologies are available for removing the chlorinated solvents. The technologies that are approved for future consideration were ozonation, carbon adsorption, air/stream stripping, and distillation.

In Situ Groundwater Treatment -- **Removed** from consideration. Several methods have been developed for treating groundwater in place, but all are dependent on a number of site-specific factors for effective use. The methods include permeable treatment beds, in situ physical/chemical treatment, in situ vitrification, and bioreclamation.

Disposal:

Sludge Treatment/Disposal -- **Approved** for consideration for offsite disposal or treatment. Chromium recovery may be feasible depending on the concentration of chromium in the sludge.

Encapsulation:

Fixation/Stabilization/Solidification with Proprietary Technologies -- **Approved** for consideration because this process has been reported to be effective with chromium contamination.

Fixation/Solidification -- **Approved** for consideration because this common method creates stronger soil bonds and reduces dust particulates from surface soil. Use of asphalt/soil, portland cement/soil, polysilicates/fly ash, and proprietary technologies are all acceptable methods of solidification. Lime solidification is unacceptable, because it could contribute to airborne contamination.

Fixation/Stabilization/Solidification -- **Approved** for consideration. Asphaltic, portland cement, and pozzolanic/lime methods are all accepted methods that can fix and retain heavy metal contaminants. Organic polymer binding is an unacceptable method because it is ineffective in fixation of metal wastes.

Physical

Containment:

Surface-Water Collection for Treatment -- **Approved** for consideration because it would be used to reduce or eliminate penetration of surface water through contaminated soil as well as to collect contaminated surface water for treatment. Storm sewers, detention ponds, and channels and ditches are standard techniques to retain the water, which would then be treated and disposed.

Paving or Capping with Asphalt or Portland Cement Concrete -- **Approved** for consideration because the traffic areas on the site will require durable surfaces to prevent air entrainment of fugitive dust.

Paving or Capping with Layered Cover System -- **Approved** for consideration because it is an effective technique that combines layers of different materials that integrate such functions as vegetation support, protection of barrier membranes, and control of water filtration.

Wind Fences/Screens -- **Removed** from consideration because it would be difficult to effectively screen the wind from the site.

Slurry Wall -- **Approved** for consideration because it is a cost-effective method of isolating and restricting the leachate plume.

Leachate Plume Barriers -- **Removed** from consideration because the geologic conditions would make sheet pile cutoff walls, grout curtains, and block displacement ineffective.

Surface Drainage Systems -- **Removed** from consideration because the depth requirement at this site, together with uncontrolled drainage of contaminated water during construction, makes these technologies (subsurface drains, trenches, and galleries) inappropriate for the FHC site.

Pumping Systems -- **Approved** for consideration because ejector wells are appropriate for the FHC site. However, well points and suction points cannot be used effectively and those options were removed from further consideration.

Injection/Recharge -- **Accepted** for consideration because modifying the groundwater flow patterns could redirect the migration of a contaminant plume. Use of water obtained offsite or use of treated groundwater for recharge were both approved.

Revegetation -- **Approved** for consideration for surface soil treatment but disapproved as a method for surface soil mitigation. This method can stabilize the surface when preceded by removal of contaminated soil, surface sealing, and grading. It has limited effectiveness in controlling the migration of contamination from the surface soil.

Institutional Containment: None

Destruction: None

Disposal:

Surface Soil Removal and Offsite Disposal -- **Approved** for consideration because it is a feasible technology.

Surface Soil Removal and Onsite Disposal -- **Approved** for consideration because the option is technically feasible. A regulated landfill (double-liner system, a leachate monitoring and collection system, and capped top) would have to be created onsite or a lined concrete vault would have to be installed below grade.

Contaminated Structural Removal -- **Approved** for consideration because removing the contaminated floor and drain is feasible.

Structural Contamination Capping -- **Approved** for consideration because the contaminated concrete floor and topsoil can be isolated and effectively capped with little difficulty.

Demolition -- **Approved** for consideration. There may be value left in this building if remediation is completed.

Disposal of Treated Water Effluent at Municipal Treatment Facility -- **Approved** for consideration because it is a feasible method of disposal.

Discharge of Treated Water Effluent to Water Body -- **Removed** from consideration, given the lack of access to a water body.

Evaporation of Treated Water Effluent -- **Removed** from further consideration because it is dependent on evaporation being greater than rainfall. In the Vancouver area, this method is infeasible.

Recharged Treated Water -- **Approved** for consideration for recharge by wells, subsurface drains, or infiltration basins. Trenches are removed from further consideration because of the potential for additional contamination from the subsurface water extracted.

Encapsulation: None

Excavation/Removal: None

Physical Handling/Processing: None

No-Action Alternative:

No-Action Alternative -- **Approved** for consideration because it is a standard procedure.

Thermal

Containment: None

Destruction: None

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Contaminated structure, surface water, groundwater, and soils, and air pollution.

1.2 STATUS: Draft Preliminary Feasibility Study as of 1987.

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Chromium - Cr^{+6}, Cr^{+3}	soils,well water	inorganic inorganic	SDWA/CWA[a] SDWA/CWA
2	Lead	soils	inorganic	SDWA/CWA
3	Nickel	soils	inorganic	CWA
4	Trichloroethylene	soils,water	organic	CWA
5	Tetrachloroethylene	soils,water	organic	CWA
6	1,1,1-trichloroethylene	soils,water	organic	CWA
7	Carbon tetrachloride	soils,water	organic	CWA

(a) Safe Drinking Water Act (SDWA) (April 1986), and Clean Water Act (CWA) (1983).

1.4 REMEDIAL ALTERNATIVE INFORMATION

UNIT PROCESS:

a. PROCESS NAME: No-Action Alternative

Description: No additional remediation measures will be implemented, but a long-term monitoring program would be implemented to provide updated information on the migration of contaminants. For groundwater, wells would be sampled quarterly, and the program would be modified as the plume changes. The monitoring program would also address surface soil, vegetation, and building components, as well as air quality.

Treatment Method: Physical

Treatment Objective: Monitoring

Treatment Mode: In situ

Source or Migration Control: N/A

Process Performance Characteristics:

Effectiveness -- Sampling wells can become plugged and they can be damaged or contaminated by other surface activities, so that replacement would be required. During the 30-year program, additional wells will be required, depending on the movement of the plume. Routine operation and maintenance will be required, updating whenever necessary so that the program continues to be effective.

Reliability -- Adequately designed and installed, the monitoring program will perform reliably for its intended purposes. Many monitoring programs have been operated, and there are standard procedures.

Confidence -- N/A

Implementability -- The monitoring program can be planned, reviewed, approved, and implemented in less than six months. The monitoring program monitors only migration of the plume, providing the opportunity to react to public health and environmental concerns, and it does not expedite or impact the time required to achieve remedial action in the aquifer.

Risk Reduction -- An alternate contaminant level (ACL) may be determined to be adequate or suitable for the site. A proposed ACL of 1 ppm, would likely not be attained within 100 years.

Cost -- The present-worth cost is estimated at $0.43 M, which includes the capital costs for well installation and indirect costs associated with sampling.

Accepted/Rejected: **Rejected**

Reasoning: Does not address community concerns; some level of remediation activity is necessary to meet those needs.

b. TREATMENT TRAIN: Surface Soil Removal and Disposal; Partial Structural Mitigation; No Subsurface Soil or Groundwater Mitigation

Description: Surface soil would be removed and disposed of offsite at a RCRA landfill. The removed soil would be replaced with clean soil. The structure would be cleaned and sealed where applicable, to remove and mitigate contaminant exposure. Periodic sampling and testing of the monitoring wells will provide regulatory data. Access by subsurface soils or groundwater will be restricted.

Treatment Method: Physical

Treatment Objective: Contaminated soil would be removed and disposed of. Structure would be cleaned, sealed, and eventually removed.

Treatment Mode: At-grade and/or offsite.

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Moderate to high for conditions both outside and inside the building.

Reliability -- Both removal and disposal of the surface contaminants and decontamination of the building are considered reliable.

Confidence -- Little documented performance information for this building-decontamination procedure is available, but it appears to be reasonable based on current evidence.

Implementability -- Planning, review, contracting, and completion of this alternative could be completed in one year. No site conditions or zoning requirements are known to prevent implementation. Offsite disposal of the surface materials is not expected to be a problem in view of the small volume.

Risk Reduction -- This alternative has low to moderate effect on preventing exposure to surface soil and building contaminants and no groundwater mitigation. No significant exposure during building decontamination and soil removal, although exposure is possible through unauthorized excavation or drilling. Overall rating - moderate.

Cost -- The present worth of the capital (excavation, backfill, grading, and drainage), indirect, and annual costs is $0.88 M.

Accepted/Rejected: **Accepted**

Reasoning: This alternative meets the remediation objectives except for that of preventing further expansion of the contaminant plume.

c. TREATMENT TRAIN: Surface and Subsurface Soil Removal/Treatment/Replacement; Groundwater Extraction/Treatment/Reinjection; Structure Removal

Description: Surface and subsurface soil would be removed and treated to remove the chromium contaminant. Groundwater would be pumped from the aquifer and treated to remove the chromium. The structure would be completely removed, including underlying soil. Treated soils would be disposed of onsite by backfilling, grading, and recompaction. Treated water would be reinjected into the aquifer. Periodic sampling and testing of the pumped groundwater at the treatment facility and periodic sampling of the monitoring wells will provide regulatory data.

Treatment Method: Physical and chemical

Treatment Objective: The short-term objective is to contain movement of the contaminant plume; the long-term objective is to reduce contaminant levels in the plume.

Treatment Mode: In situ, at-grade, and offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Technical complications resulting from the soil's high clay content bring into question the effectiveness of soil removal, treatment, and replacement because they are considered innovative and new technology. Removal of surface and subsurface soils with high chromium concentrations is needed to reduce groundwater levels to acceptable cleanup levels.

Reliability -- Uncertain, because the soil treatment process for high-clay soils has not been demonstrated at similar sites. Modern control and monitoring systems are expected to keep the reliability of the pumping, treating, and reinjecting method high.

Confidence -- Unknown at this time

Implementability -- Implementability in a reasonable time is moderately to very difficult. Success is dependent on site-specific conditions. Bench-scale and pilot testing are critical. A significant preliminary remedial design phase with pilot testing will be required that alone could last six months to a year. The entire process is expected to take a minimum of two years. The pump/treat/discharge technology can be implemented relatively easily and can be on line in less than 18 months.

Risk Reduction -- This alternative has a moderate effect on preventing plume migration. It would accomplish source removal. Moderate exposure to airborne contamination through disrupted soil would continue. Some groundwater contamination would remain. Reduction would be only moderate at the end of the operational life of the treatment system. Exposure through unauthorized wells is possible. Overall rating - moderate.

Cost -- Present worth of the capital (excavation, soil treatment, backfill, grading, drainage, well sinking, and water-treatment facility equipment and installation), operational (for soil and water-treatment facility), indirect, and annual costs is $26.4 M.

Accepted/Rejected: **Rejected**

Reasoning: This treatment is significantly higher in cost than Alternatives b, e, and f and offers no advantages.

d. TREATMENT TRAIN: Surface and Subsurface Soil Removal/Treatment/Replacement; Groundwater Extraction/Treatment/Discharge; Structure Removal

Description: Surface and subsurface soil would be removed and treated to remove the chromium contaminant. Groundwater would be pumped from the aquifer and treated to remove the chromium. The structure would be completely removed, including underlying soil. Treated soils would be disposed of onsite by backfilling, grading, and recompaction. Treated water would be disposed of offsite, to the Columbia River. Periodic sampling and testing of the pumped groundwater at the treatment facility and periodic sampling of the monitoring wells will provide regulatory data.

Treatment Method: Physical and chemical

Treatment Objective: The short-term objective is to prevent health and environmental impacts from airborne contaminants, soil ingestion, contact with internal building surfaces, contact with contaminated surface waters, and offsite migration of contaminants. The interim objective is to contain movement of the contaminant plume, and the long-term objective is to reduce contaminant levels in the plume.

Treatment Mode: In situ, at-grade, and offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Technical complications resulting from the soil's high clay content bring into question the effectiveness of soil removal, treatment, and replacement because they are considered innovative and new technology. Removal of surface and subsurface soils with high chromium concentrations is needed to reduce groundwater levels to acceptable cleanup levels.

Reliability -- Uncertain, because the soil treatment process for high-clay soils has not been demonstrated at similar sites. Modern control and monitoring systems are expected to keep the reliability of the pump, treat, and discharge method high.

Confidence -- Unknown at this time

Implementability -- Implementability in a reasonable time is moderately to very difficult. Success is dependent on site-specific conditions. Bench-scale and pilot testing are critical. A significant preliminary remedial design phase with pilot testing will be required that alone could take six months to a year. The entire process is expected to take a minimum of two years. The pump/treat/discharge technology can be implemented relatively easily and can be on line in less than 18 months, assuming that the NPDES permit process is not a problem.

Risk Reduction -- This treatment has a moderate effect on preventing plume migration. It would accomplish source removal. Moderate exposure to airborne contamination through disrupted soil would occur. Some groundwater contamination would remain. Reduction would be only moderate at the end of the operational life of the treatment system. Exposure through unauthorized wells is possible. Overall rating - moderate.

Cost -- Present worth of the capital (excavation, soil treatment, backfill, grading, drainage, well sinking, and water-treatment facility equipment and installation), operational (for soil and water-treatment facility), indirect, and annual costs is $27 M.

Accepted/Rejected: **Rejected**

Reasoning: This treatment is significantly higher in cost than Alternatives b, e, and f and offers no advantages.

e. TREATMENT TRAIN: Surface and Subsurface Soil Removal and Disposal; Groundwater Extraction/Treatment/Reinjection; Structure Removal

Description: Surface and subsurface soil would be removed and disposed of to an onsite regulated landfill or to an offsite RCRA disposal site, depending on test results. Groundwater would be pumped from the aquifer and treated to remove the chromium. The structure would be completely removed, including underlying soil. New clean soils will be brought to the site to fill the voids left by excavation. Treated water will be reinjected into the aquifer. Periodic sampling and testing of the pumped groundwater at the treatment facility and periodic sampling of the monitoring wells will provide regulatory data.

Treatment Method: Physical and chemical

Treatment Objective: The short-term objective is to prevent health and environmental impacts from airborne contaminants, soil ingestion, contact with internal building surfaces, contact with contaminated surface waters, and offsite migration of contaminants with surface water. The interim objective is to contain movement of the contaminant plume, and the long-term objective is to reduce contaminant levels in the plume.

Treatment Mode: In situ, at-grade, and offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Soil removal, disposal, and replacement with clean fill will be effective in preventing health and environmental impacts caused by airborne contaminants, soil ingestion, contact with contaminated surface waters, and offsite migration of contaminants. Removal of surface and subsurface soils with high chromium concentrations is needed to reduce groundwater contamination to acceptable cleanup levels.

Reliability -- Soil removal, disposal, and replacement with clean fill is reliable and effective. Modern control and monitoring systems are expected to keep the reliability of the pump, treat, and discharge treatment high.

Confidence -- Both soil and groundwater mitigation methods are currently in use.

Implementability -- This alternative requires the use of conventional earth-excavating equipment; labor and equipment are readily available. Soil removal, disposal, and replacement can be completed in three months. The pump/treat/discharge technology can be implemented relatively easily and can be on line in less than 18 months.

Risk Reduction -- This alternative would have a moderate effect on preventing plume migration. It would achieve source removal. Moderate exposure to airborne contamination through disrupted soil would occur. Some groundwater contamination would remain. Risk reduction would be moderate at the end of the operational life of the treatment system. Exposure through unauthorized wells is possible. Overall rating - moderate.

Cost -- The present worth of the capital (excavation, disposal, replacement-backfill, grading, drainage, well sinking, and water-treatment facility equipment and installation), operational (for soil and water-treatment facility), indirect, and annual costs is $19 M.

Accepted/Rejected: **Rejected**

Reasoning: This alternative meets remediation objectives, including containment of the plume; however, it does so at a significantly higher cost than Alternative b. The additional $18 M expense does not result in a significantly higher protection of public health and the environment.

f. TREATMENT TRAIN: Surface and Subsurface Soil Removal and Disposal; Groundwater Extraction/Treatment/Discharge; Structure Removal

Description: Surface and subsurface soil is removed and disposed of to both an onsite lined landfill that meets minimum functional standards and an offsite RCRA disposal facility. Tests of loads, zones, or batches will be made to determine which disposal site is appropriate. Groundwater is pumped from the aquifer and treated to remove the chromium. The structure would be completely removed, including underlying soil. New clean soils will be brought to the site to fill the voids left by excavation. Treated water will be reinjected into the aquifer. Periodic sampling and testing of the pumped groundwater at the treatment facility and periodic sampling of the monitoring wells will provide regulatory data.

Treatment Method: Physical and chemical

Treatment Objective: The short-term objective is to prevent health and environmental impacts from airborne contaminants, soil ingestion, contact with internal building surfaces, contact with contaminated surface waters, and offsite migration of contaminants. The interim objective is to contain movement of the contaminant plume; the long-term objective is to reduce contaminant levels in the plume.

Treatment Mode: In situ, at-grade, and offsite

Source or Migration Control: Source

Treatment Train Performance Characteristics:

Effectiveness -- Soil removal, disposal, and replacement with clean fill will be effective in preventing health and environmental impacts caused by airborne contaminants, soil ingestion, contact with contaminated surface waters, and offsite migration of contaminants. Removal of surface and subsurface soils with high chromium concentrations is needed to reduce groundwater concentrations to acceptable cleanup levels.

Reliability -- Soil removal, disposal, and replacement with clean fill is reliable and effective. Modern control and monitoring systems are expected to keep the reliability of the pump, treat, and discharge treatment high.

Confidence -- Both soil and groundwater mitigation methods are currently in use.

Implementability -- This alternative requires use of conventional earth-excavating equipment; labor and equipment are readily available. Soil removal, disposal, and replacement can be completed in three months. The pump/treat/discharge technology can be implemented relatively easily and can be on line in less than 18 months, assuming the NPDES permit process does not become a problem.

Risk Reduction -- This treatment would have moderate effect on preventing plume migration. It would achieve source removal. Moderate exposure to airborne contamination through disrupted soil would occur. Some groundwater contamination would remain. Reduction would be moderate at the end of the operational life of the treatment system. Exposure through unauthorized wells is possible. Overall rating - moderate.

Cost -- The present worth of the capital (excavation, disposal, replacement, backfill, grading, drainage, well sinking, and water-treatment facility equipment and installation), operational (for soil and water-treatment facility), indirect, and annual costs is $19.6 M.

Accepted/Rejected: **Rejected**

Reasoning: Although this alternative meets remediation objectives, including containment of the plume, it does so at a significantly higher cost than Alternative b. The additional expense of $19 M does not result in a significantly higher protection of public health and the environment.

11.0 NORTH HOLLYWOOD-BURBANK SITE

SITE NAME: North Hollywood-Burbank Site

EPA REGION: 9

STATE: California

REFERENCES: DWP (1986)

ENVIRONMENTAL MATRIX: Contaminated saturated groundwater zone with primarily trichloroethylene (TCE) and perchloroethylene (PCE).

CURRENT STATUS: FS through 1986.

HISTORICAL SKETCH: The North Hollywood-Burbank well field in the San Fernando Valley groundwater basin has been contaminated with TCE and PCE. These organic contaminants were spreading through the main aquifer providing drinking water to Los Angeles, North Hollywood-Burbank, Glendale, and San Fernando. The water supplied to these cities comes from wells that extend down to 800 feet below the land surface. Contamination is moving quickly throughout the groundwater basin supplying this drinking water.

OVERVIEW OF TREATMENT TECHNOLOGIES

Biological

Containment: None

Destruction:

Bioremediation -- **Removed** from consideration because it was felt that no proven bioremediation techniques exist for TCE and PCE.

Disposal: None

Encapsulation: None

Chemical

Containment: None

Destruction: None

Disposal: None

Encapsulation: None

Physical

Containment:

Pumping and Aquifer Management -- **Removed** from consideration because 1) only those wells situated in the contaminated area would affect contaminant migration and they would affect only their own localized area of contamination, 2) several currently producing wells would have to be removed from service, resulting in a significant cost for replacement drinking water, 3) groundwater contamination would still exist, and 4) the same environmental and public-health concerns associated with the no-action alternative would apply.

Slurry Walls -- **Removed** from consideration because use of a slurry wall as a containment alternative is infeasible, given the areal extent of observed contamination and the fact that the depth to the groundwater in the North Hollywood area is 200 feet.

Institutional Containment:

Purchase Water Supplies -- **Removed** from consideration because 1) purchasing water supplies depends on the availability of supplies, 2) costs are high, and 3) this alternative would be identical to the no-action alternative in that no positive remedial action would take place.

Destruction: None

Disposal:

Pump and Disposal to Sewer/Storm Drain or at Hazardous Waste Site -- **Removed** from consideration because 1) disposal to sewer/storm drains would require an NPDES permit. If permitted concentrations were exceeded, disposal would require pretreatment or hauling to an approved hazardous-waste site. Disposal of the groundwater would also represent a loss of a valuable resource.

Encapsulation: None

Excavation/Removal:

Pump and Treat with Aeration -- **Approved** for consideration because 1) aeration is very similar to air stripping, which is a proven technology, 2) pumping and treating is a proven technology, and aeration facilities are available from a number of vendors and can be obtained on a "turn-key" basis.

Pump and Treat with Granular Activated Carbon -- **Approved** for consideration because 1) the effectiveness of the granular activated carbon process has been demonstrated and is generally considered as reliable, and 2) pumping and treating is a proven technology.

Pump and Treat with Aeration and Granular Activated Carbon -- **Approved** for consideration because this alternative includes the best aspects of aeration combined with granular activated carbon, resulting in higher removal efficiencies and less spent carbon media.

Pump and Treat with Passive Aeration -- **Removed** from consideration because this process is not very effective at contaminant removal, with typical removal efficiencies of only 20-30%.

Pump and Treat with Selective Resin Adsorption -- **Removed** from consideration because this method, although similar to the granular activated carbon method, is significantly more expensive and the spent resin media must be disposed of in an approved fashion. Finally, volatile organic removal with this method has not been demonstrated.

Pump and Treat with Ultraviolet/Ozonation -- **Removed** from consideration because, although this process is an established process in pharmaceutical and reagent manufacturing, and by-products from this process are water vapor, carbon dioxide, and a small amount of chlorine effluent, it is felt that this procedure is as yet an unproven but promising methodology. A program has been established to investigate the effectiveness of using this method for treating TCE and PCE; until it has been completed, this method has been removed from consideration.

Physical Handling/Processing:

Pump and Blending -- **Removed** from consideration because contaminant levels for PCE and TCE are on the order of 35 and 215 $\mu g/ml$ (ppb), respectively. Blending is potentially effective to a maximum concentration of 40 $\mu g/ml$. The Recommended Maximum Contaminant Level (RMCL) for both TCE and PCE is zero, thereby effectively removing this as a viable alternative.

No-Action Alternative:

No-Action Alternative -- **Removed** from consideration because it was an unacceptable in terms of limited drinking water supplies and possible contamination to surrounding sensitive receptors.

<u>Thermal</u>

Containment: None

Destruction: None

Disposal: None

Encapsulation: None

1.1 ENVIRONMENTAL MATRIX: Contaminated Saturated Groundwater Zone with Primarily Trichloroethylene (TCE) and Perchloroethylene (PCE).

1.2 STATUS: FS through 1986.

1.3 CONTAMINANT INFORMATION:

#	CONSTITUENT	WASTE FORM	WASTE TYPE	CLEANUP GOAL
1	Trichloroethylene (TCE)	groundwater	organic	5 μg/ml[a]
2	Perchloroethylene (PCE)	groundwater	organic	4 μg/ml[b]

(a) The EPA Maximum Contaminant Level and Recommended Maximum Contaminant Level for TCE are 5 and 0 μg/ml, respectively. The California State Department of Health Services action level for TCE is 5 μg/ml.
(b) The California State Department of Health Services action level and the Recommended Maximum Contaminant Level for PCE are 4 and 0 μg/ml, respectively.

1.4 REMEDIAL ALTERNATIVE INFORMATION

TREATMENT TRAINS:

1. TREATMENT TRAIN NAME: Pump and Treat with Aeration

   Description: The pumping system would consist of eight shallow wells (about 300 feet deep), equipped with a submersible pump capable of providing the lift necessary to transport 250 gal/min (for a total of 2000 gal over the eight wells) to the surface and through the collection pipeline to the point of treatment. The aeration process involves a vertical column containing packing material with a large surface area. The contaminated water would flow down through the packing material as countercurrent air is introduced at the bottom of the column. The contaminants are then transferred from the water to the air and are discharged directly into the atmosphere.

   Treatment Method: Physical

   Treatment Objective: Removal

   Treatment Mode: At-grade

   Source or Migration Control: Migration

Treatment Train Performance Characteristics:

Effectiveness -- Removal efficiencies for TCE and PCE can exceed 99% for well-designed facilities, assuming moderate influent concentrations (on the order of 500 $\mu g/ml$).

Reliability -- Aeration has a history of reliability that is evident in the quantity of experimental and operational data; as such, it is an established treatment method. Aeration facilities offer almost no risk with respect to fire, explosion, or chemical contamination to onsite workers.

Confidence -- Aeration of contaminated waters containing between 100 and 1000 $\mu g/ml$ of contaminants can be designed to meet maximum contaminant levels of 5 and 4 $\mu g/ml$ for TCE and PCE, respectively.

Implementability -- The public may not be willing to accept direct exposure to TCE and PCE through the inhalation exposure route, regardless of the magnitude of the concentrations. Given the importance of the groundwater basin to the economic viability of the area, pumping levels would have to be coordinated with water districts to ensure safe water yields from the aquifer. Finally, the South Coast Air Quality Management District would have to be involved, given the expected release of contaminants into the air.

Risk Reduction -- The major drawback to this treatment technology is that the contaminants are merely transferred from the water to the air, resulting in the potential for exposure to surrounding sensitive receptors through inhalation and through wet and dry deposition to land and water surfaces. This exposure may result in low-level, long-term cancer risk in the adjoining community. Aeration of contaminated waters containing 100 - 1000 $\mu g/ml$ of contaminants can be designed to meet maximum contaminant levels of 5 and 4 $\mu g/ml$ for TCE and PCE, respectively.

Cost -- Total present-worth cost is $3.6 M.

Accepted/Rejected: **Rejected**

Reasoning: Although minute air concentrations will result from implementing this alternative, it suffers from a combination of indefinite cancer risk and probable resulting public opposition.

2. TREATMENT TRAIN NAME: Pump and Treat with Granular Activated Carbon (GAC)

Description: The pumping system would consist of eight shallow wells (about 300 feet deep), equipped with a submersible pump capable of providing the lift necessary to transport 250 gal/min (for a total of 2000 gal/min for the eight wells) to the surface and through the collection pipeline to the point of treatment.

Treatment Method: Physical

Treatment Objective: Removal

Treatment Mode: At-grade

Source or Migration Control: Migration

Treatment Train Performance Characteristics:

Effectiveness -- A properly designed GAC facility can treat selective contaminants to nondetectable levels.

Reliability -- GAC treatment is a demonstrated technology, as evidenced by its routine application. Its removal capability with respect to the more easily treated organic contaminants is felt to be unsurpassed. Its operation and maintenance requirements are the most demanding of any of the screened alternatives. Frequent carbon replacement may be required because of contaminant exhaustion or biofouling. The carbon replacement is labor intensive and cannot be automated, and it would potentially expose workers to contaminants through handling and transfer processes. The estimated life of the facility is 20 years.

Confidence -- GAC is resilient to large changes in influent contaminant concentrations. One difficulty is that multicomponent waste streams may exhaust the carbon prior to the end of its expected useful life, making more frequent carbon replacement necessary.

Implementability -- Given the importance of the groundwater basin to the economic viability of the area, pumping levels would have to be coordinated with water districts to ensure safe water yields from the aquifer. Permitting will be required to transport the spent carbon media to an approved hazardous-waste site (of which there are only a few) or regeneration site (which will necessarily be out of state). The construction of this method is fairly straightforward, although a "turn-key" approach would probably be expensive. A pilot study would probably have to precede final design and construction.

Risk Reduction -- This approach removes the possibility of exposing the surrounding population to TCE and PCE. The drawback of this approach is that the spent carbon media will have to be either disposed of in an approved hazardous waste site or regenerated (requiring transportation of hazardous waste out of state). In addition, the GAC treatment is felt to impose a potential health threat to plant workers who remove and handle the contaminated carbon. Although vacuum equipment could be used to assist in this operation, workers might still be exposed to fine carbon dust.

Cost -- Total present-worth cost is $6.0 M.

Accepted/Rejected: **Rejected**

Reasoning: The amount of spent carbon media may be considerable, and this alternative was the most expensive of all three alternatives.

3. TREATMENT TRAIN NAME: Pump and Treat with Aeration and Granular Activated Carbon

Description: The pumping system would consist of eight shallow wells (about 300 feet deep), equipped with a submersible pump capable of providing the lift necessary to transport 250 gal/min (for a total of 2000 gal/min for the eight wells) to the surface and through the collection pipeline to the point of treatment. The aeration process involves a vertical column containing packing material with a large surface area. The contaminated water would flow down through the packing material, while countercurrent air is introduced at the bottom of the column. The contaminants are then transferred from the water to the air and discharged directly into the GAC column. Through the process of adsorption, contaminated air is passed over granular activated carbon, which holds the constituent molecules by weak physical forces. In effect, the TCE and PCE are removed and are adsorbed onto the carbon medium. No constituents are subsequently released into the atmosphere.

Treatment Method: Physical

Treatment Objective: Removal

Treatment Mode: At-grade

Source or Migration Control: Migration

Treatment Train Performance Characteristics:

Effectiveness -- This alternative is a combination of the aeration and GAC techniques, with the difference that the GAC process operates in the vapor phase. GAC contactors for vapor phase control are available and have demonstrated performance in applications involving removal of volatile organic compounds.

Reliability -- Operation and maintenance of an aeration/GAC plant would be similar to that of a plant for aeration alone. The GAC contactors would involve much less carbon medium to dispose of than in the GAC process alone.

Confidence -- Aeration of contaminated waters containing 100 - 1000 $\mu g/ml$ of contaminants can be designed to meet maximum contaminant levels of 5 and 4 $\mu g/ml$ for TCE and PCE, respectively.

GAC is resilient to large changes in influent contaminant concentrations. One difficulty is that multicomponent waste streams may exhaust the carbon prior to the end of its expected useful life, making more frequent carbon replacement necessary.

Implementability -- Constructibility of this alternative would be the same as that associated with aeration. The GAC contactors, representing completely closed systems, present no special construction problems.

Risk Reduction -- Under this alternative, the aerated volatile organic carbons do not reach the atmosphere. Using the GAC would result in an extremely contaminated spent carbon medium, which would not be regenerated but would be removed. The spent carbon media will have to be disposed of in an approved hazardous-waste site (requiring transportation offsite). Risk concerns associated with exposure to contaminants by workers are similar to those expressed for the GAC alternative. The GAC treatment is felt to impose a potential health threat to plant workers who remove and handle the contaminated carbon. Although vacuum equipment could be used to assist in this operation, workers might still be exposed to fine carbon dust.

Cost -- Total present-worth cost is $4.1 M.

Accepted/Rejected: **Accepted**

Reasoning: Given a combination of aeration and GAC processes, treatment plant removal efficiencies can be tailored to meet and exceed maximum contaminant levels for these compounds. The combination of these techniques provides the flexibility to treat the waste water cost-effectively with a high degree of safety.

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