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FEASIBILITY STUDY FOR SITE 17 CRASH CREW TRAINING AREA NAS WHITING FIELD

3/1/2001

HARDING LAWSON ASSOCIATES

FEASIBILITY STUDY

SITE 17, CRASH CREW TRAINING AREA

NAVAL AIR STATION WHITING FIELD
MILTON, FLORIDA

USEPA ID NO.: FL2170023244

UNIT IDENTIFICATION CODE: N60508
CONTRACT NO.: N62467-89-D-0317/116

MARCH 2001

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA 29418

Harding Lawson Associates
Engineering and Environmental Services
2533 Greer Road, Suite 6
Tallahassee, Florida 32301 - (850) 656-1293

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FEASIBILITY STUDY
FOR
SURFACE AND SUBSURFACE SOILS

SITE 17, CRASH CREW TRAINING AREA

NAVAL AIR STATION WHITING FIELD
MILTON, FLORIDA

USEPA ID No.: FL2170023244

Unit Identification Code: N60508

Contract No.: N62467-89-D-0317/116

Prepared by:

Harding Lawson Associates
2533 Greer Road, Suite 6
Tallahassee, Florida 32308

Prepared for:

Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418

Linda Martin, Code 1859, Engineer-in-Charge

March 2001

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, Harding Lawson Associates, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/116 are complete and accurate and comply with all requirements of this contract.

DATE: March 29, 2001

NAME AND TITLE OF CERTIFYING OFFICIAL: Rao Angara
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Eric Blomberg, P.G.
Project Technical Lead

(DFAR 252.227-7036)

The evaluations and professional opinions rendered in this planning document describing the feasibility study for Site 17, Naval Air Station Whiting Field, Milton, Florida, were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice. This document is not intended to be used for construction of the selected alternative.

HARDING LAWSON ASSOCIATES
2533 Greer Road, Suite 6
Tallahassee, Florida 32308

4-5-01

Eric A. Blomberg, P.G.
Professional Geologist
State of Florida License No.: 1695

FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, and/or disposal of hazardous materials. Through accidental spills or leaks or as a result of and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by current standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Installation Restoration (IR) program. This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), the Resource Conservation and Recovery Act, and the Hazardous and Solid Waste Amendments of 1984. These acts establish the means to assess and clean up hazardous waste sites for both private-sector and Federal facilities. The CERCLA and SARA acts form the basis for what is commonly known as the Superfund program.

Originally, the Navy's part of this program was called the Naval Assessment and Control of Installation Pollutants (NACIP) program. Early reports reflect the NACIP process and terminology. The Navy eventually adopted the program structure and terminology of the standard IR program.

The IR program is conducted in several stages as follows:

- preliminary assessment (PA),
- site inspection (SI) (formerly the PA and SI steps were called the initial assessment study under the NACIP program),
- remedial investigation and feasibility study, and
- remedial design and remedial action.

The Southern Division, Naval Facilities Engineering Command manages and the U.S. Environmental Protection Agency and the Florida Department of Environmental Protection oversee the Navy environmental program at Naval Air Station (NAS) Whiting Field. All aspects of the program are conducted in compliance with State and Federal regulations, as ensured by the participation of these regulatory agencies.

Questions regarding the CERCLA program at NAS Whiting Field should be addressed to Ms. Linda Martin, Code 1859, at (843) 820-5574.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
AFFF	aqueous film-forming foam
ARAR	applicable or relevant and appropriate requirement
BEI	Bechtel Environmental Inc.
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm/s	centimeters per second
CT	central tendency
COPC	chemicals of potential concern
ELCR	excess lifetime cancer risk
ERA	ecological risk assessment
FDEP	Florida Department of Environmental Protection
FGGC	Florida Groundwater Guidance Concentration
FS	feasibility study
FSCG	Florida Soil Cleanup Goal
GCTL	groundwater cleanup target level
GIR	General Information Report
HHRA	human health risk assessment
HI	hazard index
HLA	Harding Lawson Associates
IR	Installation Restoration
IRA	interim remedial action
JP-5	jet propellant
LUCAP	Land-Use Control Assurance Plan
LUCIP	Land-Use Control Implementation Plan
MCL	maximum contaminant level
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Contingency Plan
PCB	polychlorinated biphenyls
RA	remedial action
RAO	remedial action objective
RBC	risk based concentration
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation

GLOSSARY (Continued)

RME	reasonable maximum exposure
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
SCTL	soil cleanup target level
SVOC	semivolatile organic compound
TBC	to be considered
TCL	target compound list
TRPH	total petroleum recoverable hydrocarbon
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
yd^3	cubic yard

1.0 INTRODUCTION

Harding Lawson Associates (formerly ABB Environmental Services, Inc. [ABB-ES]), has been contracted by the Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) to complete a feasibility study (FS) for Site 17, Crash Crew Training Area, at Naval Air Station (NAS) Whiting Field, Milton, Florida. The FS is being completed under contract number N62467-89-D-0317-116. The FS report for Site 17 is one in a series of site-specific reports being completed in conjunction with the NAS Whiting Field General Information Report (GIR) (ABB-ES, 1998a) and Remedial Investigation (RI) report (ABB-ES, 1998b), and the Remedial Action Completion Report (BEI, 2000) to present the results of the overall RI/FS for the site (Figure 1-1). This FS report includes the development, screening, and evaluation of potential remedial alternatives that address contaminated media at Site 17.

Investigations at NAS Whiting Field, a facility listed on the National Priorities List, are being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR], Part 300). The investigations at the facility are being conducted under the Navy's Installation Restoration (IR) program, which is designed to identify and abate or control contaminant migration resulting from past operations at naval installations while working within the aforementioned regulatory framework. SOUTHNAVFACENGCOM is the agency responsible for the Navy's IR program in the southeastern United States. Therefore, SOUTHNAVFACENGCOM has the responsibility to process NAS Whiting Field through preliminary assessment, site inspection, RI/FS, and remedial response selection.

The goals of the RI/FS for Site 17 at NAS Whiting Field were (1) to assess the extent, magnitude, and impact of contamination at the sites, (2) to qualitatively and quantitatively assess the risk posed to human health and the environment by site-related contamination, and (3) to develop remedial alternatives that address threats to human health and/or the environment. The first two elements have been discussed in the GIR and RI reports; the remaining element will be presented and discussed in this FS Report.

The GIR provides information common to all sites at NAS Whiting Field, such as

- facility information and history,
- description of physical characteristics of the facility (climatology, hydrology, soil, geology, and hydrogeology),
- summary of previous investigations,
- summary of the field investigations activities conducted during the RI,
- baseline risk assessment (BRA) methodology for both human health and ecological receptors, and
- a summary of the facility-wide background evaluation.

The RI serves as the mechanism for collecting data to identify the source of contamination and migration pathway characteristics, for conducting a BRA, and for collecting physical measurements and chemical analytical data necessary for remedial alternative evaluation in the FS. The RI provides the basis for determining whether or not remedial action is necessary. The RI Report for Site 17 at NAS Whiting Field provides the following information:

- a site description and a summary of previous investigations for Site 17;

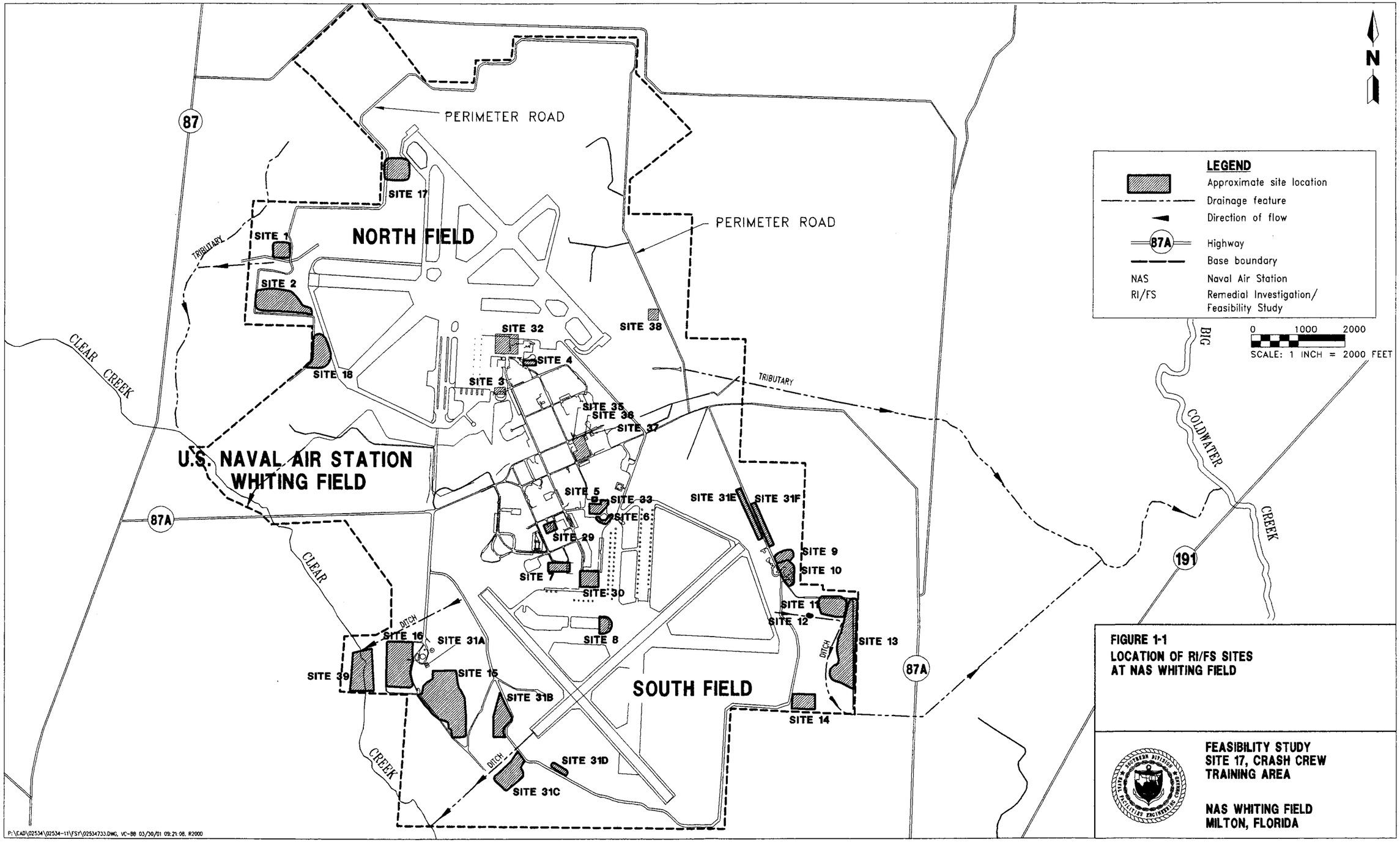

FIGURE 1-1
LOCATION OF RI/FS SITES
AT NAS WHITING FIELD

FEASIBILITY STUDY
SITE 17, CRASH CREW
TRAINING AREA

NAS WHITING FIELD
MILTON, FLORIDA

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- a summary of the interim remedial action conducted to reduce exposure risk due to arsenic and total recoverable petroleum hydrocarbons (TRPH)
- a summary of the field investigation methods used during the RI at the sites;
- a site-specific data quality assessment;
- an assessment of the extent, magnitude, and impact of contamination at the sites; and
- a qualitative and quantitative assessment of risks to human health and the environment.

The FS, described in more detail later in this chapter, uses the results of the RI and the information presented in the GIR to identify remedial action objectives (RAOs) and to develop, screen, and evaluate potential remedial alternatives. The FS is prepared in accordance with the following regulations and guidance documents: CERCLA, as amended by SARA (references made to CERCLA in this report should be interpreted as "CERCLA, as amended by SARA"); the NCP (40 CFR, Part 300); and *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (RI/FS Guidance) (USEPA, 1988).

The remaining sections in this chapter describe the FS process for CERCLA sites, present how this process is applied to NAS Whiting Field sites, provide a conceptual understanding of Site 17 environmental conditions, provide a brief description of the interim removal action completed at Site 17, and provide a summary of the RI conclusions.

1.1 THE CERCLA FS PROCESS.

The development of remedial alternatives for CERCLA sites consists of developing RAOs and then identifying applicable technologies and developing those technologies into remedial alternatives to meet the RAOs. The NCP requires that a range of alternatives be presented in the FS to the maximum extent practicable.

The first step in the FS process is to develop RAOs that specify the contaminants, media of interest, exposure pathways, and preliminary remedial goals that permit a range of alternatives to be developed. The preliminary remedial goals are developed based on chemical-specific applicable or relevant and appropriate requirements (ARARs), when available, site-specific risk-based factors, or other available information.

Once RAOs are identified, general response actions for each medium of interest are developed. General response actions typically fall into the following categories: no action, containment, excavation, extraction, treatment, disposal, or other actions, singular or in combination, that may be taken to satisfy the RAOs for the site.

The next step in the FS process is to identify and screen applicable technologies for each general response action. This step eliminates those technologies that cannot be implemented technically. Those technologies that pass the screening phase are then assembled into remedial alternatives. Remedial alternatives are then described and analyzed in detail using seven criteria described in the NCP, including

- overall protection of human health and the environment;
- reduction of toxicity, mobility, or volume of contaminants through treatment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- short-term effectiveness;
- implementability; and
- economics (i.e., cost).

Alternatives are evaluated against two 'additional factors after State participation and the public comment period for the FS:

- State acceptance, and
- community acceptance.

The results of the detailed analyses (for the first seven criteria) are summarized and compared in a comparative analysis. The alternatives are compared with each other against several criteria, including the following:

Threshold criteria:

- protection of human health and the environment; and
- attainment of Federal and State human health and environmental requirements identified for the site.

Primary Balancing criteria:

- cost effectiveness;
- use of permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable; and
- preference for treatment that reduces toxicity, mobility, or volume of contaminants as a principal element.

These criteria are used because SARA requires them to be considered during remedy selection. Modifying criteria, which include State and community acceptance, are also evaluated. State acceptance is evaluated when the State reviews and comments on the draft FS report and a proposed plan is then prepared in consideration of the State's comments. Community acceptance is evaluated based on comments received on the FS and proposed plan during a public comment period. This evaluation is described in a responsiveness summary in the Record of Decision (ROD).

The entire FS process provides the technical information and analyses that form the basis for a proposed remedial action plan (proposed plan) and subsequent ROD that documents the identification and selection of the remedy.

1.2 PURPOSE.

The purpose of the FS report for Site 17 at NAS Whiting Field is to document the results of the study that includes developing RAOs to address contaminated media at the site and developing, screening, and evaluating potential remedial alternatives to meet these objectives. The FS was based on the results and conclusions of the RI completed for the site, and the information presented in the GIR. Information presented in these reports will not be repeated in this FS Report.

The FS report for Site 17 was developed in accordance with the NCP. The NCP states that the U.S. Environmental Protection Agency (USEPA) expects containment technologies will generally be appropriate for waste (e.g., landfills) that pose a relatively low long-term threat or where treatment is impractical (Section 300.430[a][1][iii][B]). Additionally, the USEPA expects physical and/or thermal treatment to be considered for identifiable areas of highly toxic and/or mobile material that constitute the principal threat(s) posed by the site (Section 300.430[a][1][iii][A]).

Therefore, the purpose of the FS report for Site 17 is not to present all the possible variations and combinations of remedial actions that could be taken at the site, but to present distinctly different alternatives representing a range of opportunities for meeting the RAOs. It is expected that these different alternatives can be adjusted during the proposed plan and decision process, and to a lesser extent during detailed design, to accomplish RAOs in a manner similar to the initially proposed alternative. The FS report also does not present information on alternatives that fail to meet the RAOs, except for a no action alternative, which provides a baseline for comparison of all alternatives.

The following components are considered in identifying appropriate remedial action for Site 17:

- ***Remedial Action Objectives.*** RAOs are developed to specify the contaminants, media of interest, exposure pathways, and remedial action goals for the site.
- ***Applicable Technologies.*** Technologies applicable for addressing contaminated media at the site are identified and screened. Technologies that cannot be implemented are eliminated.
- ***Remedial Alternatives.*** Technologies that pass the screening phase are assembled into remedial alternatives.
- ***Detailed Analysis.*** Selected remedial alternatives are described and evaluated using seven of the nine criteria outlined in the NCP.
- ***Comparative Analysis.*** Remedial alternatives identified for Site 17 are compared against each other using threshold and primary balancing criteria.

Upon completion of the FS Report, a Proposed Plan will be developed. The Proposed Plan will identify the preferred remedial alternative for Site 17. This document will be written in community-friendly language and will be made available for public comment. Upon receipt of public comments, responses to these comments will be developed in a responsiveness summary and the ROD will be prepared. The ROD will document the chosen alternative for the site and will include the responsiveness summary as an appendix. Once the ROD is signed, the chosen remedial alternative will be implemented.

1.3 ENVIRONMENTAL CONDITIONS.

Site 17 is located along the northwestern facility boundary and near the North Air Field taxiway. The site is approximately 4 acres (Figure 1-2) in size and was in use between 1951 and 1991. Site 17 is composed of multiple shallow depressions where metallic objects were placed to simulate an aircraft after a crash. Crash crew training activities consisted of pouring approximately 100 gallons of aviation gasoline (AVGAS) or jet fuel into the depressions and then igniting it. The fires were then extinguished using an aqueous film-forming foam (AFFF) as part of crash crew training exercises (Geraghty & Miller, 1986).

Investigators conducting soil sampling during Phase IIA in 1992 collected samples in a linear area they suspected was a channel of overland flow oriented to the southwest. Neither the suspected areas nor their boundaries are currently discernable. This change may have been a result of the removal of the fuel tanks and aircraft bodies from the burn pits, after which earth-moving equipment spread the rim of mounded soil from around the burn pit depressions to the adjacent surrounding areas in September 1994. During the interim remedial action (IRA) in February 1999, contaminated areas of the site were covered with 2 feet of soil and sod was placed over the soil cover. The IRA was conducted to address soil contamination due to the presence of TRPH and arsenic at levels in excess of State and Federal industrial standards. Currently, the site is maintained as an open grassy field. This site has a slight surface gradient that slopes gently toward the southwestern site boundary. Additional IRA information follows and is presented in Section 1.4 and in Appendix F of the RI Report (HLA, 2000).

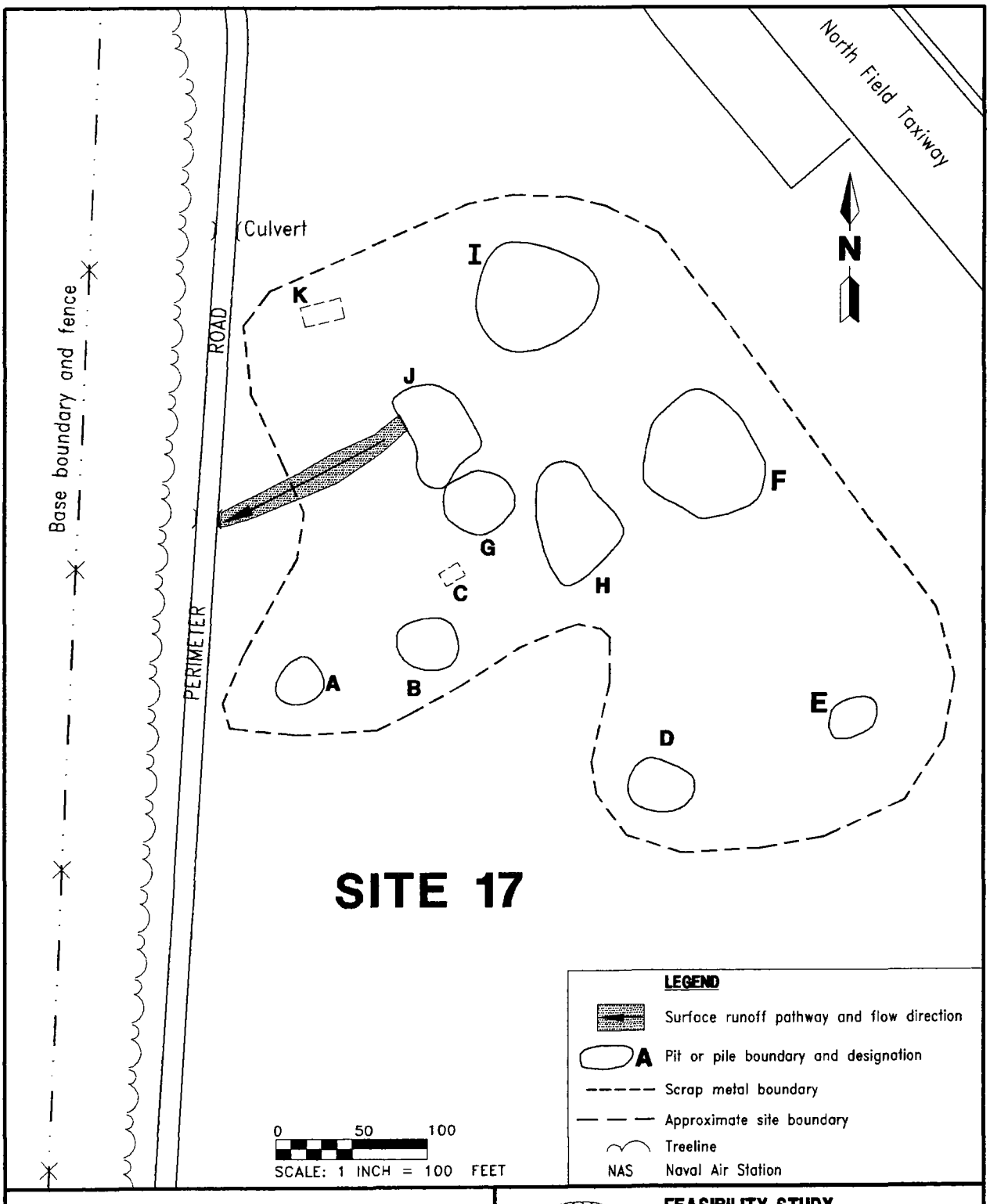

FIGURE 1-2
GENERAL FEATURES
PRIOR TO INTERIM REMEDIAL ACTION

FEASIBILITY STUDY
SITE 17, CRASH CREW TRAINING AREA

NAS WHITING FIELD
MILTON, FLORIDA

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According to the U.S. Department of Agriculture (USDA) (USDA, 1980), the surficial soil horizon at Site 17, prior to the IRA, was classified as Troup loamy sand and Orangeburg sandy loam.

1.4 INTERIM ACTIONS.

In 1999, Bechtel Environmental, Inc. (BEI) performed an IRA at Site 17. The objective of the IRA was to reduce the arsenic and total recoverable petroleum hydrocarbons (TRPH) exposure risk to potential receptors at the site. The IRA consisted of the placement of a permeable soil layer and vegetative cover over areas (see Figure 1-3) where surface soil arsenic and TRPH concentrations exceeded the Florida Department of Environmental Protection (FDEP) soil cleanup target levels (SCTLs).

Pre-construction soil sampling was conducted to delineate and minimize the site restoration area. All soil sample locations and the pre-restoration grade was surveyed prior to construction. A two-foot thick permeable soil layer was constructed to cover the contaminated surface soil. The soil cover consisted of an 18-inch thick red sandy base with a 6-inch thick brown fill for topsoil. In January 1999, approximately 8,480 cubic yards of clean fill was used to construct the 61,150 square foot soil cover. Drawing 419-DD-002 of the BEI Removal Action Report (BEI, 2000) shows the outer limits of the 24-inch soil cover and the additional soil used for blending to natural contours. Bahia grass sod was then installed as a vegetative cover and the restoration site grade was surveyed. The *Removal Action/Completion Report for Sites 9, 10, 17, 18, and 31C* (Appendix F of the RI) contains further details regarding the surface-soil contamination removal actions (BEI, 2000). Figure D-2 of the BEI Report presents the boundaries of the soil cover.

1.5 RI SUMMARY.

The final RI report was submitted by HLA in March 2000. The conclusions listed below from the RI are pertinent to the development of this FS for surface and subsurface soils are based on the risk assessment conducted prior to the completion of the IRA.

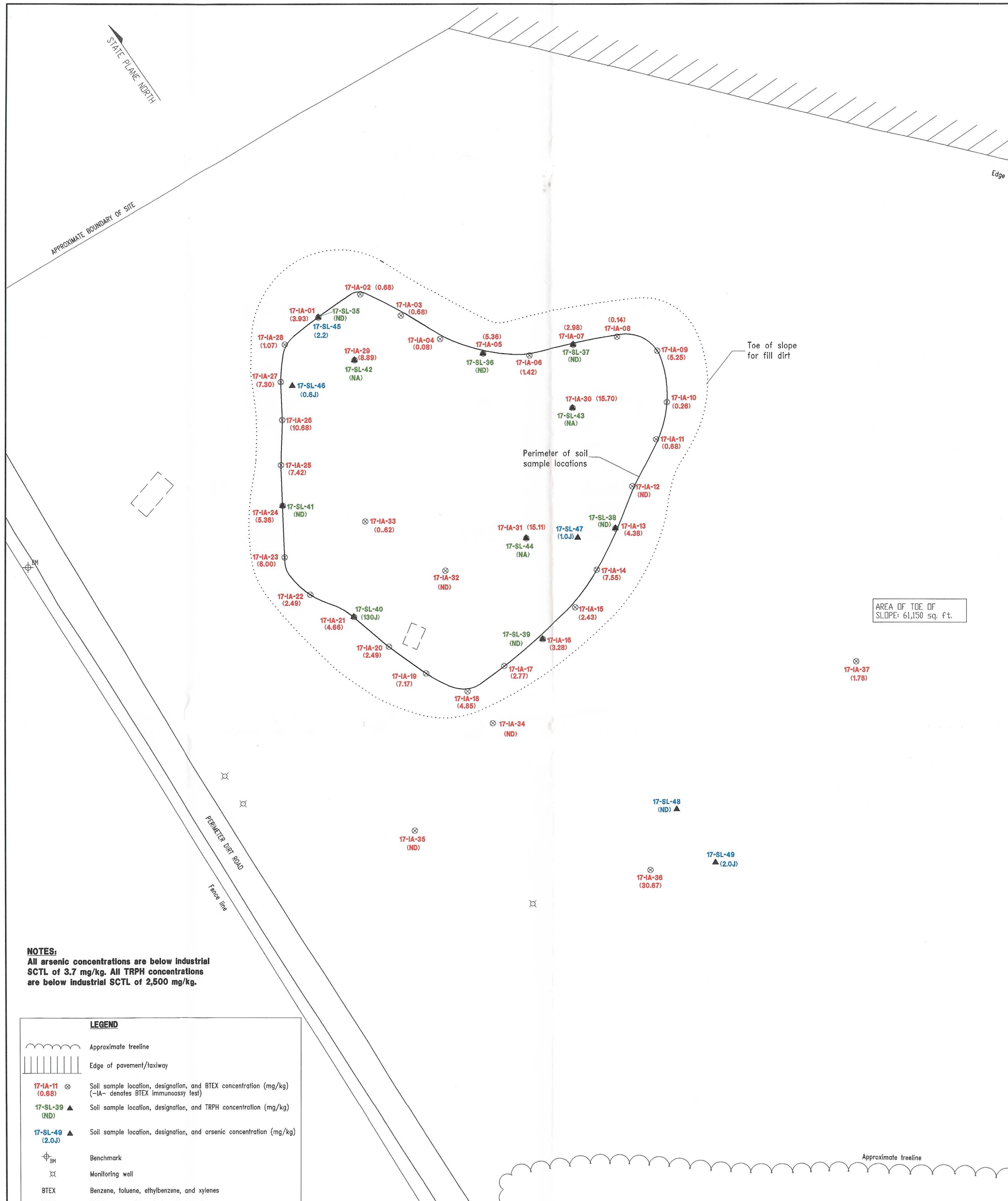
- Organic analytes detected in surface soil samples consist of seven volatile organic compound (VOCs), four semivolatile organic compound (SVOCs), and total recoverable petroleum hydrocarbons (TRPH). Five VOCs (ethylbenzene, methylene chloride, toluene, trichloroethene, and total xylenes) and one SVOC (naphthalene) exceeded Chapter 62-777, Florida Administrative code (FAC), leachability soil cleanup target levels (SCTLs). TRPH exceeded the Chapter 62-777, FAC, residential, industrial, and leachability SCTLs. No pesticides or polychlorinated biphenyls (PCBs) were detected in the surface soil sample collected from Site 17.

- Twenty target analyte list inorganic analytes were detected in the surface soil samples. Ten analytes (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, manganese, and vanadium) exceeded either the U.S. Environmental Protection Agency Region III residential soil screening values or Chapter 62-777, FAC, residential and leachability SCTLs.

- Organic analytes detected in subsurface soil samples consist of three VOCs, two SVOCs, and two pesticides or PCBs. No VOCs, SVOCs, pesticides, or PCBs exceeded Florida or Federal residential or industrial screening criteria.

- TRPH was detected in 4 of 19 subsurface soil samples and no duplicates. None of the samples exceeded the Chapter 62-777, FAC, industrial and leachability SCTLs.

- Twenty-three inorganic analytes were detected in the subsurface soil samples. Three inorganic analytes (arsenic, chromium, and iron) exceeded either the USEPA Region III industrial RBCs or Chapter 62-777,

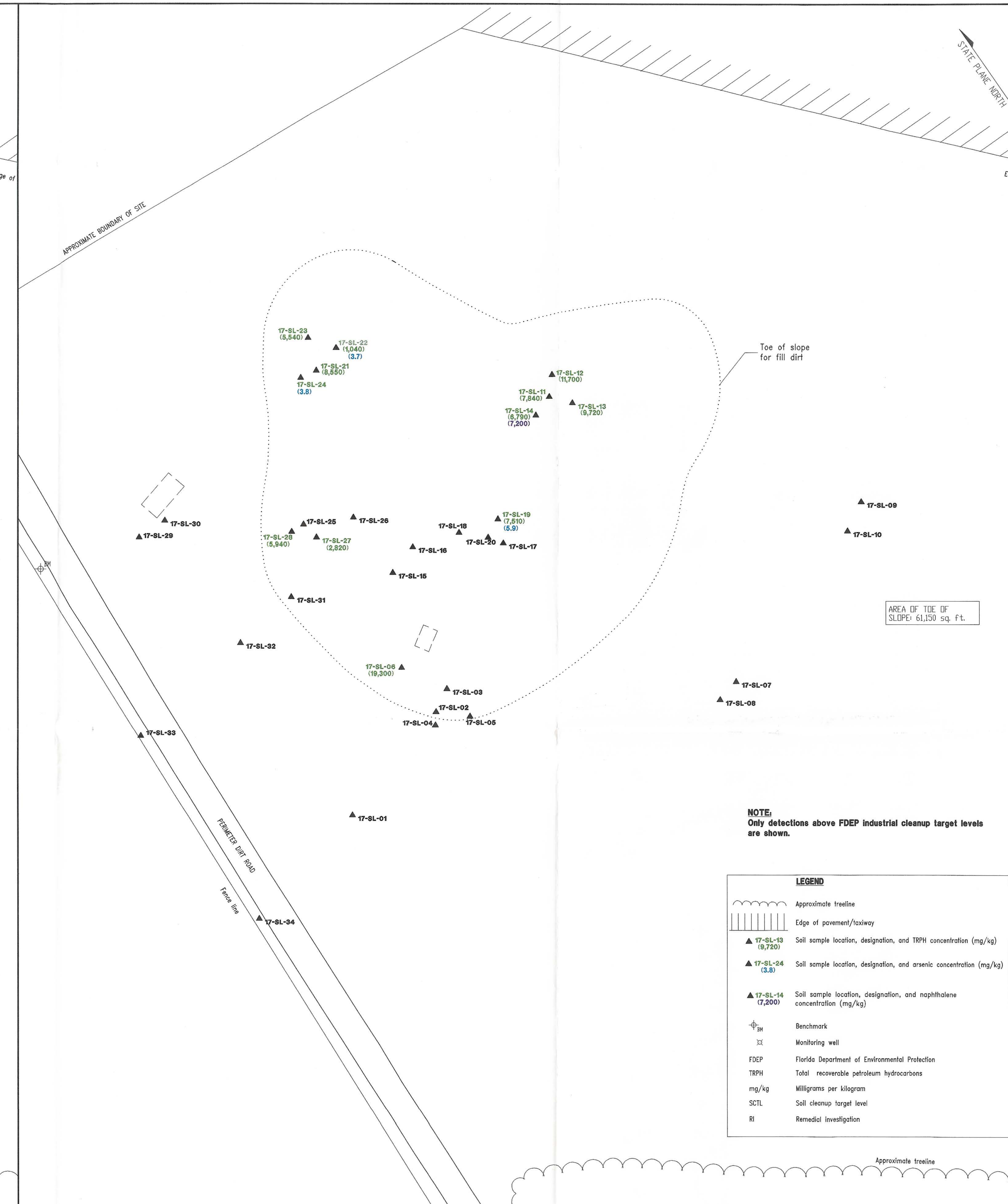


NOTES:
All arsenic concentrations are below industrial SCTL of 3.7 mg/kg. All TRPH concentrations are below industrial SCTL of 2,500 mg/kg.

LEGEND

(symbol)	Approximate treeline
(symbol)	Edge of pavement/taxiway
17-IA-11 (0.68)	Soil sample location, designation, and BTEX concentration (mg/kg) (-IA- denotes BTEX immunoassy test)
17-SL-39 (ND)	Soil sample location, designation, and TRPH concentration (mg/kg)
17-SL-49 (2.0J)	Soil sample location, designation, and arsenic concentration (mg/kg)
BM	Benchmark
(symbol)	Monitoring well
BTEX	Benzene, toluene, ethylbenzene, and xylenes
TRPH	Total recoverable petroleum hydrocarbons
mg/kg	Milligrams per kilogram
SCTL	Soil cleanup target level
IRA	Interim remedial action

IRA ANALYTICAL RESULTS



NOTE:
Only detections above FDEP industrial cleanup target levels are shown.

LEGEND

(symbol)	Approximate treeline
(symbol)	Edge of pavement/taxiway
17-SL-13 (9,720)	Soil sample location, designation, and TRPH concentration (mg/kg)
17-SL-24 (3.8)	Soil sample location, designation, and arsenic concentration (mg/kg)
17-SL-14 (7,200)	Soil sample location, designation, and naphthalene concentration (mg/kg)
BM	Benchmark
(symbol)	Monitoring well
FDEP	Florida Department of Environmental Protection
TRPH	Total recoverable petroleum hydrocarbons
mg/kg	Milligrams per kilogram
SCTL	Soil cleanup target level
RI	Remedial investigation

RI ANALYTICAL RESULTS

FIGURE 1-3
BOUNDARY OF IRA SOIL COVER AND ANALYTICAL RESULTS

FEASIBILITY STUDY
SITE 17

NAVAL STATION WHITING FIELD
MILTON, FLORIDA

FAC, industrial and leachability SCTLs. Arsenic was detected in four subsurface soil samples at concentrations that exceeded the State and Federal industrial screening criteria. The cancer risks associated with excavation worker exposure is $6x10^{-8}$. This is below the USEPA cancer risk range and also below the FDEP target risk level.

- The human health chemicals of potential concern (HHCPCs) detected in surface soil do not pose unacceptable carcinogenic risks to the receptors evaluated based on USEPA risk criteria.

- The total estimated lifetime cancer risk at Site 17 associated with ingestion of surface soil by a hypothetical future resident exceeds Florida's target risk level of concern 1×10^{-6} due primarily to arsenic.

- Noncancer risk levels for soil, subsurface soil, and groundwater meet the USEPA and FDEP target hazard index of one.

- Although RME concentrations of cadmium and lead exceeded their respective benchmark values, CT exposure concentrations of these constituents were below the benchmark values. In addition, no evidence of stressed vegetation outside of the burn pits was observed at Site 17. Therefore, it is unlikely that plant cover and/or biomass at Site 17 would be reduced such that small mammals and birds would be affected.

- Reduction in invertebrate biomass across the entire Site 17 area is not expected to occur.

- Only sublethal risks associated with ingestion of cadmium in surface soil and food items are predicted for small mammals and birds at Site 17. However, this exposure route was eliminated by the construction of the soil cover.

- In February 1999, BEI completed an IRA at Site 17. The objective of the IRA was to reduce the arsenic and the total recoverable petroleum hydrocarbons (TRPH) exposure risk to potential industrial or residential receptors at the site. The IRA consisted of the placement of a permeable soil layer and vegetative cover over areas where surface soil arsenic and TRPH concentrations exceeded the Florida Department of Environmental Protection (FDEP) industrial soil cleanup target levels (SCTLs).

2.0 REMEDIAL ACTION OBJECTIVES

This section presents the goals and objectives for remedial action at Site 17 that provide the basis for selecting appropriate RAOs and, subsequently, identifying remedial technologies and developing alternatives to address contamination at the site. To establish these objectives, ARARs are first identified (Section 2.1). Next, RAOs are defined based on consideration of ARARs, the results and conclusions of the RI, the risk assessment, and other criteria (Section 2.2). Next, the volume of contaminated media for Site 17 is presented (Section 2.3). Finally, general response actions appropriate for technology identification are discussed (Section 2.4). The information presented in this chapter will be used to identify appropriate remedial technologies for the sites (presented in Chapter 3.0).

2.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS.

ARARs are Federal and State human health and environmental requirements used to define the appropriate extent of site cleanup, identify sensitive land areas or land uses, develop remedial alternatives, and direct site remediation. CERCLA and the NCP require that remedial actions comply with State ARARs that are more stringent than Federal ARARs, legally enforceable, and consistently enforced statewide.

The NCP defines two ARAR components: (1) applicable requirements, and (2) relevant and appropriate requirements.

> Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, or other circumstance found at a CERCLA site. State standards that may be applicable are only those which (1) have been identified by the State in a timely manner, (2) are consistently enforced, and (3) are more stringent than Federal requirements.
>
> Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements under Federal and State environmental and facility citing laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the CERCLA site so that their use is well suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

"Applicability" is a legal determination of jurisdiction of existing statutes and regulations, whereas "relevant and appropriate" is a site-specific determination of the appropriateness of existing statutes and regulations. Therefore, relevant and appropriate requirements allow flexibility not provided by applicable requirements in the final determination of cleanup levels. Once a requirement is identified as an ARAR, the selected remedy must comply with ARARs, even if the ARAR is not required to assure protectiveness. The general relevant and appropriate requirements apply only to actions at the site. Applicable requirements apply to both on- and off-site remedial actions.

Other requirements "to be considered" (TBC) are Federal and State nonpromulgated advisories or guidance that are not legally binding and do not have the status of potential ARARs (i.e., they have not been promulgated by statute or regulation). However, if there are no specific ARARs for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment.

Under the description of ARARs set forth in the NCP and SARA, State and Federal ARARs are categorized as:

- chemical-specific (i.e., governing the extent of site remediation with regard to specific contaminants and pollutants);
- location-specific (i.e., governing site features such as wetland, floodplains, and sensitive ecosystems and pertaining to existing natural and manmade site features such as historical or archaeological sites); and
- action-specific (i.e., pertaining to the proposed site remedies and governing the implementation of the selected site remedy).

During the detailed analysis of remedial alternatives, each alternative will be analyzed to determine its compliance with ARARs. Chemical-, location-, and action-specific ARARs are discussed in the following subsections, and presented in Table 2-1.

2.1.1 Chemical-Specific ARARs

Chemical-specific requirements are standards that limit the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual cleanup levels or the basis for calculating such levels. The State of Florida has promulgated SCTLs under Florida Administrative Code (FAC) 62-777 (FDEP, 1999).

2.1.2 Location-Specific ARARs

Location-specific ARARs govern site features (e.g., wetland, floodplains, wilderness areas, and endangered species) and manmade features (e.g., places of historical or archaeological significance). These ARARs place restrictions on concentrations of hazardous substances or the conduct of activities based solely on the site's particular characteristics or location.

As stated in the RI (ABB-ES, 1998b), no State or federally listed rare, threatened, or endangered species or species of concern are known to inhabit Site 17 (Nature Conservancy, 1997). Furthermore, Site 17 is not located within the 100-year flood plain or known to contain areas of historical or archeological significance. Therefore, location-specific ARARs do not apply to Site 17.

2.1.3 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based limitations controlling activities for remedial actions. Action-specific ARARs generally set performance or design standards, controls, or restrictions on particular types of activities. To develop technically feasible alternatives, applicable performance or design standards must be considered during the detailed analysis of remedial alternatives. During the detailed analysis of alternatives, each alternative will be analyzed to determine compliance with action-specific ARARs.

Certain action-specific ARARs include permit requirements. Under CERCLA Section 121(e), permits are not required for remedial actions conducted entirely on site at Superfund sites. This permit exemption applies to all administrative requirements, including approval of or consultation with administrative bodies, documentation, record keeping, and enforcement. However, the substantive requirements of these ARARs must be attained.

Table 2-1
Synopsis of Federal and State ARARs and Guidance

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Hazardous Substance and Contingency Plan Regulations (40 Code of Federal Regulations [CFR], Section 300.430)	Discusses the types of institutional controls to be established at CERCLA sites.	**Applicable.** These regulations may be used as guidance in establishing appropriate institutional controls at Site 17.	Action-specific
Occupational Safety and Health Act (OSHA) Occupational Safety and Health Standards (29 CFR Part 1910)	Requires establishment of programs to ensure worker health and safety at hazardous waste sites.	**Applicable.** These requirements apply to all response activities conducted in accordance with the National Contingency Plan. During the implementation of any remedial alternative for Site 17, compliance with these regulations must be attained.	Action-specific
Resource Conservation and Recovery Act (RCRA) Regulations, Identification and Listing of Hazardous Waste (40 CFR, Part 261)	Defines those solid wastes that are subject to regulation as hazardous wastes.	**Applicable.** Any alternative that would excavate and dispose of soil offsite would be sampled and analyzed for hazardous characteristics as defined by 40 CFR Part 261.	Action-specific
RCRA Regulations, Standards Applicable to Transporters of Hazardous Wastes (40 CFR Part 263)	Establishes the responsibilities of the generators and transporters of hazardous waste in the handling, transportation, and management of that waste. To avoid duplicative regulation, USEPA has expressly adopted certain DOT regulations governing the transportation of hazardous waste.	**Applicable.** For excavation and offsite disposal alternatives, the hazardous material would need to be handled, manifested, and transported to a permitted offsite disposal facility in compliance with these regulations.	Action-specific
RCRA Regulations, Releases from Solid Waste Management Units (40 CFR, Part 264, Subpart F)	Contains general groundwater monitoring requirements. Establishes detection and compliance monitoring programs that apply to owners and operators of solid waste units.	**Applicable.** For capping alternatives, these regulations provide guidance for establishing and conducting a groundwater monitoring program at sites contaminated with RCRA wastes.	Action-specific
Hazardous Materials Transportation Act Regulations (49 CFR Parts 171-179)	USDOT provides requirements for packaging, labeling, manifesting, and transporting hazardous materials. Similar requirements are found in 40 CFR Part 263.	**Relevant and Appropriate.** For excavation and offsite disposal alternatives, the hazardous material would need to be handled, manifested, and transported to a permitted offsite disposal facility in compliance with these regulations	Action-specific

See notes at end of table.

Table 2-1 (Continued)
Synopsis of Federal and State ARARs and Guidance

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
USEPA Region III Risk-Based Concentrations (RBCs), October 1998	Provides risk-based concentrations from ingestion or exposure to chemicals in soil, tap water, ambient air, and fish consumption.	**Relevant and Appropriate.** The chemicals detected at Site 17are screened against these standards for selection of chemicals concern and developing RAOs.	Chemical-specific
Florida Rules on Hazardous Waste Warning Signs (FAC, Chapter 62-736)	Requires warning signs at National Priorities List (NPL) sites to inform the public of the presence of potentially harmful conditions.	**Applicable.** This requirement is applicable for sites that are on the NPL.	Action-specific
Florida Petroleum Contaminated Site Cleanup Criteria (FAC, Chapter 62-770)	Rule establishes a cleanup process to be followed at petroleum-contaminated sites. The cleanup criteria apply to sites contaminated with petroleum or petroleum products but does not apply to sites contaminated with significant quantities of other substances.	**Relevant and Appropriate.** Site 17was a former crash crew training area; however, analytical data does not show evidence of petroleum contamination in the soil or groundwater.	Chemical-specific
Florida Contaminant Cleanup Criteria Rule (FAC, 62-777)	Establishes soil and groundwater cleanup criteria	**Relevant and Appropriate**. The soil cleanup target levels should be considered when evaluating RGOs.	Chemical-specific

Notes: ARAR = applicable or relevant and appropriate requirement.
USEPA = U.S. Environmental Protection Agency.
TBC = to be considered guidance materials.

2.1.4 To Be Considered Criteria

As previously stated, TBCs are Federal and State nonpromulgated advisories or guidance that are not legally binding and do not have the status of being a potential ARAR (i.e., have not been promulgated by statute or regulation). However, if there are no specific regulatory requirements for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment.

2.2 IDENTIFICATION OF RAOs.

RAOs are defined in the CERCLA RI/FS guidance manual as media-specific goals that are established to protect human health and the environment and are typically based on chemicals of concern, exposure routes, and receptors present or available at the site. RAOs are developed to ensure compliance with ARARs. RAOs for Site 17 will be identified by consideration of ARARs, the RI, the risk assessment (RA), and the IRA. Although the risk assessment was conducted before the IRA, the risk assessment will not be revised in light of the IRA.

Groundwater. Groundwater at NAS Whiting Field has been identified as a separate site (Site 40) and if necessary, groundwater will be investigated and remediated separately from Site 17. Therefore, no RAOs for groundwater will be established.

Surface Water. Site 17 does not contain surface water. Therefore, RAOs for surface water will not be established.

Surface Soil. Chemical-specific ARARs and TBCs for surface soil were considered when identifying RAOs based on ARARs. The State of Florida has promulgated SCTLs under the Contaminant Cleanup Criteria Rule (FAC 62-777). And USEPA Region III published RBCs for ingestion of soil. Table 2-2 provides a summary of the detected concentrations for COCs with an ELCR of greater than $1x10^{-6}$ or an hazard quotient (HQ) greater than 0.1 and their respective Florida SCTLs and USEPA Region III RBCs.

Organic analytes detected in surface soil samples consist of seven VOCs, four SVOCs, and TRPH. Five VOCs (ethylbenzene, methylene chloride, toluene, trichloroethene, and total xylenes) and one SVOC (naphthalene) exceeded Chapter 62-777, FAC, leachability SCTLs. All of the VOC and SVOCs detected were below the State and Federal residential and industrial target levels. TRPH exceeded the Chapter 62-777, FAC residential, industrial, and leachability SCTLs. No pesticides or PCBs were detected in the surface soil samples collected from Site 17.

Ten inorganic analytes (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, manganese and vanadium) were detected at concentrations exceeding either USEPA Region III residential soil screening values or Chapter 62-777, FAC, residential and leachability SCTLs (Table 5-9).

Arsenic was the only inorganic detected at concentrations exceeding both USEPA Region III RBCs and Chapter 62-777, FAC, SCTLs for residential and industrial sites. Iron exceeded the Federal residential screening criterion (2,300 milligrams per kilogram [mg/kg] based on a non-hazardous risk multiplier of 0.1) in all 34 surface soil samples.

In response to the detection of TRPH and arsenic above screening criteria, the Navy conducted the IRA at Site 17. The IRA involved placing 2 feet of clean soil and a vegetative cover over the area shown in Figure 1-3. The extent of the soil cover was governed by site specific COC concentrations exceeding Florida industrial SCTLs and confirmation samples collected during the IRA.

Table 2-2
Summary of Chemicals Exceeding ARARs and TBCs in Surface Soil

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Analyte	Frequency of Detection[1]	Range of Detected Analyte Concentrations	Mean Analyte Concentration[2]	Background Screening Values	Florida Soil Cleanup Target Level[5] Residential/ Industrial/Leachability	USEPA Region III RBCs[6] Residential/Industrial
Inorganic Analytes (mg/kg)						
Aluminum	35/47	4,500 to 29,900	13,700	19,580	72,000/---/SPLP	7,800/200,000
Arsenic	23/47	0.29 to 5.9	2.2	3.6	0.8/3.7/29	0.43/3.8
Iron	47/47	2,550 to 23,800	7,740	11,172	23,000/480,000/SPLP	23,000/610,000
TRPH (mg/kg)						
TRPH	38/47	2.3 to 19,300	3,090	NA	340/2,500/340	NA

[1] Frequency of detection is the fraction of total samples analyzed in which the analyte was detected.
[2] The mean of detected concentrations is the arithmetic mean of all environmental samples in which the analyte was detected, including duplicate samples. The arithmetic mean does not include those environmental samples in which the analyte was not detected.
[3] Source: Contaminant Cleanup Criteria Rule, Chapter 62-777, F.A.C., July 1, 1999.
[4] USEPA Region II Risk-Based Concentrations (RBCs) for soil ingestion based on an excess lifetime cancer risk of $1x10^{-6}$ or an adjusted hazard quotient of 0.1, 1998.

Notes: ARAR = applicable or relevant and appropriate requirement.
NA = Not available
FDEP = Florida Department of Environmental Protection.
TBC = to be considered guidance material
TRPH = Total Recoverable Petroleum Hydrocarbons.

The human health risk assessment (HHRA), completed for Site 17 prior to the completion of the IRA, evaluated risks to current and future users of the site.

For the current land- use scenario, the cancer risks associated with exposure to surface soil (ingestion, dermal contact, and fugitive dust inhalation) are 4×10^{-7} for an aggregate (combined adult and adolescent) trespasser and 1×10^{-7} for a site maintenance worker. The cancer risk values for both receptors are below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000 and FDEP target risk level of 1 in 1,000,000. The noncancer risks associated with surface soil ingestion, dermal contact, and fugitive dust inhalation exposure pathways under current land use (adolescent trespasser, adult trespasser, and site worker) are below USEPA's target HI of 1.

The cancer risks associated with exposure to surface soil ingestion, dermal contact, and fugitive dust inhalation under hypothetical future land use are 7×10^{-6} for an aggregate resident (combined adult and child), 4×10^{-7} for an aggregate trespasser (combined adult and adolescent), 8×10^{-7} for an occupational worker, 1×10^{-7} for a site maintenance worker, and 3×10^{-8} for an excavation worker under hypothetical future land use. All of these hypothetical future receptor risks are within or below the USEPA acceptable cancer risk range; however, the hypothetical future residential risk exceeds the Florida level of concern of 1×10^{-6} (due to arsenic).

However, a portion of Site 17 was remediated to eliminate exposure to surface soils that posed an unacceptable risk to human receptors at the site. The remedial action involved placing a two-foot thick soil cover over approximately 50% of the site. Risks to ecological receptors were recalculated utilizing data from sample locations that were not covered during the remediation activities. During the reevaluation of ecological risks a hot spot was identified, at sample location 17-SL-29. Elevated concentrations of cadmium and chromium, the primary risk drivers for ecological receptors (i.e., small mammals and small birds) were detected at this location. Surface soil analytical data from the unremediated area, excluding data from location 17-SL-29 were summarized and new RME and CT concentrations were calculated for cadmium and chromium (see Table 2-3). These new estimated exposure concentrations were used in the food web model to recalculate risks to representative wildlife receptors (see Table 2-4). The site area was also reduced from 4 acres to 2 acres, to account for the area of the site that was left uncovered.

Table 2-3
Recalculated Cadmium and Chromium Concentrations

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

	RME (mg/kg)	CT (mg/kg)	Notes
Cadmium	1.1	0.66	RME is arithmetic 95th UCL on mean
Chromium	17	13	RME 95th UCL by Land's method

Notes: RME: Reasonable Maximum Exposure
CT: Central Tendency
mg/kg: milligrams per kilogram

The ecological risk assessment originally concluded that there would be no lethal effects from exposure to RME concentrations. The HIs presented in the first column of Table 2-4, represent results using recalculated cadmium and chromium RME concentrations. In the original evaluation, sublethal impacts were identified for small mammals and small birds, based on RME and CT concentrations. The recalculated HIs are

presented in the second and third columns of Table 2-4. These HIs were derived utilizing the recalculated RME and CT concentrations for cadmium and chromium presented in Table 2-3.

Based on the results presented in Table 2-4, risks to small birds would be significantly reduced if covering or removing contamination at sample location 17-SL-29 occurs. The HIs for small birds only slightly exceed 1, based on RME concentrations, and HIs based on CT concentrations are equal to or less than 1. Risks to small mammals would also be reduced, by addressing contamination at sample location 17-SL-29, with all HIs for small mammals less than 5.

Table 2-4
Summary of Hazard Indices (HIs) for Representative Wildlife

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

	Lethal Effects from Exposure to RME Concentrations	Sublethal Effects from Exposure to RME Concentrations	Sublethal Effects from Exposure to CT Concentrations
Cotton mouse	0.32	3.6	2.2
Mourning dove	0.0078	1.7	1.0
Short-tailed shrew	0.79	4.9	3.1
Eastern meadow lark	0.037	1.2	0.74
Red fox	0.0013	0.014	0.0078
Red-tailed hawk	0.000013	0.0054	0.0032

Cadmium is the primary risk driver for the cotton mouse. The background concentration for cadmium is 0.58 mg/kg, which is consistent with the CT concentration and is greater than half the RME concentration, 0.66 and 1.1 mg/kg, respectively. The primary risk drivers for the short-tailed shrew are chromium (RME and CT exposures) and zinc (RME exposure, only). The background concentration of chromium is 14 mg/kg, which is consistent with the RME and CT concentrations, 17 and 13, respectively. The HQ for zinc, based on RME concentration slightly exceeded one for the short-tailed shrew. However, the HQ for zinc, based on CT concentrations was less than 1. Therefore, based on the relatively low magnitude of HIs (i.e., less than five for RME and CT concentrations) and the consistency between background and RME and CT concentrations, population level impacts to small mammals, following remediation in the vicinity of 17-SL-29, are considered unlikely.

Based on information presented above, an RAO to address human exposure to arsenic and TRPH in soils at Site 17 will be identified.

> **RAO 1:** Address surface soil containing arsenic and TRPH contamination exceeding action levels at Site 17.

Subsurface Soil. Chemical-specific ARARs and TBCs for subsurface soil were considered when identifying RAOs. The cancer risks associated with excavation worker exposure to subsurface soil via ingestion, dermal contact, and fugitive dust inhalation, under hypothetical future land use, is 6×10^{-8}. The cancer risk is below the USEPA cancer risk range and FDEP target risk level.

The noncancer risk associated with subsurface soil ingestion, dermal contact, and fugitive dust inhalation exposure pathways, under future land use for a hypothetical excavation worker, is below USEPA's and FDEP's target HI of 1. Therefore no RAO will be established for subsurface soils at Site 17.

As noted in the surface soil discussions above, surface soils with TRPH concentrations above industrial SCTLs were covered with 2 feet of clean soil during the IRA. Direct exposure to these soils will only occur in the event of intrusive work at the site. In order to address the risk posed by this direct exposure, the following RAO is established:

> **RAO 2:** Address possible future risk of direct exposure to subsurface soil to an excavation worker at Site 17.

Summary of RAOs. Two RAOs have been established for Site 17. Table 2-5 lists these RAOs.

Table 2-5
Summary of Remedial Action Objectives for Site

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Remedial Action Objective	Description
1	Address surface soil containing arsenic and TRPH contamination exceeding action levels at Site 17.
2	Address the possible future risk of direct exposure to subsurface soil to an excavation worker at Site 17.

2.3 VOLUME OF CONTAMINATED MEDIA.

Soil is the only media at Site 17 for which RAOs have been established. Therefore, this section presents the basis for the calculation of the volume of soil containing COCs above the action levels at Site 17. Appendix C contains calculations and supporting information used to develop the soil volume. The sampling locations where chemical concentrations exceeded their respective SCTLs are also presented in Appendix B.

Volume calculations for soil removal include the 2-foot thick constructed soil cover and the 2-foot thick original contaminated surface soil layer.

2.4 IDENTIFICATION OF GENERAL RESPONSE ACTIONS.

General response actions describe potential medium-specific measures that may be employed to address the RAO. Potential response actions for CERCLA sites include the following general response categories:

- no action
- limited action
- containment
- treatment (either *in situ* or *ex situ*)
- disposal

3.0 REMEDIAL ACTION ALTERNATIVES

The approach and rationale leading to the development of remedial alternatives for Site 17 are presented in this chapter. The development of remedial alternatives for CERCLA sites consists of identifying applicable technologies, screening those technologies, and using the selected technologies to develop remedial alternatives that accomplish the RAOs identified in Chapter 2.0.

The NCP requires that a range of remedial alternatives be considered and SARA emphasizes the use of treatment technologies. Treatment alternatives range from those that eliminate the need for long-term management to those that reduce toxicity, mobility, or volume of contaminants. The range of alternatives considered in this FS include technologies from the following categories:

- no action
- limited action
- containment
- treatment
- disposal

In the following sections, technologies that contribute to achieving the RAO is identified and evaluated. Next, alternatives are developed using the selected technologies. A detailed evaluation of remedial alternatives is presented in Chapter 4.0.

3.1 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES.

The purpose of this section is to identify and screen appropriate technologies for assembly into remedial alternatives that address the RAO identified for Site 17. Each technology is then screened based on site- and waste-limiting characteristics.

Site characteristics considered during this process included the following:

- site geology, hydrogeology, and terrain;
- availability of space and resources necessary to implement the technology; and
- presence of special site features (e.g., wetlands, forest areas, floodplains, or endangered species).

Based on the review of site characteristics, no special site features or characteristics exist at Site 17that would preclude any remedial technology from implementation.

The following waste characteristics were also considered:

- contaminated media,
- types and concentrations of waste constituents, and
- physical and chemical properties of the waste (e.g., volatility, solubility, and mobility).

Table 3-1 presents and screens the remedial technologies applicable for addressing the RAO. The technology screening process reduces the number of potentially applicable technologies by evaluating the applicability of each technology to site- and waste-limiting factors. Technologies deemed ineffective or not implementable (such as physical or chemical treatment technologies) were eliminated from Table 3-1. The remaining technologies are assembled into remedial alternatives in Section 3.2.

Several alternatives propose to manage COCs in soil through limited action or containment. For these alternatives, long-term groundwater monitoring may be necessary. Because groundwater assessment and monitoring will be presented under a facility-wide groundwater RI/FS designated Site 40, groundwater monitoring will not be included as a component in any alternatives for this FS. Furthermore, if groundwater

Table 3-1
Identification and Screening of Remedial Technologies

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

General Response Action And Technology	Description of Technology	Applicability to:		Screening Status
		Site Characteristics	Waste Characteristics	
No Action				
No action	No remedial actions are taken at Site 18. Five-year site reviews would be required.	Applicable.	Applicable.	Retained. This alternative is retained for a baseline for comparison with other alternatives as required by CERCLA.
Five-year site reviews	Under CERCLA, if wastes are left on a site after closure, the site should be reviewed every 5 years.	Applicable.	Applicable.	Retained. This alternative is retained based on the CERCLA requirement that if wastes remain on site after closure, a review of the site must be completed every 5 years.
Limited Action				
Land-use controls (LUC)	Use of LUC documents to maintain the site for non-residential purposes.	Applicable.	Applicable.	Retained. This alternative is retained because it would achieve RAOs.
LUC Implementation Plan (LUCIP)	Identifies each LUC objective for Site 17and specifies actions required to achieve those objectives (i.e, install fencing, post warning signs). LUCIP includes a description of the disposal history and the status of the site conditions during inspections and sampling and analysis, if required.	Applicable.	Applicable.	Retained. This component would achieve RAOs.
Containment				
Soil Cover	Development of a closure plan for site monitoring and maintenance. Plan includes a description of the disposal history, status of the site conditions during inspections and sampling, and effectiveness of the cover design.	Applicable.	Applicable.	Eliminated. This was completed during the IRA.

See notes at end of table.

Table 3-1 (Continued)
Identification and Screening of Remedial Technologies

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

General Response Action and Technology	Description of Technology	Applicability to:		Screening Status
		Site Characteristics	Waste Characteristics	
Containment (Continued)				
Groundwater Monitoring	Sampling and analysis of the upgradient, downgradient, and crossgradient wells at Site 17 to assess whether COCs in surface soil are leaching into groundwater over time.	Applicable.	Not applicable. COCs in soil may leach into groundwater.	Eliminated. Groundwater monitoring will be addressed separately on a facility-wide basis (designated Site 40).
Soil Stabilization	Soils are mixed with an additive, such as a reactive chemical or concrete, to bind specific analytes chemically or physically with soil particle. This technology eliminates migration of contaminants from soil. The process can be performed *in situ* or *ex situ*.	Applicable.	Applicable.	Eliminated. This alternative would not achieve the RAOs, and significant arsenic migration from Site 17 is not expected.
Disposal				
Excavate Soil	Surface soil is excavated to a depth of 4 feet in contaminated areas.	Applicable. Site is accessible for removal or excavation activities.	Applicable. Constructed soil cover and underlying "hot spots" have been identified where soil containing COCs above action levels would be removed.	Retained. Would achieve RAOs and eliminate risks to human health and ecological receptors.
Offsite Soil Disposal:				
RCRA Subtitle D Solid Waste Landfill	Excavated soil is sampled and analyzed for waste classification. Soil is transported to a non-hazardous, solid waste landfill based on analytical results from excavated soil.	Applicable.	Applicable. Analytical results from the RI indicate that the soil would not be classified as hazardous.	Retained. Would achieve RAOs and eliminate risks to human health and ecological receptors.
RCRA Subtitle C Hazardous Waste Landfill	Excavated soil is sampled and analyzed for waste classification. Soil is transported to a hazardous, solid waste landfill based on analytical results from excavated soil.	Applicable.	Not Applicable. Analytical results from the RI indicate that the soil would not be classified as hazardous.	Eliminated.

Notes: CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
RAO = remedial action objective.

monitoring is deemed necessary under Site 40 RI/FS alternatives, would not interfere with any of the proposed soil remedial alternatives.

3.2 REMEDIAL ALTERNATIVES.

Remedial technologies that passed the technology screening are assembled into alternatives that meet the RAOs. Table 3-2 presents the alternative development for Site 17. The alternatives were developed to address closure of the crash crew training areas in accordance with ARARs.

Based on the applicable technologies identified in the preceding section, three remedial alternatives were developed. These alternatives are options under the no action, limited action, and disposal general response categories. The no action alternative was developed to provide a baseline for comparison with other alternatives (USEPA, 1988).

3.2.1 Alternative 1: No Action

The NCP requires the development of the no action alternative to provide a baseline for comparison against other remedial alternatives. This alternative does not involve the implementation of any remedial technologies to treat wastes. Under CERCLA Section 121(c), any remedial action that results in hazardous substances, pollutants, or contaminants remaining on site must be reviewed at least every 5 years. The 5-year site review typically involves an administrative review of site records. For this FS, Alternative 1 would include 5-year reviews for a period of 30 years. A period of 30-years was chosen for costing purposes only. The alternatives developed for Site 17 are discussed in the following subsections.

3.2.2 Alternative 2: Land-Use Controls

Alternative 2 consists of activities necessary to maintain land-use controls at the Site 17 crash crew training area. These activities are:

- development and implementation of land-use controls,
- 5-year site reviews.

Land-use controls restricting the use of the land in the vicinity of a site and placing regulatory controls on excavation of soil would be drafted, implemented, and enforced in compliance with local regulations as a part of this alternative. The land-use controls will be placed on the parcel of land encompassing the site, including a typical buffer zone, as is currently used at other sites in the State.

Under CERCLA Section 121(c), any remedial action that results in hazardous substances, pollutants, or contaminants remaining on site must be reviewed at least every 5 years.

3.2.3 Alternative 3: Soil Removal and Disposal

One disposal alternative developed for Site 17 consists of off-site disposal of the contaminated soil. Prior to soil removal composite samples would be collected from the site to characterize the soil for off-site disposal. After the soil is taken to off-site disposal areas, the excavation area would be backfilled with clean fill and topsoil. The fill material and topsoil would be transported from a nearby off-site borrow source using dump trucks and tractor-trailers. The backfill would be spread across each excavated area using a bulldozer. Once in place, the soil layer would be seeded.

Table 3-2
Development of Remedial Alternatives

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Alternative	Description of Key Components
Alternative 1: No action	Five-year site reviews.
Alternative 2: Land-Use Controls	Land-Use Controls including LUC Implementation Plan (LUCIP). Five-year site reviews.
Alternative 3: Soil Removal and Disposal	Excavate soil. Sample and analyze excavated soil for waste classification. Confirmatory sampling of open excavation areas. Backfill excavation with clean fill. Establish vegetative cover. Five-year site reviews.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

This chapter presents detailed analyses of alternatives for Site 17 at NAS Whiting Field. A detailed analysis is performed to provide decision makers with sufficient information to select the appropriate remedial alternative for a site. The detailed analysis has been conducted in accordance with CERCLA Section 121, the NCP, and USEPA RI/FS Guidance (USEPA, 1988). The detailed evaluation of each remedial alternative includes the following:

- a detailed description of the alternative, emphasizing the applications of the technology or actions proposed for each alternative; and

- a detailed analysis of the alternative against seven of the nine CERCLA criteria.

The remedial alternatives are examined with respect to the requirements stipulated by CERCLA and factors described in the USEPA's *Guidance for Conducting RI/FS Under CERCLA* (USEPA, 1988). The nine criteria from the RI/FS Guidance document are

- overall protection of human health and the environment,
- compliance with ARARs,
- long-term effectiveness and permanence,
- reduction of toxicity, mobility, and volume of contaminants through treatment,
- short-term effectiveness,
- implementability,
- cost,
- State acceptance, and
- community acceptance.

This FS presents evaluation of the first seven criteria in the alternative evaluation process. Table 4-1 outlines the specific elements considered for these seven criteria.

Typically, State acceptance (i.e., the eighth factor) is addressed when comments on the draft FS Report have been received from the State. Therefore, State comments will be addressed, and a response to State comments will be included in the Final FS Report.

Community acceptance (i.e., the ninth factor) is addressed upon receipt of public comments on the Proposed Plan (USEPA, 1988). The responsiveness summary, included as an appendix to the ROD for the site, is intended to provide the overview of achievement of this ninth criterion.

4.1 DETAILED ANALYSIS FOR ALTERNATIVE 1: NO ACTION.

Alternative 1 is a no action alternative. Under this alternative, no actions would be taken to address contamination at the site. A description of this alternative is presented in Subsection 4.1.1 and a technical assessment of this alternative is presented in Subsection 4.1.2.

4.1.1 Detailed Description of Alternative 1

In accordance with the NCP, the no-action alternative is used as a baseline for comparison against other alternatives. Because hazardous substances, pollutants, or contaminants would be left in place at Site 17, this alternative would include 5-year site reviews. Under this alternative, soil would remain in place, thus allowing natural processes to reduce the concentrations of organic COCs; however, concentrations of inorganic COCs would not be reduced. No other additional remedial or institutional controls would be implemented under this alternative. There would be no restrictions on land-use types; therefore, the site

could be used for residential, industrial, or commercial uses. Sample locations identifying inorganics as COPCs (ecological or human health) were covered with a 2-foot thick soil cover and sod during the IRA (Figure 1-3).

Table 4-1
Criteria for Evaluation of Remedial Action Alternatives

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Factors	Criteria to Consider
Overall protection of human health and the environment	How risks are eliminated, reduced, or controlled. Short-term or cross-media effects.
Compliance with ARARs	Compliance with chemical-specific ARARs. Compliance with location-specific ARARs. Compliance with action-specific ARARs.
Long-term effectiveness and permanence	Magnitude of residual risk. Adequacy of controls. Reliability of controls.
Reduction of mobility, toxicity, and volume of contaminants through treatment	Treatment process and remedy. Amount of hazardous materials destroyed or treated. Reduction of mobility, toxicity, or volume through treatment. Irreversibility of treatment. Type and quantity of treatment residual.
Short-term effectiveness	Protection of community during remedial action. Protection of workers during remedial action. Environmental effects. Time until RAOs are achieved.
Implementability	Ability to construct technology. Reliability of technology. Ease of undertaking additional remedial action, if necessary. Coordination with other agencies.
Cost	Capital cost. Operation and maintenance cost. Total present worth of alternative.

Notes: ARAR = applicable or relevant and appropriate requirement.
RAO = Remedial Action Objective.

Five-Year Site Reviews. Under CERCLA Section 121(c), any remedial action that results in hazardous substances, pollutants, or contaminants remaining on site must be reviewed at least every 5 years. It is assumed, for this FS, that these reviews would occur over a 30-year period. These reviews would consist of evaluating changes to site conditions at the site (e.g., construction, demolition, change in potential receptors, migration pathways, qualitative risks, etc.) to assess whether or not human health and the environment continue to be protected by the alternative. The appropriateness of this alternative would then be compared to other remedial alternatives to confirm that it is still the most appropriate selection.

4.1.2 Technical Criteria Assessment of Alternative 1

This subsection provides the technical criteria assessment of Alternative 1 against the seven criteria.

Overall Protection of Human Health and the Environment. This alternative would provide no additional protection to human or ecological receptors who may be exposed to soil at Site 17. If this alternative were selected, 5-year site reviews would be instituted. No adverse short-term or cross-media effects are anticipated with this no-action alternative.

Compliance with ARARs. This alternative would not comply with chemical-specific ARARs or TBCs (e.g., MCLs, Florida GCTLs, or Florida SCTLs) in the short term. Eventually, this alternative may comply with ARARs if natural processes including physical, chemical, and biological changes in the soil and groundwater reduce contaminant concentrations. However, this alternative would not comply with ARARs for arsenic concentrations in soil.

Long-term Effectiveness and Permanence. Land-use controls are not part of the alternative; therefore, human and ecological risks due to exposure to site soils would not be addressed via this alternative. Therefore, these risks would remain over a period of time until natural processes reduce the contaminant concentrations and reduce the mobility of the contaminants, or other land-use controls are implemented.

Administrative actions proposed in this alternative (e.g., 5-year site reviews) would provide a means of evaluating the effectiveness of the alternative, but would not provide a permanent remedy for the site. Administrative actions are considered to be reliable controls.

Reduction of Toxicity, Mobility, and Volume of Contaminants through Treatment. Although treatment is not included in this alternative, this alternative may provide some reduction in TRPH toxicity through natural degradation processes. No reduction in arsenic and cadmium toxicity is anticipated. This alternative would not provide a reduction in contaminant mobility or volume because active mitigation of contaminant mobility or reduction in volume is not proposed. On the other hand, treatment residuals would not be produced if this alternative were implemented.

Short-term Effectiveness. This alternative would not reduce human health risks in the short term because no land-use restrictions or active treatment would be implemented.

This alternative would not comply with RAOs in the short term because the only means of contaminant reduction is natural degradation processes for TRPH. No reduction in inorganic concentrations would be anticipated. This alternative does not pose a threat to workers through exposure to contaminated soil because remedial construction activities are not proposed under this alternative.

Implementability. This alternative does not require remedial construction for implementation. Other activities, such as 5-year site reviews are easily implemented.

Cost. The present worth cost of Alternative 1 is presented on Table 4-2. The cost includes 5-year site reviews over a 30-year monitoring period. A 30-year period was chosen because RI/FS guidance suggests using this timeframe when contaminants are left onsite. The total present worth cost of Alternative 1 is $19,000. Cost estimates are presented in Appendix C.

4.2 DETAILED ANALYSIS FOR ALTERNATIVE 2: LAND-USE CONTROLS.

Alternative 2 consists of LUC actions to limit the exposure to surface soil at Site 17. A description of this alternative is presented in Subsection 4.2.1 and a technical assessment of this alternative is presented in Subsection 4.2.2.

Table 4-2
Cost Summary Table, Alternative 1: No Action

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Operation and Maintenance Cost (O&M) (per event)	
5-year site review	$5,000
Total O&M cost (per event)	$5,000
Total O&M cost (present worth of semi-annual O&M for 30 years)	$17,000
Contingency (10 percent)	$2,000
Total cost Alternative 1: no action	$19,000

Notes: Cost are rounded to the nearest $1,000. See Appendix C for cost details.
Total costs are based on present worth costs.

4.2.1 Detailed Description of Alternative 2

Under this alternative, land-use controls would be implemented to provide protection of human receptors. land-use controls would involve the use of institutional controls that would restrict the use of the land in the vicinity of Site 17. Land-use controls would place regulatory controls on the excavation of soil or similar activities that have the potential to disturb the site soil or increase the likelihood of exposure to the site soil.

The land-use control would be placed on a parcel of land slightly larger than the boundaries of Site 17. This would ensure that an appropriate buffer zone is created and maintained between the disposal areas and other areas of NAS Whiting Field. Warning signs stating restricted access would be posted to discourage trespassing.

Land-use controls would remain in place until the level of contamination at the sites has been adequately addressed. As part of this alternative, a quarterly site inspection program would be established to insure that compliance with the agreed upon land-use controls is maintained. The results of these inspections would be summarized in quarterly reports and an annual report provided to appropriate parties. The inspection and reporting activities would be performed as long as the land-use controls are in place. The following components would be included as part of this alternative:

- Land-Use Controls
- 5-year site reviews

Land-Use Controls. Under new USEPA Region IV guidance (USEPA, 1998), the use of land-use controls as a remedy for contaminated sites requires the development of land-Use Control Implementation Plan (LUCIP). These documents detail the actions required when land-use controls are selected as a remedy for a site.

The LUCIP is developed for each site where land-use controls are necessary on the facility. The LUCIP would include details regarding additional required activities, such as quarterly and annual inspection and reporting for the specific area. These activities are required as part of the LUC agreement to insure compliance, while the land-use controls for the sites are in effect. Further, as land-use controls will remain in effect until the contamination at the sites has been adequately addressed, the activities identified in the LUCIP will also remain in effect until such time that the contamination present at the sites has been adequately addressed.

5-Year Site Reviews. Refer to Subsection 4.1.1 for a detailed description of these reviews.

4.2.2 Technical Criteria Assessment of Alternative 2

This subsection presents the technical criteria assessment of Alternative 2.

Overall Protection of Human Health and the Environment. Human receptors would be protected if this alternative were implemented. Regulatory controls (i.e., land-use controls) would prohibit potential future residents from exposure to the site because residential use of the site would be restricted under the proposed land-use controls. Based on data presented in the RI report, this alternative would not provide protection for ecological receptors at the site. However, the sublethal risk to small mammals and birds from the ingestion of cadmium in surface soil was reduced when a soil cover was placed over the site.

Compliance with ARARs. This alternative would not comply with chemical-specific ARARs or TBCs (e.g., MCLs, FGCTLs) in the short term. Eventually, this alternative may comply with ARARs for TRPH if natural processes in the soil reduce organic contaminant concentrations. Reduction of arsenic concentrations are not expected; therefore, ARARs would not be achieved.

Long-term Effectiveness and Permanence. Naturally occurring processes, such as biological activity, may reduce organic contaminant concentrations (TRPH) in the soil over the long term but would not reduce arsenic concentrations. The risks presented to the future resident based on exposure to surface soil at the site would be addressed via the land-use controls. The long-term effectiveness and permanence of these controls will be controlled by the facility under the MOA developed for NAS Whiting Field.

Administrative actions proposed in this alternative (e.g., Land-use controls and 5-year site reviews) would provide a means of evaluating the effectiveness of the alternative. These administrative actions are considered to be reliable controls.

Reduction of Toxicity, Mobility, and Volume of Contaminants through Treatment. Although treatment is not included in this alternative, this alternative may provide some reduction in TRPH toxicity through natural degradation processes. No reduction in arsenic toxicity is anticipated; however arsenic can form low solubility metal arsenates. This alternative would not provide a reduction in contaminant mobility or volume because active mitigation of contaminant mobility or reduction in volume is not proposed. On the other hand, treatment residuals would not be produced if this alternative were implemented.

Short-term Effectiveness. This alternative would reduce human health risks in the short term by reducing the potential exposure to Site 17 soil by human receptors. Furthermore, the threat to trespassers is considered to be minimal. Access to the base is restricted and continued operation of the base is expected. Additionally, the site is remote (i.e. far from base housing).

This alternative does not pose a threat to workers through exposure to contaminated soil because no construction activities are proposed under this alternative.

Implementability. This alternative does not require remedial construction for implementation. Other activities, such as land-use controls, and 5-year site reviews, are easily implemented.

Cost. The present worth cost of Alternative 2 is presented on Table 4-3. Both the land-use controls and 5-year site reviews were costed over a 30-year monitoring period. A 30-year period was chosen because RI/FS guidance suggests using this timeframe where COCs remain onsite. The total present worth cost of Alternative 2 is $135,000. Cost estimates are presented in Appendix C.

4.3 DETAILED ANALYSIS FOR ALTERNATIVE 3: SOIL REMOVAL AND DISPOSAL.

Alternative 3 includes remedial actions to excavate the constructed soil cover and other site areas exceeding residential SCTLs and dispose of the excavated soil at an FDEP-approved and permitted disposal facility. A description of this alternative is presented in Subsection 4.3.1 and a technical criteria assessment of this alternative is presented in Subsection 4.3.2.

4.3.1 Detailed Description of Alternative 3

Under this alternative, the top 4 feet of soil from the constructed soil cover (2 feet of soil cover and 2 feet of original surface soil) and 2 feet of soil from other site areas exhibiting exceedance of residential SCTLs would be excavated, sampled and analyzed, transported and disposed at an approved offsite disposal facility. Based on the low COC concentrations in surface soil during the RI, the excavated soil would most likely be suitable for disposal at a Subtitle D (non-hazardous, solid waste) facility. Excavation and offsite disposal of the contaminated surface soil would eliminate COC exposure to humans and ecological receptors in Site 17 soil.

Table 4-3
Cost Summary Table, Alternative 2: Land-Use Controls

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Direct Cost		
Land-use controls		$12,000
	Total direct cost	$12,000
Operation and Maintenance Cost (O&M) (per event)		
5-year site review		$ 5,000
Inspection/Reporting		$7,000
	Total O&M cost (per event)	$ 12,000
	Total O&M cost (present worth of semi-annual O&M for 30 years)	$111,000
	Total Direct and O&M	$123,000
	Contingency (10 percent)	$12,000
	Total cost Alternative 2: Land-Use Controls	$135,000

Notes: Costs are rounded to the nearest $1,000. See Appendix C for cost details.
The cost of the IRA soil cover was $102,000.
Total costs are based on present worth costs.

The following components of this alternative include:

- mobilization and site preparation
- excavation and stockpiling surface soil
- soil sampling and analysis
- transportation and offsite disposal
- site restoration
- Five-year site reviews

These activities are discussed in the following sections.

Mobilization and Site Preparation Under this alternative, heavy equipment such as a front end loader and backhoe would be mobilized to the site. Mobilization and site preparation would include all activities and construction prior to excavating surface soil. Since there is no electrical power or water supply at Site 17, a

portable generator and a high pressure washer with water tank would be mobilized to the site to supply power and water during decontamination procedures. A temporary decontamination area would be constructed at the site. Equipment and vehicles used during site preparation, excavation, and soil sampling would be steam-cleaned and decontaminated at this location.

A staging area for excavated soil would be constructed on site using 2 layers of 6-millimeter plastic sheeting as lining.

Excavating and Stockpiling of Soil The constructed soil cover and pre-construction surface soil areas will be excavated to a depth of 4 feet and 2 feet respectively below surface and stockpiled for waste characterization. The excavation area is shown in Appendix B and is approximately 130,000 ft^2. The total volume of soil removed for disposal is approximately 14,150 cubic yards (16,980 tons).

Soil Sampling and Analysis A soil sampling and analysis plan would be developed for two reasons: (1) to characterize the excavated soil for offsite disposal and (2) to confirm COC removal from the open excavation areas. To meet offsite disposal requirements, stockpiled soil samples would be analyzed for hazardous waste characteristics (TCLP metals, VOCs, SVOCs, pesticide/herbicides) and TRPH. In addition, composite soil samples would be collected from the bottom of the open excavation areas to confirm contaminant removal. Confirmatory soil samples would be collected and analyzed for COCs (i.e., arsenic and TRPH).

Transportation and Offsite Disposal Based on the relatively low concentrations of COCs in surface soil (Table 2-2), it was assumed that the excavated soil would be characterized as nonhazardous and would be disposed of in a nonhazardous, solid waste landfill (RCRA Subtitle D Landfill). Excavated soil would be loaded onto DOT-approved transport vehicles or rolloff containers (22 ton load capacity) and transported to an FDEP-approved Subtitle D landfill.

Site Restoration and Demobilization Once contaminated soil has been removed, the excavation area would be backfilled with clean fill and topsoil. The fill material and topsoil would be transported from a nearby offsite borrow source using dump trucks and trailers and the top 2 feet of soil form the IRA soil cover area will also be used as backfill material. The material would be spread across the excavated areas using a front-end loader. Once the excavation areas have been backfilled, the areas would be seeded and fertilized to promote vegetative growth. Hay would be used to protect the seed and fertilizer during initial development. Decontamination water generated during implementation of this alternative would be sampled and either discharged on the ground at Site 17 or transported to the NAS Whiting Field FOTW for treatment. The storage trailer, heavy equipment, miscellaneous equipment and tools used during the implementation of this alternative would be demobilized.

Five Year Site Reviews Five year site reviews would be conducted to assess the effectiveness of this alternative. Refer to Alternative 1 for a description of this component.

4.3.2 Technical Criteria Assessment of Alternative 3

This subsection presents the technical criteria assessment of Alternative 3.

Overall Protection of Human Health and the Environment. This alternative would minimize human and ecological exposure to COCs in Site 17 surface soil because the hot spot soil areas would be excavated and disposed offsite. Soil, where concentrations of COCs are above the FDEP SCTLs, would be removed from the site and the resulting excavation would be backfilled with clean fill. As a result, risks posed to human and ecological receptors by exposure to contaminated surface soil would be minimized.

Compliance with ARARs. It is expected that source excavation, transportation and disposal, and backfilling activities would comply with ARARs (see Section 2.1).

Worker safety standards will be maintained during remedial activities to comply with ARARs. A site-specific health and safety plan will be developed and implemented during all site activities.

Long-Term Effectiveness and Permanence. This alternative is expected to provide long-term effectiveness and permanence by excavation and offsite disposal of hot spot contaminated surface soil. A five-year site review will be used to assess changes in site conditions to ensure long-term effectiveness and permanence. Alternative 3 can be viewed as a permanent method of reducing human health and ecological risks posed by ingestion of contaminated surface soil by excavation and removal of hot spot soil areas.

Reduction of Toxicity, Mobility, and Volume of Contaminants through Treatment. Disposal of the excavated surface soil within an approved landfill would not reduce the toxicity, mobility, or volume of the waste because active treatment of the soil would not occur. However, the toxicity, mobility, and volume of waste would be reduced onsite for Site 17 surface soil because the waste would be transported and disposed at an approved offsite disposal facility.

Short-Term Effectiveness. Through implementation of this alternative, there would be an immediate reduction in risk to human health and the environment. During excavation and soil handling activities, site workers would wear appropriate personal protective equipment (PPE) for protection against exposure to site-related contaminants.

This alternative would also ensure the protection of non-site workers and trespassers immediately after backfilling the excavation with clean fill.

Implementability. This alternative is easily implementable. Equipment and materials are readily available for excavation and removal activities. Site work would be completed within a 2-month period, allowing for a 28-day turnaround time (TAT) for analytical results. If an expedited remedial action is required, this alternative can be completed within 2 to 4 weeks using an expedited TAT for analytical results.

Cost. The cost estimate for Alternative 3 is presented in Table 4-4 and detailed cost calculations are provided in Appendix C. O&M activities include a 5-year review and quarterly/annual reporting and inspections for a 30-year monitoring period. The total present worth cost of Alternative 3 is approximately $3,247,000.

Table 4-4
Cost Summary Table, Alternative 3: Soil Removal and Disposal

Feasibility Study
Site 17, Crash Crew Training Area
Naval Air Station Whiting Field
Milton, Florida

Direct Cost		
Mobilization		$8,000
Site Preparation and Clearing		$2,000
Excavating and offsite Transportation and Disposal (Subtitle D Landfill)		$2,174,000
Soil Sampling and Analysis		$37,000
Site Restoration and Vegetative Support Layer		$108,000
	Total direct cost	$2,329,000
Indirect Cost		
Health and safety (3 percent)		$70,000
Administration and permitting (3 percent)		$70,000
Engineering and design (10 percent)		$233,000
Construction support services (10 percent)		$233,000
	Total indirect cost	$606,000
	Total capital cost (direct + indirect)	$2,935,000
Operation and Maintenance (O&M) Cost (capitalized)		
5-year site review		$17,000
	Total O&M cost (capitalized)	$17,000
	Total Capital and O&M costs	$2,952,000
	Contingency (10 percent)	$295,000
	Total cost Alternative 3: Soil Removal and Disposal	$3,247,000

Notes: Costs are rounded to the nearest $1,000. See Appendix C for cost details.
Total costs are based on present worth costs.

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Remedial alternatives for Site 17 were developed in Chapter 3.0 and were individually evaluated in Chapter 4.0 using seven technical criteria. For comparative purposes, these criteria are grouped into the following categories:

- threshold criteria,
- primary balancing criteria, and
- modifying criteria.

This chapter presents a comparison of remedial alternatives with respect to these criteria. This comparison is intended to provide technical information required to support the selection of a preferred alternative for Site 17. It is anticipated that modifying criteria (i.e. State and community acceptance) will be used in conjunction with the information presented herein to select an appropriate remedial alternative for Site 17. The remainder of this chapter presents this comparison.

5.1 OVERALL APPROACH TO COMPARATIVE ANALYSIS.

As presented in Chapter 4.0, remedial alternatives were developed to accomplish the RAO identified for the site. The 3 sets of criteria identified above are used to streamline the comparison between alternatives while ensuring compliance with the RAO. Components of these criteria are described below.

5.1.1 Threshold Criteria

Because the selected remedy must be protective of human health and the environment, as well as comply with ARARs, the following two threshold criteria are essential:

- overall protection of human health and the environment, and
- compliance with ARARs.

An individual assessment of each alternative with respect to these criteria was presented in Chapter 4.0. An overall comparative analysis of alternatives using threshold criteria is presented in Section 5.2.

5.1.2 Primary Balancing Criteria

Primary balancing criteria consist of the following 5 components:

- long-term effectiveness and permanence;
- reduction of toxicity, mobility, and volume of contaminants through treatment;
- short-term effectiveness;
- implementability; and
- cost.

These criteria are used to provide an assessment of the permanence of each remedial alternative, while ensuring their implementability and cost-effectiveness. An individual assessment of each alternative with respect to these criteria is presented in Chapter 4.0. An overall comparative analysis of alternatives using primary balancing criteria is presented in section 5.2.

5.1.3 Modifying Criteria

The final two criteria are as follows:

- State acceptance, and
- community acceptance.

Typically, State acceptance (i.e., the eighth factor) is addressed when comments on the draft FS Report have been received from the State. Therefore, State comments will be addressed and a response to State comments will be included in the Final FS Report.

Community acceptance (i.e., the ninth factor) is addressed upon receipt of public comments on the Proposed Plan (USEPA, 1988). The responsiveness summary, included as an appendix to the ROD for the site, is intended to provide the overview of achievement of this ninth criterion.

Based on this information, an evaluation of modifying criteria is not included in this FS.

5.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES.

This section provides the comparative analysis for remedial alternatives for Site 17 with respect to the criteria described in Section 5.1. Alternatives presented in this FS include:

- Alternative 1: No Action
- Alternative 2: Land-Use Controls
- Alternative 3: Soil Removal and Disposal

5.2.1 Comparison of Threshold Criteria

The remedial alternatives for Site 17 were first compared to the two threshold criteria, overall protection of human health and the environment and compliance with ARARs.

Alternative 1 does not provide a means of restricting future land use of the area. Therefore, this alternative does not protect potential future residents from environmental conditions at the site. Alternative 1 would not achieve the RAO established for Site 17.

The implementation of Alternative 2 would provide a measure of continued protection of human health and the environment because the alternative includes land-use controls (including LUCIP). In this manner, Alternative 2 would achieve the RAOs established for the site and would also achieve ARARs.

Alternative 3 would achieve the RAOs through removal of the previously constructed soil cover and other site areas and provide a measure of continued protection of human health and the environment. In this manner, Alternative 3 would achieve the RAOs established for the site and would therefore achieve ARARs. Implementation of Alternative 3 may have potential short-term effects of exposure to site workers.

Because the implementation of Alternative 3 would achieve the RAOs and eliminate COC exposure in surface soil as opposed to leaving COCs in surface soil, Alternative 3 is the best alternative in providing overall protection of human health and the environment. However, Alternative 3 will also require the removal of soil cover constructed during the IRA.

5.2.2 Comparison of Primary Balancing Criteria

A comparison is made between alternatives with respect to five criteria: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume; short-term effectiveness; implementability; and cost.

For long-term effectiveness, Alternatives 1 and 2 may reduce concentrations of TRPH through natural mechanisms, but unlikely for arsenic. Alternative 3 would provide long-term effectiveness by removing surface soil where COC concentrations exceed action levels established in the RAOs.

The alternatives evaluated for Site 17 would not reduce the toxicity or volume of contaminants at the site, as none of the alternatives involve treatment of contaminants in media at the site. On the other hand, Alternative 3 is the only alternative where offsite removal of contaminated surface soil would reduce the toxicity and volume onsite. Also, Alternative 3 would provide a reduction in the mobility (i.e., leaching) of contaminants from the soil; however, it does not appear that contaminants are currently leaching to the groundwater. In addition, groundwater at NAS Whiting Field has been identified as a separate site (Site 40), which will be investigated and remediated separately from Site 17.

The implementability of Alternatives 2 and 3 would be relatively easy. For Alternative 2 a LUCIP would need to be developed. The documents should be relatively easy to complete, but implementation of the land-use controls may be extended until agreement is reached among the regulatory agencies as to the format for these documents at NAS Whiting Field.

The relative present-worth cost estimates are shown below for each alternative. In accordance with USEPA guidance for contaminants left in place, the cost for Alternatives 1, 2, and 3 is based on a 30-year timeframe.

- Alternative 1: $19,000
- Alternative 2: $135,000
- Alternative 3: $3,247,000

As expected, Alternative 1, the no-action alternative, has the lowest estimated overall cost. Alternative 2 involves land-use controls and quarterly/annual inspections and reporting over 30 years and is the next lowest cost. Alternative 3 involves soil removal and disposal at a cost of $3,247,000.

5.2.3 Modifying Criteria

As stated in Subsection 5.1.3, an evaluation of modifying criteria will not be included in this FS.

REFERENCES

ABB Environmental Services, Inc. (ABB-ES). 1998a. *Remedial Investigation and Feasibility Study, General Information Report, Naval Air Station Whiting Field, Milton, Florida.* Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

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U.S. Department of Agriculture. 1980. *Soil Survey of Santa Rosa County, Florida.* Soil conservation Service. Washington, D.C.

U.S. Environmental Services Protection Agency (USEPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final.* Office of Solid Waste and Emergency Response. Washington, D.C. (October).

USEPA. Region IV. 1998. *Assuring Land-Use Controls at Federal Facilities.* Memorandum from Jon D. Johnston, Chief of Federal Facilities Branch to the Region IV Federal Facilities Branch.

APPENDIX A

RESPONSE TO AGENCY COMMENTS

Response to EPA Review Comments
Site 17, Crash Crew Training Area
Draft Feasibility Study

1. **Cover Page**. The EPA ID number should be included on the cover page both inside and outside.

   Response: The EPA ID number will be added to the cover page and the report title page.

2. **Glossary, Page –viii-**. The abbreviation "BRA" defined as "baseline risk assessment" should be included in the glossary. In the definition for "LUCIP", change the word "Installation" to "Implementation". The definition for "RA" should be "remedial action" instead of "risk assessment". These abbreviations should be changed throughout the document, accordingly, wherever they occur.

   Response: As suggested by the reviewer, the abbreviation "BRA" for "baseline risk assessment" will be included in the glossary. Also "CPC" will be changed to "COPC". In the definition for "LUCIP", the word "Installation" will be replaced by "Implementation". The report will be revised to reflect "RA" means "remedial action" and not risk assessment. These abbreviations will be changed throughout the document.

3. **Section 1.0, Page 1-1**. Change the word "Priority" to "Priorities" in the first sentence of the second paragraph.

   Response: The word "Priority" will be changed to "Priorities" in the first sentence of the second paragraph.

4. **Section 1.3, Page 1-5**. The second paragraph of this section should address why the interim action was conducted. The text discusses actions taken during the interim action without first providing a basis for the action.

   Response: The 2nd paragraph of this section will be revised to include the following information. "The IRA was conducted to address soil contamination due to the presence of TRPH and arsenic at levels in excess of federal and State industrial standards."

5. **Section 3.2.2, Page 3-4**. In the first full paragraph of this section, delete the words "such as LUC Agreements, LUCAP/LUCIP, or other documents". These documents are not considered LUCs but rather tools to implement LUCs.

   Response: In the first paragraph of this page, words "such as LUC Agreements, LUCAP/LUCIP, or other documents" will be deleted.

6. **Section 4.0, Page 4-1**. Delete the second sentence in the fourth paragraph. State comments are addressed in the final FS prior to a Proposed Plan being developed. A summary of State acceptance is not typically provided in the FS.

   Response: The 2nd sentence in the 4th paragraph will be revised to read as follows. "Therefore, State comments will be addressed and a response to State comments will be included in the Final FS Report."

7. **Table 4-2, 4-3, and Table 4-4**. Each of these tables should indicate that the total costs are present worth costs.

   Response: A note indicating the total costs are present worth costs will be added to Tables 4-2, 4-3, and 4-4.

8. **Section 5.1.3, Page 5-2**. The second sentence at the top of the page should be deleted. See Comment No. 6 above.

Response: The 2nd sentence at the top of Page 5-2 will be deleted.

Response to FDEP Review Comments
For Feasibility Study Report
Site 17, Crash Crew Training Area

1. It is not always clear in this document that a two-foot thick soil cover was placed on Site 17. This should be clearly stated early in the document. Additionally, replacing the present Figure 1-3 with figure requested in the RI review is desirable. To do so will help address many of my comments.

   Response: The placement of a 2-foot thick soil cover will be clearly stated in the FS on page 1-5 and 1-7. A figure (Figure 1-3), similar to the one requested for the RI report, will be included in the FS. This figure will depict the IRA soil cover boundary and analytical results.

2. Page 1-1, third paragraph: following "NAS Whiting Field," use "were" in place of "are."

   Response: The text revision will be made as requested.

3. Page 1-3: add a "bulleted" item that gives a summary description of the IRA that was accomplished. This should also be discussed in Section 1,2, Purpose, first paragraph.

   Response: A summary description of the IRA will be included on page 1-3 and in Section 1.2.

4. On page 1-5, next to the last line: change to read: "Additional IRA information follows and is presented in Appendix A."

   Response: The text revision will be made as requested.

5. Page 1-7, Section 1.4, Interim Actions, last paragraph: following "and 31C," add "and Figure X in Appendix Y of the RI" before "contains further details.." Note that "X" refers to the figure number requested in the RI review and "Y" refers to the appropriate appendix where Figure "X" was placed in the RI.

   Response: The text revision will be made as requested.

6. Page 1-7, Section 1.5, RI Summary: in the first "bulleted" paragraph, it is noted that leachability levels were exceeded for one SVOC and for TRPH. This is in apparent disagreement with the statement on the top of page 3-4 where it says; "it is highly unlikely that groundwater actions would interfere with any of the proposed soil remedial alternatives." I think the use of the term "highly unlikely" is marginal, given that leaching of SVOCs and TRPH may be a problem at the site. Please note also that in Table 3-1 on page 3-3, under Waste Characteristics related to Groundwater Monitoring, it states that COCs are *not* leaching into the groundwater; this has not been shown to be the case and should be corrected.

   Response: The last sentence of the referenced paragraph will be revised to read as follows. "Furthermore, if groundwater monitoring is deemed necessary under Site 40 RI/FS alternatives, it would not interfere with any of the proposed soil remedial alternatives."

   Table 3-1 will also be revised to indicate COCs may leach to groundwater.

7. Page 3-4, Section 3.2.2, discussion of Alternative 2 and Section 4.2.1 on page 4-4: whenever the LUCAP is discussed, the Navy should refer to it as the Memorandum of Agreement (MOA), in the present tense, not the future tense, since it has been adopted. LUCAP was the proper term before the MOA was adopted; however, that is past, and MOA should be used.

   Response: The text will be revised per USEPA comment No. 5. All references to LUCAP will be deleted.

8. Page 4-1, Section 4.1.1 and other following sections: the Navy should acknowledge that cadmium is (was, if you consider that the IRA covered the cadmium locations, which has not yet been shown to be the case) also a COC from an ecological standpoint. Since the ecological risk assessment noted significant risk that was attributed to cadmium, at some point (hopefully by referring to the figure that was requested in my review of the RI), it must be shown that this contaminant was properly addressed in the IRA. This circumstance should also be discussed in Section 4.1.2, page 4-3, Reduction of Toxicity, Mobility and Volume of Contaminants through Treatment and in the section on Short-term Effectiveness on page 4-3.

Response: Please see response to Comment 9. Also, a figure depicting all chemical data will be added to the FS report. Appropriate information will be added to Section 4.1.2 (Reduction, Toxicity, Mobility and Volume of Contaminants through Treatment) and in the section on Short-term Effectiveness.

9. Page 4-4, Section 4.2.2: the document should discuss and clearly state why Alternative 2 would not provide ecological protection. How will the Navy address this in the Proposed Plan, which I already know recommends alternative 2?

Response: A portion of Site 17 was remediated to eliminate exposure to surface soils that posed an unacceptable risk to human receptors at the site. The remedial action involved placing a two-foot thick soil cover over approximately 50% of the site. Risks to ecological receptors were recalculated utilizing data from sample locations that were not covered during the remediation activities. *During the reevaluation of ecological risks a hot spot was identified, at sample location 17-SL-29.* Elevated concentrations of cadmium and chromium, the primary risk drivers for ecological receptors (i.e., small mammals and small birds) were detected at this location. Surface soil analytical data from the unremediated area, excluding data from location 17-SL-29 were summarized and new RME and CT concentrations were calculated for cadmium and chromium (see Table 1). These new estimated exposure concentrations were used in the food web model to recalculate risks to representative wildlife receptors (see Table 2). The site area was also reduced from 4 acres to 2 acres, to account for the area of the site that was left uncovered.

Table 1. Recalculated Cadmium and Chromium Concentrations

	RME (mg/kg)	CT (mg/kg)	Notes
Cadmium	1.1	0.66	RME is arithmetic 95th UCL on mean
Chromium	17	13	RME 95th UCL by Land's method

RME: Reasonable Maximum Exposure
CT: Central Tendency
mg/kg: milligrams per kilogram

The ecological risk assessment originally concluded that there would be no lethal effects from exposure to RME concentrations. The HIs presented in the first column of Table 2, represent results using recalculated cadmium and chromium RME concentrations. In the original evaluation, sublethal impacts were identified for small mammals and small birds, based on RME and CT concentrations. The recalculated HIs are presented in the second and third columns of Table 2. These HIs were derived utilizing the recalculated RME and CT concentrations for cadmium and chromium presented in Table 1.

Response to FDEP Review Comments
For Feasibility Study Report
Site 17, Crash Crew Training Area

Based on the results presented in Table 2, risks to small birds would be significantly reduced if covering or removing contamination at sample location 17-SL-29 occurs. The HIs for small birds only slightly exceed 1, based on RME concentrations, and HIs based on CT concentrations are equal to or less than 1. Risks to small mammals would also be reduced, by addressing contamination at sample location 17-SL-29, with all HIs for small mammals less than 5.

Table 2. Summary of Hazard Indices (HIs) for Representative Wildlife

	Lethal Effects from Exposure to RME Concentrations	Sublethal Effects from Exposure to RME Concentrations	Sublethal Effects from Exposure to CT Concentrations
Cotton mouse	0.32	3.6	2.2
Mourning dove	0.0078	1.7	1.0
Short-tailed shrew	0.79	4.9	3.1
Eastern meadow lark	0.037	1.2	0.74
Red fox	0.0013	0.014	0.0078
Red-tailed hawk	0.000013	0.0054	0.0032

Cadmium is the primary risk driver for the cotton mouse. The background concentration for cadmium is 0.58 mg/kg, which is consistent with the CT concentration and is greater than half the RME concentration, 0.66 and 1.1 mg/kg, respectively. The primary risk drivers for the short-tailed shrew are chromium (RME and CT exposures) and zinc (RME exposure, only). The background concentration of chromium is 14 mg/kg, which is consistent with the RME and CT concentrations, 17 and 13, respectively. The HQ for zinc, based on RME concentration slightly exceeded one for the short-tailed shrew. However, the HQ for zinc, based on CT concentrations was less than 1. Therefore, based on the relatively low magnitude of HIs (i.e., less than five for RME and CT concentrations) and the consistency between background and RME and CT concentrations, population level impacts to small mammals, following remediation in the vicinity of 17-SL-29, are considered unlikely.

The text will be revised to indicate that ecological risks at Site 17 are unlikely.

APPENDIX B

VOLUME ESTIMATES FOR CONTAMINATED MEDIA

PROJECT	COMP. BY	JOB NO.
Site 17 FS- Draft Soil Volume calculations	RA CHK. BY	DATE 4/1/00

Area calculations completed by using a Planix 7 (Digital Planimeter)

- Site Area based on boundary presented on the attached figure is 130,000 ft^2.
- Area for IRA Soil Cover = 61,000 ft^2.

Volume calculations:

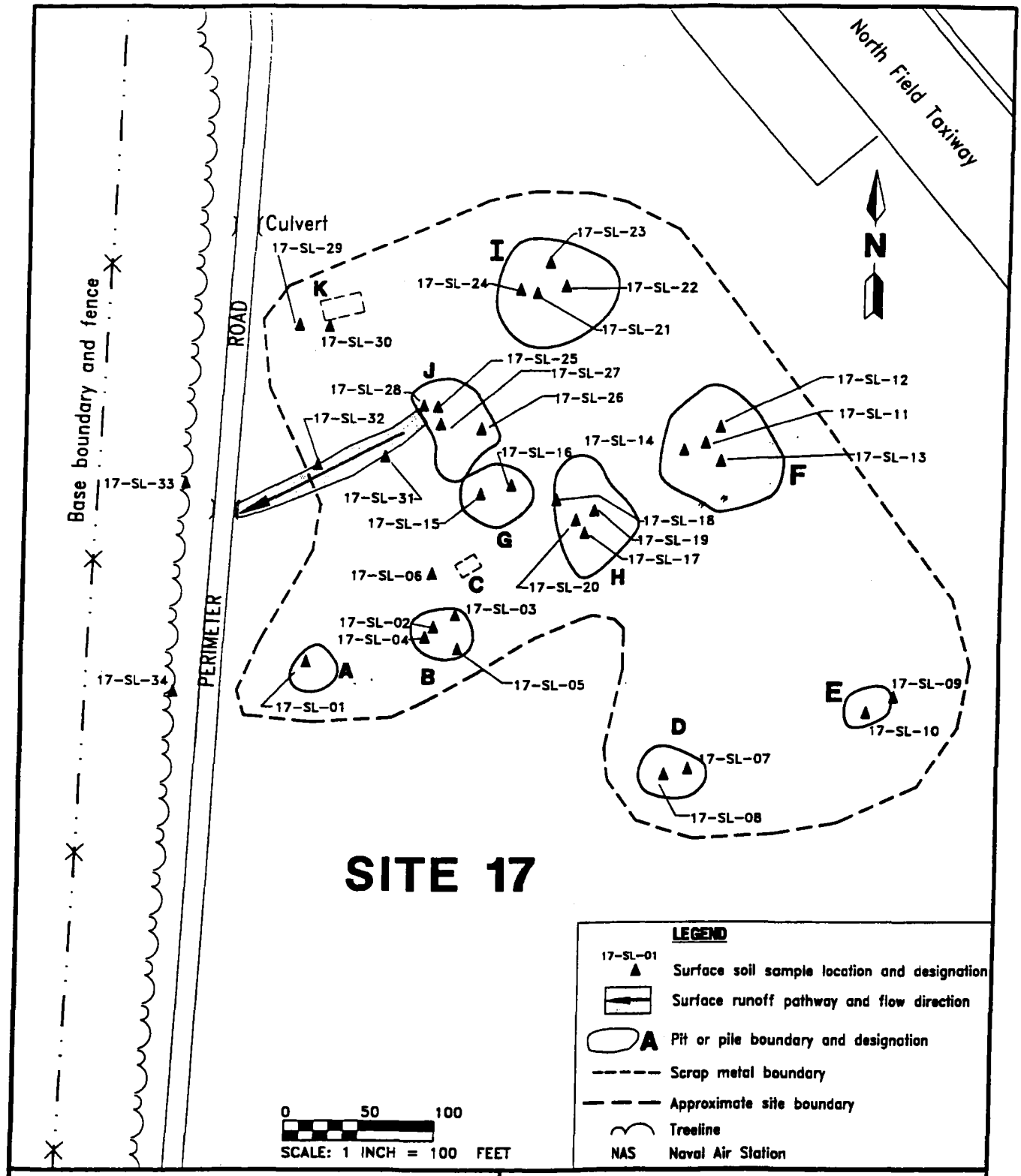
IRA Soil Cover Area - 61,000 x 4 = 244,000 ft^3
Assumed 4 feet depth. Upper 2 feet is Soil Cover and Soil from 2-4 feet is the original surface soil.

Remainder of Site - Volume = (130,000 - 61,000) x 2
= 138,000 ft^3.

The top 2 feet of soil from the IRA Soil Cover will be seperated and used as backfill.

Total Volume for disposal = (~~122,000~~ 244,000 + 138,000) ft^3
= ~~260~~,382,000 ft^3 = ~~9,600~~ 14,150 cubic yds
≈ ~~11,600~~ 16,980 tons.

[redacted]



Soil Volume Calculations

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SITE 17, CRASH CREW TRAINING AREA

NAS WHITING FIELD
MILTON, FLORIDA

APPENDIX C

COST CALCULATIONS FOR REMEDIAL ALTERNATIVES

ALTERNATIVE #1: NO ACTION, SITE 17

	Quantity	Unit	Unit Cost	Total Cost
FIVE YEAR SITE REVIEW COSTS				
Five-year Site Reviews (every 5 years for 30 years)				
Meetings (includes travel time)				
Senior Scientist	16	hrs	$90.00	$1,440
Mid-level Engineer	16	hrs	$60.00	$960
ODCs (includes per diem and rental car)	1	lump sum	$110.00	$110
Five-year Report				
Report				
Senior Scientist	15	hrs	$90.00	$1,350
Mid-level Engineer	20	hrs	$60.00	$1,200
ODCs (includes photocopying, etc.)	1	lump sum	$250.00	$250
Total 5-year costs				*$5,310*
Present Worth of 5-year costs at i=6%				*$17,352*
TOTAL FIVE YEAR SITE REVIEW COSTS				**$17,352**
CONTINGENCY @ 10 PERCENT				**$1,735**
TOTAL COST OF ALTERNATIVE #1				**$19,087**

ALTERNATIVE #2: LAND USE CONTROLS, SITE 17

	Quantity	Unit	Unit Cost	Total Cost
FIVE YEAR SITE REVIEW COSTS				
Five-year Site Reviews (every 5 years for 30 years)				
Meetings (includes travel time)				
Senior Scientist	16	hrs	$90.00	$1,440
Mid-level Engineer	16	hrs	$60.00	$960
ODCs (includes per diem and rental car)	1	lump sum	$110.00	$110
Five-year Report				
Report				
Senior Scientist	15	hrs	$90.00	$1,350
Mid-level Engineer	20	hrs	$60.00	$1,200
ODCs (includes photocopying, etc.)	1	lump sum	$250.00	$250
Total 5-year costs				*$5,310*
Present Worth of 5-year costs at i=6%				*$17,352*
TOTAL FIVE YEAR SITE REVIEW COSTS				**$17,352**
Land Use Controls (LUCs)				
Direct Costs				
Survey Plat	1	lump sum	$2,500.00	$2,500
Land Use Restriction Fees (Filling, Legal, etc.)	1	lump sum	$5,000.00	$5,000
Land Use Implementation Plan:				
Senior Scientist	20	hrs	$90.00	$1,800
Mid-level Engineer	40	hrs	$60.00	$2,400
ODCs (includes photocopying, etc.)	1	lump sum	$250.00	$250
Total Direct Costs for Land Use Controls				**$11,950**
Annual Operation and Maintenance (O&M) Costs				
Quarterly Inspection				
Senior Scientist	0	hrs	$90.00	$0
Mid-level Engineer	32	hrs	$60.00	$1,920
ODCs (per diem, rental vehicle, etc.)	1	lump sum	$320.00	$320
Quarterly Reporting				
Senior Scientist	8	hrs	$90.00	$720

Mid-level Engineer	32	hrs	$60.00	$1,920
ODCs (per diem, rental vehicle, etc.)	1	lump sum	$1,000.00	$1,000
Annual Reporting				
Senior Scientist	2	hrs	$90.00	$180
Mid-level Engineer	8	hrs	$60.00	$480
ODCs (per diem, rental vehicle, etc.)	1	lump sum	$250.00	$250
Total Annual Operation and Maintenance Costs				$6,790
Present Worth of Land Use Control costs at i=6%				*$93,464*
TOTAL LAND USE CONTROLS COSTS				**$105,414**
COST OF ALTERNATIVE #2				**$122,766**
CONTINGENCY @10 PERCENT				**$12,277**
TOTAL COST OF ALTERNATIVE #2				**$135,043**

Alternative 3: Soil Removal and Disposal, Site 17

	Quantity	Unit		Unit Cost		Total Cost
CAPITAL COSTS						
TOTAL DIRECT COSTS						
Mobilization						
Miscellaneous						
Storage Trailer	2	day	$	150.00	$	300.00
Trailer Delivery, Setup, Removal	1	each	$	300.00	$	300.00
Toilet/Water Cooler Service	0	day	$	50.00	$	-
Misc. Equipment	1	LS	$	2,500.00	$	2,500.00
Labor (Site Preparation)						
Foreman (1 man @ 2 days @ 10hrs/day)	20	hrs	$	60.00	$	1,200.00
Equipment (Mobilization)						
Dump Truck	3	each	$	250.00	$	750.00
Backhoe	2	each	$	250.00	$	500.00
Front End Loader	1	each	$	250.00	$	250.00
Portable Generator	1	each	$	50.00	$	50.00
Water Tank	1	each	$	250.00	$	250.00
Pressure Washer	1	each	$	250.00	$	250.00
Equipment (Mobilization)	1	LS	$	1,200.00	$	1,200.00
General Site Mobilization	1	LS	$	250.00	$	250.00
Mobilization					**$**	**7,800.00** ✓
Soil Sampling						
Soil Sampling and Analysis (Waste Characterization)						
Sampling Plan						
Mid-level Engineer/Scientist	16	hrs	$	75.00	$	1,200.00
ODCs	1	LS	$	250.00	$	250.00
Sample Collection						
Associate Scientist	30	hrs	$	60.00	$	1,800.00
Technician	30	hrs	$	40.00	$	1,200.00
ODCs, Sample Equipment, Supplies	1	LS	$	500.00	$	500.00
Waste Characterization and Clean Fill Analysis						
TCLP, Metals, VOCs, SVOCs, Pest/Herb, TRPH	40	each	$	800.00	$	32,000.00
Soil Sampling and Analysis					**$**	**36,950.00** ✓

Alternative 3: Soil Removal and Disposal, Site 17

Site Preparation

Labor (Site Preparation)						
Laborers (2 men @ 1 days @ 8 hrs/day)	16	hrs	$	36.00	$	576.00
Foreman (labor included in mobilization)						
Equipment and Disposal Costs						
Backhoe and Operator	1	days	$	1,200.00	$	1,200.00
Miscellaneous Tools	1	LS	$	300.00	$	300.00
Transport and Disposal - Misc. Debris	5	tons	$	69.00	$	345.00
Site Preparation					**$**	**2,421.00** ✓
Excavation and Off-site Landfill Disposal (14,150 cy = 16,980 tons)						
Backhoe and operator (15 days @ 10 hrs/day)	15	days	$	1,200.00	$	18,000.00
Laborers (4 @ 15 days @ 10 hrs/day)	600	hrs	$	40.00	$	24,000.00
Site Superintendent	150	hrs	$	60.00	$	9,000.00
RCRA Subtitle D (Solid Waste) Landfill						
Transportation and Disposal	16,980	tons	$	125.00	$	2,122,500.00
Excavating and Off-site Landfill Disposal (16,980 tons)					**$**	**2,173,500.00** ✓
Vegetative Support Layer						
Clean Fill - 18" layer, Purchase & Haul	10613	yd^3	$	8.00	$	84,900.00
Topsoil - 6" layer, Spread	3538	yd^3	$	2.00	$	7,075.00
Site Superintendent (10 day @ 10 hrs/day)	100	hrs	$	60.00	$	6,000.00
Vegetative Support Layer					**$**	**97,975.00** ✓
Site Restoration						
Fertlize, Seed, Mulch	4	acres	$	2,000.00	$	8,000.00
Demob of Equipment	1	LS	$	2,000.00	$	2,000.00
Site Restoration					**$**	**10,000.00**
TOTAL DIRECT COSTS					**$**	**2,328,646.00**
INDIRECT COSTS						
Health and Safety (@ 3% of Direct Costs)					$	69,859.38

Alternative 3: Soil Removal and Disposal, Site 17

Administative Fees (@ 3% of Direct Costs)	$	69,859.38
Engineering and Design (@ 10% of Direct Costs)	$	232,864.60
Construction Support Services (@ 10% of Direct Costs)	$	232,864.60
TOTAL INDIRECT COSTS	**$**	**605,447.96**
TOAL CAPITAL COSTS - Total Direct Costs + Total Indirect Costs	***$***	***2,934,093.96***
OPERATION AND MAINTENANCE COSTS (ANNUAL)		
5-Year Site Review (see Alternative #1)		
Total LOE	$	4,950.00
Total ODCs	$	360.00
Subtotal Cost	$	5,310.00
Present Worth (capitallized @ 6%, 30 years)	**$**	**17,352.00**
TOTAL O&M COSTS (Annual Monitoring, 5-Year Review, LUCs)	***$***	***17,352.00***
TOTAL CAPITAL COSTS & O&M COSTS	***$***	***2,951,445.96***
Contingency (@ 10%)	**$**	**295,144.60**
TOTAL COST OF ALTERNATIVE #3	***$***	***3,246,590.56***