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DRAFT TECHNICAL MEMORANDUM FOR LIMITED FEASIBILITY STUDY FOR SITE 36 OF CATEGORY VIII BUILDING 3380 NAS PENSACOLA FL

8/2/1994

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TECHNICAL MEMORANDUM

NAVAL AIR STATION PENSACOLA
LIMITED FEASIBILITY STUDY
SITE 36 OF CATEGORY VIII
BUILDING 3380

Prepared for:

Comprehensive Long-Term Environmental Action Navy (CLEAN)
Naval Support Activity
Naval Air Station Pensacola
Pensacola, Florida

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LIST OF ACRONYMS

ABB	ABB Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
BWL	Bilge Water Line
CA	Contamination Assessment
CAR	Contamination Assessment Report
CERCLA	Comprehensive Environmental Resource, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Contaminant of Concern
E/A&H	Ensafe/Allen & Hoshall
E&E	Ecology and Environment, Inc.
FDEP	Florida Department of Environmental Protection
FS	Feasibility Study
GAC	Granular Activated Carbon
IAS	Initial Assessment Study
IWDT	Industrial Waste Drainage Trench
IWTP	Industrial Waste Treatment Plant
LTTD	Low Temperature Thermal Desorption
NAS	Naval Air Station
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
OSWER	Office of Solid Waste and Emergency Response
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SVE	Soil Vapor Extraction
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UV	Ultra Violet

Table of Contents

List of Tables

1.0 INTRODUCTION

Site 36 is part of Category VIII at Naval Air Station (NAS) Pensacola. Solvents were identified in groundwater during a contamination assessment of a known leaking underground storage tank (UST) site. The site, which is directly northwest of Building 2662 and the area near Building 3380, was investigated by ABB Environmental Service, Inc. (ABB), of Tallahassee, Florida (ABB 1994). Due to the close proximity of the Industrial Waste Treatment Plant (IWTP) sewer line, the groundwater underlying an area possibly containing solvents near Building 3380 was investigated during a Phase I investigation of the IWTP sewer line by E/A&H.

Previous studies have outlined the background, history, physical setting, physical survey, geology, and ecology of Site 36 and NAS Pensacola. This information is contained in the Initial Assessment Study (IAS) completed by the Naval Energy and Environmental Support Activity (NEESA [1983]), and the Phase I Contamination Assessment by Ecology and Environment, Inc., (E&[illegible] [illegible]]). The information also is summarized in the site-specific work plan (E&E [illegible] ampling and analysis plan (SAP [E/A&H 1994]).

1.1 Site Background Information

From January 1992 to March 1994 a Contamination As[illegible]ment (CA) was performed by the UST Section of the Comprehensive Long-Term Environmental Action Navy (CLEAN) Group by ABB at Site 2662W, the former site of a 1,000-gallon UST near Building 2662 in the southeast part of Chevalier Field. The contamination assessment (CA) identified two distinct areas of contamination in the vicinity of Building 2662. The first, north of Building 2662, appears to have resulted from leaky UST under investigation and other activities in that area. The second, southeast of Building 2662 and near Building 3380, does not appear to have been caused by the leaky UST. Additionally, chlorinated compounds were identified near Building 3380 in ABB's Contamination Assessment Report, (ABB 1994).

As agreed by the Tier I Partnering Team, investigation of the chlorinated compound contamination in the area near Building 3380 has been transferred to the Installation Restoration Program. The area is included under E/A&H Site 36 investigation because of the high concentrations of chlorinated compounds, the areal distinction of the plume, and because it is close to the IWTP sewer line.

1.2 Nature and Extent of Problems

During ABB's CA, 95 soil borings were advanced, and 52 permanent and 15 temporary monitoring wells were installed at the site (Site 2662W and 3380 Solvent Area). Benzene, ethylbenzene, toluene, xylene, acenaphthene, fluorene, naphthalene, total recoverable petroleum hydrocarbons, chlorobenzene, 1,2-dichlorobenzene (1,2-DCB), 1,3-dichlorobenzene (1,3-DCB), 1,4-dichlorobenzene (1,4-DCB), vinyl chloride, and tetrachloroethene (PCE) were identified in groundwater samples collected in the vicinity of Building 3380.

Building 3380, located 180 feet southeast of Building 2662, is used as a hazardous material storage facility. Hazardous materials are stored inside the fenced area and include oils, paint, and other flammable liquids. ABB identified several underground pipelines as possible sources of contamination at the site. The IWTP sewer line is approximately 100 feet west of Building 3380 and is being investigated under Phase I of the Site 36 investigation. An industrial waste drainage trench (IWDT) is located along the perimeter of the helicopter maintenance and defueling area northwest of Building 2662. The IWDT drains into an oil-water separator northeast of Building 2662. An industrial waste line carries the oil and floating liquid from the separator to IWTP Manhole A-11-A which drains into the main IWTP sewer line. The water flows under the baffles inside of the separator and out through the spillway to the east into the marshy area lying northeast of Building 3380. A bilge water line (BWL) is located along the eastern side of Building 3390. The BWL is used to transport oily wastewater from the bilges of ships docked at NAS Pensacola.

1.3 Objective of Remedial Action

The objective of remediation of the Building 3380 area is to:

- remediate contaminated soils

In doing so, the remedial alternatives must:

1. Provide overall protection of human health and the environment.
2. Comply with Applicable or Relevant and Appropriate Requirements (ARAR)
3. Provide long-term effectiveness and permanence of remedial alternative.
4. Reduce the toxicity, mobility, and volume of contamination through treatment.
5. Provide short-term effectiveness of remedial alternative.
6. Be easily implemented (construction and operation).
7. Be cost effective.
8. Achieve state and USEPA acceptance.
9. Achieve community acceptance.

2.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Feasibility Study Process

This section describes the initial steps toward remedy selection: identification of remedial objectives, general response actions and applicable technologies, along with regulatory constraints under which remediation is conducted. This section summarizes sections of the *National Contingency Plan*[1] (NCP) and United States Environmental Protection Agency (USEPA) guidance addressing USEPA program goals and procedures.

ARARs can be found in Appendix A of *Technical Memorandum, NAS Pensacola - Site 36: Phase I, August, 1994* prepared by E/A&H.

1 National Oil and Hazardous Substances Pollution Contingency Plan, Final Rule, 40 CFR Part 300, Federal Register, Vol. 55, No. 46, March 8, 1990.

3.0 REMEDIAL ACTION ALTERNATIVES DEVELOPMENT

3.1 General Response Actions

General response actions are media-specific, generic actions that can achieve remedial action objectives alone or in combination with others. Table 3-1 summarizes objectives and general response actions.

Table 3-1
General Response Actions and Applicable Media

Remedial Action Objective	General Response Action
For Protection of Human Health: Prevent ingestion of site soil having site contaminants in excess of Florida Department of Environmental Protection (FDEP) soil cleanup standards.	No Action/Institutional Controls
	Containment Actions
For Environmental Protection: Protect the surficial aquifer from further lateral or vertical contamination from soil.	Excavation/Treatment/Disposal Actions

3.2 Identification of Technologies

This section presents different technology types which are potentially applicable to Site 36. These technologies will be screened in Section 3.3.

Summary of Technology Types

No Action

The NCP requires evaluation of a no-action alternative as a basis of comparison with other remedial alternatives.

Institutional Controls

The responses associated with institutional actions reduce potential hazards by limiting public exposure, not by reducing volume, mobility, or toxicity of hazardous substances. Some examples of such responses are listed as follows.

- Site access controls.
- Public awareness, education.
- Groundwater usage restrictions.
- Deed restrictions.
- Warnings against excavation, soil use.
- Technical monitoring requirements.

Removal

Soil removal actions may include excavation of the surficial soils with the use of heavy equipment such as backhoes, scrapers, etc.

Containment

Containment of soil may be achieved by capping the contaminated area with a low permeability soil layer or impervious constructed materials such as asphalt or concrete pavement.

Treatment

Treatment of soil may be achieved by vapor extraction, bioremediation, incineration, low temperature thermal desorption (LTTD), vitrification, soil washing, or stabilization/solidification.

Discharge/Disposal

Excavated soil and sediment that meets the definition of listed hazardous waste may be disposed, either offsite at an approved facility, delisted (after treatment such as LTTD) and used a site fill material, or isolated in a Resource Conservation and Recovery Act (RCRA) containment unit onsite.

3.3 Screening of Soil Technologies

Table 3-2 summarizes the initial screening of remedial technologies in detail below.

3.3.1 No Action

The no-action alternative, as required by the NCP, forms the baseline for comparing all other alternatives. No action means that contaminants remain onsite and the site characteristics remain unaltered.

This hypothetical alternative is ineffective because it does not address remdial action objectives (RAOs). This alternative will be analyzed and compared as required by the NCP and amendments.

3.3.2 Institutional Controls

Institutional controls are measures limiting public exposure to contaminants. Land and water deed restrictions at Site 36 would aid in reducing the risk to human health by reducing exposure. These restrictions include habitation, recreation, construction, etc. in conjunction with public awareness (publicity, education, newspaper, etc.) and soil and groundwater monitoring.

- The effectiveness of this alternative is limited because it does not address the RAOs including elimination of contaminant migration.
- This alternative would be easy to implement; however, approval by the local government, public approval, and legal authority would be required and enforcement of the restrictions may be difficult.

This alternative will be retained for further evaluation.

3.3.3 Soil Containment Actions

Capping: A cap can be installed across an area of contamination in order to contain the contaminated soil, to prevent surface water from percolating to the underlying groundwater

Table 3-2
Identification/Initial Screening of Remedial Technologies

Media	General Response Action	Technology Type	Process Option	Description	Screening Comments
Soil	No Action	Not Applicable	None	No Action	Required for consideration by NCP
	Institutional Actions	Access restriction	Fencing, deed restrictions	Secure site with fencing, restrict water/land use	Potentially applicable
		Monitoring	Soil and Groundwater monitoring	Program of groundwater analysis	Potentially applicable
	Containment Actions	Capping	RCRA-type, clay, soil, synthetic, asphalt, concrete	Clay, synthetic membrane, soil/vegetative cover; paving; pad	Not applicable as no source area was identified during investigations
		Vertical barriers	Slurry wall, sheet piling	Soil, clay, or steel installed around contaminated area	No confining unit present for vertical barrier footing
	Removal Actions	Excavation	Backhoe, heavy equipment	Removal of near surface soil	Potentially applicable
	Ex-situ Treatment Actions	Physical	Solidification, stabilization	Chemical added to soil to prevent migration of contaminants	Potentially applicable
		Chemical	Soil washing	Wash excavated soil with solvent to remove/recover contaminants	Potentially applicable
		Thermal	Low temperature desorption, incineration	Mobile equipment applied onsite to volatilize and recover, or destroy contaminants	Potentially applicable
		Biological	Aerobic, anaerobic degradation of contaminants, possibly within POTW	Biodegradation of contaminants in groundwater by cultured microbes	Not applicable to halogenated volatiles
	In-situ Treatment Actions	Physical	Soil venting or vapor extraction	Extraction of soil pore space air with vacuum sources applied to wells or pipe in horizontal trenches	Potentially applicable

Table 3-2
Identification/Initial Screening of Remedial Technologies

Media	General Response Action	Technology Type	Process Option	Description	Screening Comments
		Biological	Aerobic, or anaerobic	Degradation of contaminants with bacteria	Not applicable to halogenated volatiles
	Disposal Actions	Offsite	Landfill, incineration	RCRA permitted facility	Potentially applicable
		Onsite	Used as fill	Delisting if needed, and use as backfill	Potentially applicable
			RCRA containment cells	Contain/isolate contaminated soil in RCRA containment unit	Potentially applicable

aquifers, and to prevent short-circuiting of induced vacuum under soil-vapor extraction. In addition, the potential for direct contact with the exposed contaminated soil will be eliminated.

The installation of a cap reduces the amount of airborne contaminants. Regular inspections and maintenance of deteriorated cap material (asphalt, concrete, vegetation) are required to maintain the integrity of the cap.

Due to the location of soil contamination near marshy areas or underneath paved areas, this option will not be considered further.

Contaminated soil may also be isolated using slurry walls as barriers preventing horizontal transport of contaminants in groundwater. Due to the lack of a relatively shallow confining layer which is essential in the effectiveness of slurry walls, this option will not be considered further.

Sediment and surface water controls may be required during any corrective measure activity to prevent contaminants from migrating during corrective measure activities. Similarly, dust generation is most likely to occur during corrective measure activities. These technologies will be applicable at that time. These technologies are considered as appropriate "engineering controls" as a result of the implementation of other corrective measures.

3.3.4 Soil Removal Actions

Excavation: Excavation of soil is a step that must be carried out before *ex-situ* treatment technologies may be implemented, or where contamination levels exceed that which can effectively be addressed by *in-situ* approaches. This procedure can be conducted utilizing heavy equipment and manual tools, but care must be taken to mitigate fugitive air emissions (volatiles and contaminated dust). The risk of workers being exposed to contaminants may outweigh the advantages of excavation. Treatment and disposal of the soil must be conducted for excavation to be effective.

Removal of contaminated soil is an effective alternative for applying treatment technologies to soil. The depth of soil contamination is shallow, and does not cover a large area. This option will be retained for further consideration.

3.3.5 Soil Treatment Actions

Vapor Extraction: Soil-vapor extraction is a proven (SVE), commercially available technology effective for *in-situ* removal of volatile organic compounds from vadose soil. The process consists of applying a vacuum stress to soil (via standard wells or horizontally arranged perforated pipe). By increasing advection in the soil pore spaces, contaminants are extracted in vapor phase. Contaminants which are closely held in soil, or which are in contaminated areas removed from areas of greater advection, diffuse toward preferential pathways and thereby are also removed. The cleanup rate for the diffusion/advection reaction, however, is not as rapid. The process can also be applied to excavated soil, but fugitive air emission of volatile compounds becomes an implementation issue.

SVE is primarily applicable to volatile contaminants; semivolatiles may be removed, but to a lesser degree and at a slower rate. SVE is not regarded as an effective technology when groundwater is encountered at shallow depths. SVE may cause groundwater levels to rise due to negative pressure in pore spaces, thus causing groundwater to be extracted through SVE wells, reducing the efficiency of the system. Therefore, this option will not be considered further.

Biodegradation: Solid-phase and slurry-phase *ex-situ* soil bioremediation are applicable to organic site contaminants. As with *in-situ* groundwater bioremediation, these options involve the establishment of microbial populations which metabolize or co-metabolize organic contaminants in soil. Proper temperature, moisture, nutrients, oxidative potential, and microbes are necessary to decompose the target organic compounds. The effectiveness of soil bioremediation depends on moisture content, oxygen content, nutrient content, pH, and compaction of the soil matrix, as well as bioavailability and toxicity of the target contaminants. Therefore, the effectiveness of bioremediation depends on the characteristics of the contaminated soil.

Although implementable given extensive characterization and treatability work, this option will be dropped from further consideration.

Incineration: Incineration is a technology that follows the excavation of soil. Incineration may occur in a fluidized bed incinerator, rotary kiln incinerator, or infrared incinerator.

The fluidized bed incinerator consists of a vessel containing a bed of inert, granular, sand-like material (refractory lining) where combustion air is forced upward through the bed. A secondary reaction chamber is employed where the retention times are maintained and the combustion gases are drawn out of the end chamber and treated for removal of acid gas and particulate constituents.

The rotary kiln incinerator is operated by injecting wastes and auxiliary fuel into a combustion chamber where it is rotated to create turbulence and to increase the degree of burnout of the solids. Flue gases are passed through a secondary combustion chamber, then through a pollution control unit for removal of acid gases and particulate constituents.

Infrared incinerators use silicon carbide elements to generate thermal radiation beyond the red end of the visible spectrum. The waste materials to be treated pass through the unit on a belt and are exposed to the radiation. The off-gases pass through a secondary chamber for further irradiation and increased retention time. Flue gases, ash, and scrubber effluents are treated and emitted.

While incineration is an effective technology for treatment of organic-contaminated soil, metal concentrations present in site soil may require additional treatment and/or significant off-gas [illegible]r attainment of air pollution standards. Therefore, this option will not be considered further.

Low Temperature Thermal Desorption: Thermal desorption includes a number of different processes that use either direct or indirect heat exchange to increase the temperature of a waste material and volatilize organic contaminants. The volatilized contaminants are separated from the solids by a purge gas such as air, nitrogen, a combustion gas, or other inert gas. After the purge gas exits the desorper, it is treated by an off-gas treatment system. The organic compounds may be destroyed in an afterburner or collected by a physical/chemical treatment system which usually consists of a series of condensers followed by activated carbon. Cyclones and baghouses are normally used to control particulate emissions.

Thermal desorption systems are not effective in separating or stabilizing metal contaminants, which are contaminants of concern (COC) at Site 36. However, because the NAS Pensacola will have an operating LTTD unit, this option will be considered for the treatment of semi-volatiles.

Vitrification: Thermal fixation/glassification of site contaminants through vitrification is an effective means of immobilizing inorganic contaminants. Organic contaminants are likely to be volatilized and oxidized during the vitrification process.

The effectiveness of the technology may be adversely impacted by the high water table. Additionally, the availability of a vitrification unit is limited. Therefore, this option will not be considered further.

Soil Washing: Soil washing is a system applied to excavated soil using a liquid such as water as the washing solution. The washing fluid may be composed of water, organic solvents, water/chelating agents, water/surfactants, acids, or bases depending on the contaminant to be removed.

The contaminated soil enters a feeder where non-soil, untreatable material is screened and removed. The waste enters a soil scrubber, where it is sprayed with the washing fluid. Soil particles with a diameter greater than 2 mm are sorted, rinsed, and dewatered. The remaining soil enters a countercurrent chemical extractor, where washing fluid is passed countercurrent to the soil flow, removing the contaminants. The treated soil is then dewatered. Used washing fluid may be treated at the onsite IWTP.

This technology effectively treats excavated contaminated soil, and while the process produces a large volume of contaminated water, it would be discharged to the IWTP.

This process is fairly difficult to implement because of the amount of design and pilot testing required. However, it is effective in removing semi-volatiles and metals, which are COCs at Site 36. Therefore, this option will be retained for further consideration.

Stabilization/Solidification: Solidification/stabilization is a method used to immobilize contaminants in a low-permeability, low-leachability monolith. Soil is combined with sorbents or cementitious materials to "lock" or encapsulate primary contaminants of concern. Solidification/stabilization may also be used to improve material handling properties of soil and sludge before treatment with other technologies.

This option will be considered further.

3.3 Disposal Actions

Disposal of soil removed from contaminant source areas would be shipped offsite for treatment or remain onsite for treatment, then shipped offsite, or used onsite as fill. Land disposal of hazardous waste, whether onsite or offsite, is subject to federal land disposal restrictions and treatment standards, including permitting. These disposal routes are necessary and sufficient components of any contaminant source soil remedy which includes excavation of the soil.

3.4 Air Emissions

Some of the and soils treatment technologies include transferring volatile organics from the environmental media to air. To remain protective of public health and the environment, alternatives including such technologies will most likely require some control of volatile and semi-volatile air emissions. Viable options for controlling volatile emissions include adsorption, thermal destruction, and photolysis.

Adsorption: Granular Activated Carbon (GAC) is a common adsorbent for gas-phase (as well as liquid-phase) collection of light organic compounds. Semi-volatile-laden air streams are passed through vessels filled with GAC, in some cases after pretreatment to reduce humidity, and modulate temperature for better adsorption effectiveness and capacity. The GAC vessels remove semi-volatiles from the air discharge stream until adsorptive capacity is reached, then are regenerated by steam onsite, or offsite by thermal treatment. Either method would include proper disposal and eventual destruction of the residual organic compounds.

Thermal Treatment: More applicable to concentrated streams, thermal treatment involves combustion of semi-volatiles in a fume incinerator, somewhat like the secondary combustion occurring in incinerators or low temperature thermal desorption systems. Thermal treatment, in combination with catalysis, lowers the required temperature, and sometimes residence time required for complete destruction of semi-volatiles. This method is highly effective, but energy intensive. Residual chlorine, although not expected to result in toxic concentrations, would be present in the discharge of a fume incinerator if used at Site 36. This may preclude the common use of heat exchangers to recover energy from combustion gases.

UV/Photolysis: This technology is similar to liquid-phase UV/oxidation but also applies to air [illegible] one process uses illuminated titanium dioxide to destroy volatiles. A volatile-laden air stream is passed through a jacket around a fluorescent tube. UV light in the range of 300 to 400 nanometer wavelength activates titanium dioxide (TiO_2) catalyst which coats a mesh in the jacket. Strongly oxidizing chemical species are produced on the catalyst, which quickly react with volatiles in the stream. The result is carbon dioxide, and hydrogen chloride. The process requires humidity to be effective, which is typically present in streams from air strippers.

All of these technologies are likely to be effective in mitigating volatile content in air stream generated by other processes. The selection will depend on the remedy selected and number, size, and character of the air streams requiring treatment. All technologies will be retained for further evaluation.

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

In this section, general response actions and the process options chosen to represent technology types are combined to form remedial alternatives that address the site as a whole. These alternatives include removal, treatment, disposal, and containment response actions. Once developed, the remedial alternatives are screened based on overall site effectiveness, implementability, and cost. This screening will ensure that only the most promising alternatives are evaluated in detail in Section 5 of this report. The NCP goal of evaluating a range of alternatives that vary in level of effort, protection of health and the environment, and remediation time-frame was considered.

4.1 Development of Soil Remediation Alternatives

The following alternatives will be examined in this section:

- Alternative 1 — No Action
- Alternative 2 — Institutional Controls
- Alternative 3 — Excavation/Disposal at a RCRA Permitted Facility
- Alternative 4 — Excavation/Treatment via Soil Washing
- Alternative 5 — Excavation/Treatment via Low Temperature Thermal Desorption and Stabilization/Solidification

4.1.1 Alternative 1: No Action

During the development and evaluation of alternatives, EPA guidance requires considering a no-action alternative as a "baseline case" against which all others will be evaluated. The no-action alternative fails to protect the surficial aquifer from further contamination downgradient of the site. This alternative is retained for the detailed analysis of alternatives, as per the NCP.

4.1.2 Alternative 2: Institutional Controls

Applying institutional controls to Site 36 includes access controls, deed restrictions, and well permit restrictions within a specified radius of the site. The primary objective of institutional controls is to minimize future contact with contaminated soil. Access restrictions are already integrated into facility security due to nature of the site. Deed restrictions would prevent installation of domestic, industrial, or agricultural wells into the surficial aquifer onsite as well as require future monitoring of the surficial aquifer system. Well permit restrictions would prohibit installation of domestic, industrial, or agricultural wells within a specific radius of the site.

The institutional controls alternative fails to protect the surficial aquifer from further contamination. This alternative will not be retained for detailed analysis as it does not protect the surficial aquifer and does not prevent migration of contaminants offsite.

4.1.3 Alternative 3: Excavation/Subsequent Disposal at a RCRA Permitted Facility

Excavation of soil is a step that must be carried out before *ex-situ* treatment technologies may be implemented. This procedure can be conducted utilizing heavy equipment and manual tools. Once the soil has been excavated, it will be transported to a RCRA permitted facility.

Removal and disposal of contaminated soil is an effective alternative for applying treatment technologies to soil. However, this alternative does not reduce the toxicity or volume of the contaminated soil, but instead transfers it to a RCRA unit that will make the contaminants less mobile. Therefore this alternative will not be considered further.

4.1.4 Alternative 4: Excavation/Treatment via Soil Washing

Excavation of soil is a step that must be carried out before *ex-situ* treatment technologies may be implemented. This procedure can be conducted utilizing heavy equipment and manual tools.

The contaminated soil enters a feeder where non-soil, untreatable material is screened and removed. The waste enters a soil scrubber, where it is sprayed with the washing fluid. Soil particles with a diameter greater than 2 mm are sorted, rinsed, and dewatered. The remaining soil enters a countercurrent chemical extractor, where washing fluid is passed countercurrent to the soil flow, removing the contaminants. The treated soil is then dewatered. Used washing fluid will be discharged to the IWTP.

Removal and disposal of contaminated soil is an effective alternative for applying treatment technologies to soil. Soil washing is effective in removing both COCs at Site 36, semi-volatiles and metals.

This alternative will be retained for detailed screening in Section 5 below.

4.1.5 Alternative 5: Excavation/Treatment with Low Temperature Thermal Desorption and Stabilization/Solidification

Excavation of soil is a step that must be carried out before *ex-situ* treatment technologies may be implemented. This procedure can be conducted utilizing heavy equipment and manual tools.

Removal and disposal of contaminated soil is an effective alternative for applying treatment technologies to soil. However, LTTD is not effective in removing or treating metals, which are COCs at Site 36. Therefore, stabilization/solidification of the semi-volatile-treated soil will be required with subsequent disposal at a RCRA facility or placement back in the excavated areas. Treatment, such as carbon adsorption, of off-gas for semi-volatiles from the LTTD unit will be necessary.

As an LTTD unit is already planned for use at NAS Pensacola, this alternative will be retained for detailed screening in Section 5 below.

4.2 Alternatives Retained for Detailed Analysis

The following soil remedial alternatives have been retained for detailed analysis:

- Alternative 1 — No Action

- Alternative 4 — Excavation/Treatment via Soil Washing
- Alternative 5 — Excavation/Treatment via Low Temperature Thermal Desorption and Stabilization/Solidification

5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, the remedial alternatives selected in Section 4.2 are examined with respect to requirements stipulated in CERCLA as amended, and the NCP.

5.1 Detailed Analysis Procedure

The detailed analysis of alternatives consists of analyzing and presenting the relevant information needed to allow decision-makers to select a site remedy, not the decision-making process itself. During the detailed analysis, each alternative is assessed against the evaluation criteria described in the OSWER Directive No. 9355.3-01. The results of the assessment are arrayed to compare the alternatives and identify the key tradeoffs among them. This approach to analyzing alternatives is designed to provide decision-makers with sufficient information to adequately compare the alternatives, select an appropriate remedy for a site, and demonstrate satisfaction of the CERCLA remedy-selection requirements of the remedial action decision.

Nine evaluation criteria have been developed to address the CERCLA requirements and [illegible]ations, and to address the additional technical and policy considerations that have proven to be important for selecting among remedial alternatives. These evaluation criteria serve as the basis for conducting the detailed analyses during the limited feasibility study (FS) and for subsequently selecting an appropriate remedial action. The evaluation criteria with the associated statutory considerations are:

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- Compliance with ARARS
- Overall protection of human health and the environment

- State acceptance
- Community acceptance

Each remedial alternative is evaluated with respect to the above criteria, as described in the following sections. At the completion of all detailed analyses, a section is included in which the statutory factors and criteria listed above are compared for each alternative to assist in the remedy-selection process.

5.1.1 Short-term Effectiveness

The short-term effectiveness of a remedial alternative is evaluated relative to its effect on human health and the environment while implementing the remedial action. The short-term effectiveness assessment is based on four key factors:

- Risks that occur to the community while implementing the remedial action.
- Risks to workers while implementing the remedial action.
- Potential for adverse environmental impact to occur as a result implementing the remedial action.
- Time until remedial response objectives are achieved.

5.1.2 Long-term Effectiveness and Permanence

The evaluation of alternatives under this criterion addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The magnitude of residual risk and the adequacy and reliability of controls should be addressed for each alternative.

Magnitude of Residual Risk

The magnitude of residual risk is that risk remaining from untreated waste or treatment residuals when remedial activities are concluded. The potential for this risk may be measured by numerical standards, such as cancer risk levels or the volume or concentration of contaminants in waste, media, or treatment residuals remaining onsite.

Adequacy and Reliability of Controls

The adequacy and suitability of any controls used to manage treatment residuals or untreated wastes remaining at the site also must be assessed. They may include assessing containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and environmental receptors is within protective levels.

5.1.3 Reduction of Toxicity, Mobility, or Volume

This evaluation criterion addresses the statutory preference for remedial actions employing treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of the hazardous substances as their principal element.

The ev[illegible]ould consider the following specific factors:

- [illegible]nent processes, the remedies they will employ, and the materials they will treat.
- [illegible] amount of hazardous materials that will be destroyed or treated, including how principal threat(s) will be addressed.
- The degree of expected reduction in toxicity, mobility, or volume, measured as a percentage of reduction (or order of magnitude) when possible.
- The degree to which the treatment will be irreversible.
- The type and quantity of treatment residuals remaining following treatment.
- Whether the alternative would satisfy the statutory preference for treatment as a principal element.

5.1.4 Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. This criterion involves analyzing five factors.

Technical Feasibility

The technical feasibility of an alternative assesses the technical difficulties and unknowns associated with constructing and operating a technology.

Reliability

The reliability of an alternative focuses on the likelihood that technical problems associated with implementation will lead to schedule delays.

f Undertaking

The ease of implementing the remedial action discusses future remedial actions that may need to be undertaken and how difficult it would be to implement such additional actions.

Monitoring

These considerations address the ability to monitor the effectiveness of the remedy, including an evaluation of the exposure risks if monitoring is insufficient to detect a system failure.

Administrative Feasibility

Administrative feasibility involves activities to be coordinated with other offices and agencies, and availability of the remedial technologies included in the alternative, such as the following:

- Services and materials.
- Availability of adequate offsite treatment, storage capacity, and disposal services.
- Necessary equipment and specialists, and provisions to ensure any necessary additional resources.

- Services and materials, plus the potential for obtaining competitive bids, which may be particularly important for innovative technologies.
- Prospective technologies.

5.1.5 Cost

A cost estimate is developed for each remedial alternative. These estimates are based on engineering analyses, estimates by suppliers of necessary technology, and costs for similar actions (such as excavation) at other CERCLA and RCRA sites. Costs are expressed in 1991 dollars. The cost estimate for a remedial alternative consists of two principal elements: capital costs and O&M costs. Capital costs include direct and indirect costs.

Direct Cost

Direct costs are those of equipment, labor, and materials used to develop, construct and implement a remedial action.

Indirect Cost

Indirect costs include the costs of engineering, financial, and other services not actually a part nstruction but required to implement a remedial alternative. The percentage applied to the direct cost varies with the degree of difficulty associated with construction and/or implementation of the alternative.

In this limited FS, the indirect costs include:

- Health and safety (H&S) items.
- Permitting and legal fees.
- Bid and scope contingencies.
- Engineering design and services.

Annual O&M Costs

O&M costs refer to post-construction costs necessary to ensure the continued effectiveness of a remedial action. They typically refer to long-term power and material costs (such as the operational cost of a water treatment facility), equipment replacement costs, and long-term monitoring costs.

The cost elements for each remedial alternative are summarized in the cost-analysis section. The study estimate costs provided for the alternatives are intended to reflect actual costs with an accuracy of -30 percent to +50 percent, in accordance with the EPA guidelines.

5.1.6 Compliance with ARARs

This evaluation criterion is used to determine whether each alternative will meet all of its federal and state ARARs that have been identified in previous stages of the RI/FS process. The detailed analysis should identify which requirements are applicable or relevant and appropriate to an [illegible] Chemical-, location-, and action-specific ARARs should be addressed for each alternative during the detailed analysis. The actual determination of which requirements are applicable or relevant and appropriate is made by the lead agency in consultation with the support agency.

5.1.7 Overall Protection of Human Health and the Environment

This evaluation criterion provides a final check to assess whether each alternative adequately protects human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluating the overall protectiveness of an alternative should focus on whether it achieves adequate protection by eliminating, reducing, or controlling the risk posed by each pathway through treatment, engineering, or institutional controls. This evaluation also considers whether an alternative poses any unacceptable short-term or cross-media impacts.

5.1.8 State Acceptance

This criterion will not be addressed as the Navy is the lead agency at the Site 36.

5.1.9 Community Acceptance

This assessment evaluates the issues and concerns the public may have regarding each of the alter[illegible]. The public will have an opportunity to comment on the plan.

5.2 Detailed Evaluation of Soil Remedial Alternatives

This section presents the detailed analysis of the three alternatives retained in Section 4.2. The alternatives are as follows:

- Alternative 1: No Action
- Alternative 4: Excavation/Treatment via Soil Washing
- Alternative 5: Excavation/Treatment via Low Temperature Thermal Desorption and Solidification/Stabilization

5.2.1 Alternative 1

The no-action alternative for Site 36 involves no active remedial effort. A groundwater monitoring plan would be implemented onsite to document contaminant migration and attenuation. Once every five years, the site would be reassessed to determine site risk.

Short-term Effectiveness

Because this alternative involves no active remedial action, implementation presents no risk to the community or workers.

Long-term Effectiveness

This alternative leaves the semi-volatile and metal contaminants in the soil. Continued leaching of contaminants from the soil to the shallow aquifer will result in continued groundwater contamination. The alternative lacks treatment actions that would provide permanence.

Reduction of Toxicity, Mobility, or Volume

The no-action alternative does not reduce the toxicity, mobility, or volume of contaminated soil. No treatment is effected, and the alternative does not satisfy statutory preference for irreversible treatment.

Implementability

This alternative is technically feasible and easily implemented.

Cost

The study cost estimate for this alternative is detailed in Table 5-1, and has an approximate cost range of $10,750 to $15,850.

Table 5-1
Cost Analysis for Alternative 1

Cost Area	Item	Quantity	Unit Cost	Estimated Cost
Capital Costs	Groundwater Monitoring Wells	4 wells	$2,000 - $3,000	$8,000 - $12,000
O&M	Laboratory Analysis	5 - 7 samples	$550	$2,750 - $3,850
PRESENT WORTH FOR ALTERNATIVE 1				**$10,750 - $15,850**

Compliance with ARARs

The no-action alternative does not comply with ARARs.

Overall Protection of Human Health and the Environment

The no-action alternative does not protect human health or the environment.

Community Acceptance

Community acceptance of the no-action alternative will be established after the public comment period for the limited FS.

5.2.2 Alternative 4

Short-term Effectiveness

Because this alternative involves removal of contaminated soil, workers may be at risk of inhaling contaminants. However, with proper PPE, this risk is minimized.

Long-term Effectiveness

This alternative removes the semi-volatile and metal contaminants from the soil, thereby eliminating source of contamination to groundwater. The treated soil could be placed back in the excavated areas and continued leaching of contaminants from the soil to the shallow aquifer will cease. The alternative provides actions that would provide permanence.

Reduction of Toxicity, Mobility, or Volume

The alternative reduces the toxicity, mobility, and volume of contaminated soil via treatment. This alternative satisfies statutory preference for irreversible treatment.

Implementability

This alternative is technically feasible and can be implemented with pilot studies.

Cost

The study cost estimate for this alternative is detailed in Table 5-2, and has an approximate cost range of $297,500 to $563,000.

Table 5-2
Cost Analyses for Alternative 4

Cost Area	Item	Approximate Quantity	Unit Cost (per ton)	Estimated Total Cost
Direct Costs	Soil Washing	1,000 - 2,000 tons	$150 - $250	$250,000 - $500,000
Indirect Costs	Engineering Costs	—	—	$20,000 - $30,000
O&M	Annual Maintenance	—	—	—
	Laboratory Analysis	50 - 60 samples	$550/sample	$27,500 - $33,000
	Regulatory Compliance	—	—	—
PRESENT WORTH FOR ALTERNATIVE 4				$297,500 - $563,000

Compliance with ARARs

The excavation and soil washing alternative complies with ARARs.

Overall Protection of Human Health and the Environment

The excavation and soil washing alternative protects human health and the environment.

Community Acceptance

Community acceptance of this alternative will be established after the public comment

5.2.3 Alternative 5

Short-term Effectiveness

Because this alternative involves removal of contaminated soil, workers may be at risk of inhaling contaminants. However, with proper PPE, this risk is minimized.

Long-term Effectiveness

This alternative removes the semi-volatile contaminants from the soil, but does not adequately treat metals exceeding FDEP soil cleanup standards. The semi-volatile treated soil could not be placed back in the excavated areas so long as it exceeded the allowable metals concentrations. This alternative does not provide actions that would provide permanence of metals removal.

Reduction of Toxicity, Mobility, or Volume

The alternative reduces the toxicity, mobility, and volume of semi-volatile-contaminated soil but does not reduce that of metals (nickel and lead). This alternative does not satisfy statutory preference for irreversible treatment.

Implementability

This alternative is technically feasible and easily implemented.

Cost

The study cost estimate for this alternative is detailed in Table 5-3, and has an approximate cost range of $197,500 to $308,000.

Table 5-3
Cost Analysis for Alternative 5

Cost Area	Item	Approximate Quantity	Unit Cost (per ton)	Estimated Cost
Direct Costs	LTTD	1,000 - 2,000 tons	$30 - $55	$60,000 - $110,000
	Stabilization/ Solidification	1,000 - 2,000 tons	$35 - $50	$70,000 - $100,000
Indirect Costs	Engineering Costs	—	—	$40,000 - $65,000
O&M	Annual Maintenance	—	—	—
	Laboratory Analysis	50 - 60 samples	$550/sample	$27,500 - $33,000
	Regulatory Compliance	—	—	—
PRESENT WORTH FOR ALTERNATIVE 5				$197,500 - $308,000

Compliance with ARARs

This alternative does not comply with ARARs.

Overall Protection of Human Health and the Environment

This alternative does not protect human health or the environment.

Community Acceptance

Community acceptance of this alternative will be established after the public comment period for the limited FS.

5.3 Comparative Analysis of Alternatives

This section compares the remedial alternative detailed in this section. This comparison will address similarities, differences, advantages, and disadvantages of each of the seven remedial alternatives with respect to the eight criteria listed below:

- Short-term effectiveness
- Long-term effectiveness
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- Community acceptance

The ninth criterion, state acceptance, is accounted for in this limited FS as the Navy is the lead agency at Site 36.

Table 5-4 summarizes the results from the analysis of soil remedial alternatives for Site 36.

Table 5-4
Summary Comparison of Soil Alternatives

Assessment Criteria	1 No Action	4 Excavation with Subsequent Treatment via Soil Washing	5 Excavation/Treatment with LTTD and Stabilization/Solidification
General Description	Natural degradation of contaminants;	Excavation of contaminated soils; removal of semi-volatiles and metals (nickel and lead) with soil washing process; discharge of process water to IWTP. Treated soils placed back in excavated areas.	Excavation of contaminated soil; volatilization of semi-volatiles via LTTD; stabilization of metals; placement of soil back into excavated areas.
Short-term Effectiveness: Remedial Worker Risk	No activities. Minimal.	Increased risk of contact/ inhalation/ ingestion due to excavation activities.	Increased risk of contact/ inhalation/ ingestion due to excavation activities.
Community Chemical Risk	No Activities. Minimal.	Minimal.	Minimal.
Time required to achieve RAOs	Unknown.	4 to 6 weeks	4 to 6 weeks
Long-term Effectiveness: Magnitude of Residual Risk	Soils above FDEP cleanup standards.	Soils are treated effectively.	Semi-volatiles are removed from soil effectively. Mobility of metals is reduced.
Reliability of Controls	No controls.	Soil treatment adequate.	Soil treatment adequate.
Reduction of Toxicity, Mobility, or Volume	No reduction in TMV in soils.	Soil contaminants removed and soils treated irreversibly. Treatment of wash water effected at IWTP.	Semi-volatiles treated irreversibly. Reduction in metals mobility.
Implementability: Availability of Technology		Readily available.	Readily available.
Treatability Study Required		Required.	None.
Material and Service Availability	Readily available.	Readily available.	Readily available.

Table 5-4
Summary Comparison of Soil Alternatives

Assessment Criteria	1 No Action	4 Excavation with Subsequent Treatment via Soil Washing	5 Excavation/Treatment with LTTD and Stabilization/Solidification
Ability to monitor effectiveness	Readily monitored.	Readily monitored.	Readily monitored.
Potential barriers to implementation	None.	None.	None.
Costs: Capital	$8,000 - $12,000	$293,000 - $488,000	$170,000 - $275,000
O&M	$10,750 - $15,850	$27,500 - $33,000	$27,500 - $33,000
Compliance with ARARs: Chemical-specific	Would not comply with FDEP cleanup standards.	Will comply with FDEP standards for treated soils.	May not comply with FDEP standards for treated soil.
Location-specific	Not applicable.	Not applicable	Not applicable.
Action-specific	Not applicable.	Not applicable	Not applicable.
Overall Protection of Human Health and the Environment	No protection provided.	Will provide overall protection of human health.	Will provide overall protection of human health.
Community Acceptance	The community will have opportunity to comment.	The community will have the opportunity to comment.	The community will have the opportunity to comment.