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CORRECTIVE MEASURES STUDY REPORT FOR SOLID WASTE MANAGEMENT UNIT 7
REVISION 2 WITH TRANSMITTAL LETTER NAS KEY WEST FL
3/9/1999
TETRA TECH NUS

0122

Rev. 2
3/9/99

Corrective Measures Study Report
for
Solid Waste Management Unit 7
(SWMU 7)

Naval Air Station Key West
Boca Chica Key, Florida

DEPARTMENT OF THE NAVY
SOUTHERN DIV FACILITIES ENGINEERING COMD

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0007

March 1999

TETRA TECH NUS, INC.
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AIK-99-0042

March 9, 1999

Project Number HK 7046 *via U.S. Mail*

Mr. Dudley Patrick - Code 1858
Southern Division
NAVFACENGCOM
P.O. Box 190010
North Charleston, South Carolina 29419-9010

Reference: CLEAN Contract No. N62467-94-D-0888
Contract Task Order No. 007

Subject: Corrective Measures Study Reports for Solid Waste Management Units 5 and 7, Rev. 2
Naval Air Station Key West, Florida

Dear Mr. Patrick:

Tetra Tech NUS, Inc. (TtNUS) is pleased to submit the enclosed Corrective Measures Study (CMS) Reports for Solid Waste Management Units (SWMUs) 5 and 7, Rev. 2, Naval Air Station (NAS) Key West. These documents incorporate all comments on previous versions of the documents as resolved by the NAS Key West Partnering Team and they are considered the final versions, pending regulatory acceptance. I have enclosed only those pages that have changed from the Rev. 1 version of the documents to save paper. For your convenience, I have also enclosed pages 2-15 and 2-16 from the SWMU 7 CMS report because it was not copied correctly when the Rev. 1 version of the report was submitted in December 1998.

As you requested, copies of the two enclosed documents are being sent to members of the NAS Key West Partnering Team and Restoration Advisory Board. Please call me at (803) 649-7963, extension 345 with any questions you may have regarding the enclosed documents.

Sincerely,

D Scott Fleiger for...

C. M. Bryan
Project Manager

CMB:spd

Enclosures

cc: Ms. M. Berry, EPA (2 copies)
Mr. J. Caspary, FDEP (2 copies)
Mr. R. Demes, NAS Key West
Mr. P. Williams, NAS Key West (2 copies)
Mr. R. Cohose, Bechtel Environmental, Inc.
Mr. M. Perry, TtNUS Technical Coordinator
Ms. R. Orlandi, RAB Community Member
Ms. M. Stafford, RAB Community Member
Mr. M. Ingram, RAB Community Member
Ms. R. Haag, South Florida Water Management District
Files: 7046-7.13.3, 7.14.3

Rev. 2
3/9/99

CORRECTIVE MEASURES STUDY REPORT
FOR
SOLID WASTE MANAGEMENT UNIT 7 (SWMU 7)

NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
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661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0007

MARCH 1999

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Rev. 2
3/9/99

CERTIFICATION OF TECHNICAL CONFORMITY

Name: Mark P. Speranza

Signature: Mark P. Speranza

Professional Engineer
Certificate Number: PE0050304

Date: March 9, 1999

This Professional Engineer Certificate indicates that this document complies with the State of Florida's regulatory requirements for an engineering document. The Professional Engineering Certificate does not indicate that this report can be used for construction.

Mark P. Speranza

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ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
B&R Environmental	Brown & Root Environmental
BDAT	best demonstrated available technology
bgs	below ground surface
BTAG	Biological Technical Assistance Group
CAA	Clean Air Act
CAMP	Corrective Action Management Plan
CAO	corrective action objective
CAP	Corrective Action Program
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
cm/sec	centimeters per second
CMS	corrective measures study
COC	chemical of concern
COPC	chemicals of potential concern
CWA	Clean Water Act
cy	cubic yard
DDD	dichlorodiphenyl dichloroethane
DDE	dichlorodiphenyl dichloroethylene
DDT	dichlorodiphenyl trichloroethane
dl	deciliter
DOD	Department of Defense
DOT	Department of Transportation
ECC	ecological chemicals of concern
EPC	Exposure Criteria
ERA	ecological risk assessment
ER-L	effects range - low
ER-M	effects range - median
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection

ft	feet
ft^2	square feet
g	gram
gpd	gallons per day
HHRA	human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendments
ICR	incremental cancer risk
IEUBK	integrated exposure and uptake biokinetic
IRA	interim remedial action
IRP	Installation Restoration Program
kg	kilogram
L	liter
LDR	land disposal restriction
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
meq	milliequivalent
MOA	Memorandum of Agreement
µg	microgram
mg	milligram
msl	mean sea level
NAAQS	National Ambient Air Quality Standards
NACIP	Naval Assessment and Control of Installation Pollutants Program
NAS	Naval Air Station
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	no further action
NPDES	National Pollution Discharge Elimination System
NSPS	New Source Performance Standards
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
ppb	parts per billion

PPE	personal protective equipment
ppm	parts per million
QA	quality assurance
QC	quality control
RAB	Restoration Advisory Board
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RFI	RCRA Facility Investigation
RGO	remedial goal options
RI	remedial investigation
SAL	screening action level
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SCG	soil clean-up goals
SDWA	Safe Drinking Water Act
SIP	State Implementation Plan
SPT	standard penetration test
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TBC	to be considered
TCLP	Toxicity Characteristic Leaching Procedure
TOC	total organic compound
TSDF	treatment, storage, and disposal facility
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
yd	yard
yd^3	cubic yards
VOC	volatile organic compound

EXECUTIVE SUMMARY

This Corrective Measures Study (CMS) for Solid Waste Management Unit (SWMU) 7, Boca Chica Building A-824, at the Naval Air Station (NAS) located in Key West, Florida has been prepared for the Southern Division, Naval Facilities Engineering Command (NAVFACENGCOM). This work has been authorized under Contract Task Order Number 0007 under Contract N62467-94-D-0888. This report is based on the results of previous investigations as listed below.

Investigation/Activity	Date	Regulatory Driver
Visual Site Inspection conducted by the United States Environmental Protection Agency (U.S. EPA)	1988	Resource Conservation and Recovery Act (RCRA)
Clean-up activities performed by Blasland, Bouck, & Lee	1991	RCRA
RCRA Facility Investigation/Remedial Investigation (RFI/RI) conducted by IT Corporation	1994	RCRA/ Comprehensive Environmental Response Compensation and Liability Act (CERCLA)
Interim Remedial Action (IRA) at SWMU 7 conducted by Bechtel Environmental, Inc.	1995	RCRA/CERCLA
Supplemental RFI/RI for Eight Sites, conducted by Brown & Root Environmental (B&R Environmental)	1997	RCRA/CERCLA

SITE DESCRIPTION

SWMU 7 (Building A-824) is a former temporary hazardous waste storage area. The site consists primarily of Building A-824, a grassy area enclosed by a chain-link fence that surrounds the building, and two small ponds located north and south of the building. The northern pond is approximately 30 feet by 30 feet in size and 3 to 4 feet deep. The southern pond is approximately 15 feet by 20 feet in size and 2 feet deep. A ditch extends southward from the northern pond to the southern pond approximately 150 feet south of Building A-824. This ditch is approximately 18 inches deep and 18 inches wide. The ditch branches to the southwest at a point approximately midway between these two small ponds and terminates near a road around the perimeter of the area. The sediment in the ditch consists of material eroded from the limestone and fill material present at the site. Material used as fill at the site was brought in from either Boca Chica Channel, Key West Harbor, or Flagler railroad. Water in the ditch consists of runoff from the site and overflow from the pond.

Navy records indicate that Building A-824 was previously used to store supplies and small electrical transformers, and it also served as a temporary staging area for 55-gallon drums of hazardous waste.

Although no reported releases of contaminants were recorded, in 1994 IT Corporation identified a potential roadside diesel fuel spill (east of the building beyond the roadway). Also, base personnel indicate that transformer oil was occasionally dumped on the ground immediately north of the building. Samples collected in 1991 and 1993 indicated the presence of hydrocarbons and metals in the soil around the building and polychlorinated biphenyls (PCBs), pesticides, and metals in sediment west of the building. Subsequently, a clean-up of possible hazardous materials was performed. The building currently houses a solvent recovery operation and is used for storage of empty 55-gallon drums, old transformers, and other equipment.

PURPOSE

The purpose of this CMS is to identify corrective action objectives (CAOs), identify and screen corrective measure technologies, develop corrective measure alternatives, evaluate corrective measure alternatives, and justify and recommend a final corrective action for soil.

CORRECTIVE ACTION OBJECTIVES

CAOs specify chemicals of concern (COCs), media of interest, exposure pathways, and clean-up goals or acceptable contaminant concentrations. CAOs may be developed to permit consideration of a range of treatment and containment alternatives. This CMS addresses arsenic and Aroclor 1260 contamination within SWMU 7 soil. Groundwater and surface water were found not to be of concern. Concentrations of chemicals within sediment were found to be below remedial goal options (RGOs).

Based upon the ecological risk assessment conducted as part of the Supplemental RFI/RI (B&R Environmental, 1998), existing conditions at SWMU 7 do not pose significant potential risks to ecological receptors. However, based upon the calculated risks in the human health assessment to hypothetical future residents, trespassers, and occupational workers, the Supplemental RFI/RI recommended preparation of a CMS for SWMU 7. To protect the public from potential current and future human health risks, as well as to protect the environment, the following CAOs have been developed for SWMU 7 soil to address the primary exposure pathways:

- Prevent human receptors from contacting contaminants in the soil at concentrations that would result in unacceptable health risks.
- Prevent the migration of surface soil contaminants to groundwater via infiltration and subsequent migration to surface water.

CORRECTIVE MEASURE ALTERNATIVE DEVELOPMENT

Alternatives were developed that evaluate corrective measures that address the COCs and exposure pathways in order to achieve the CAOs. Alternatives were developed that range from no action to those that address all contaminants that could potentially affect human receptors. The alternatives that were assembled are briefly described below.

SWMU 7 Alternatives

Alternative 1 - No Action: Alternative 1 is a "walk-away" alternative retained to provide a baseline for comparing the other alternatives and, therefore, does not address existing contamination at the site. There would be no reduction in toxicity, mobility, or volume of the contaminants from treatment at SWMU 7 other than that which would result from natural processes (e.g., advection, dispersion, adsorption, or other attenuating factors).

Alternative 2 - Institutional Controls with Monitoring: This alternative consists of one major component, institutional controls (i.e., land-use controls, monitoring, site development restrictions, and educational programs). Land-use controls would be maintained to eliminate or reduce the pathways of human exposure to contaminants at the site. Site development restrictions would be implemented as stipulated in CNBJAXINST 5090.2N4 (U.S. Navy, 1997) and appropriate changes would be made to the NAS Key West Master Plan. Educational programs would be created to inform the public of hazards related to site contaminants.

To assess whether natural processes are diminishing the concentration of site contaminants over time and to monitor potential soil contaminant migration to surface water and sediment, surface water, groundwater, and sediment sampling would be conducted (quarterly for the first year and annually for the next nine years). Per the NAS Key West Memorandum of Agreement (MOA) with the U.S. EPA and FDEP (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site.

Alternative 3 - Remove and Treat and/or Dispose of Soil That Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls: This alternative consists of three major components: (1) removal of contaminated soil, (2) transport of contaminated soil for off-site treatment and/or disposal, and (3) institutional controls.

Approximately 150 cubic yards of contaminated soil in excess of the industrial RGOs (2,100 µg/kg for Aroclor 1260 and 3.7 mg/kg for arsenic) would be excavated from SWMU 7. Confirmation sampling would be conducted to ensure that the removal of contaminated soil in excess of the industrial RGOs is completed.

Excavated soil would be transported to an off-site RCRA-permitted transportation, storage, and disposal facility (TSDF) for treatment, if required, and disposal. If soil is determined to be a RCRA hazardous waste, off-site treatment options would include incineration and stabilization/solidification.

Land-use controls would be maintained to prohibit unauthorized personnel (e.g., base residents) from obtaining entry to the site. Site development restrictions would be added to the NAS Key West Master Plan in accordance with CNBJAXINST 5090.2N4 (U.S. Navy, 1997). These restrictions would implement administrative actions to prohibit future residential site use. To assess the effectiveness of the soil removal and to determine whether natural processes are diminishing the concentration of any remaining site contaminants over time, surface water, groundwater, and sediment sampling would be conducted (quarterly for the first year and annually for the next 9 years). Per the MOA (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site and will determine whether changes to the controls are required.

EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

Each alternative was evaluated using the nine criteria specified in the Guidance for RCRA Corrective Action Plan (OSWER Directive 9902.3-2A, U.S. EPA May, 1994). These criteria include protection of human health and the environment; media clean-up standards; source control; waste management standards; long-term reliability and effectiveness; reduction in toxicity, mobility, or volume; short-term effectiveness; implementability; and cost. The development and evaluation of these alternatives take into consideration the effects of an Interim Remedial Action (IRA) completed in the Spring of 1996. Section 5.0 of this report presents the results of this evaluation process.

A comparative analysis of alternatives was completed. This comparative analysis was performed with respect to specific factors for each of the nine above-mentioned criteria, and differences among the alternatives were identified. The results of this analysis are presented in Section 6.0. The estimated costs for each alternative are as follows:

Alternative	Capital ($)	Operating ($/year)	Present Worth ($)
1	0	0	0
2	13,400	11,500-46,000	151,000
3	102,000	11,500-46,000	239,000

The costs are itemized in the detailed cost sheets presented in Appendix C. It should be also noted that, to date, the Navy has spent approximately 7.9 million dollars on IRAs at nine sites/SWMUs/areas of concern. SWMU 7 was one of the SWMUs where an IRA was performed.

Alternative	Capital ($)	Operating ($/year)	Present Worth ($)
1	0	0	0
2	13,400	11,500-46,000	151,000
3	102,000	11,500-46,000	239,000

The costs are itemized in the detailed cost sheets presented in Appendix C. It should be also noted that, to date, the Navy has spent approximately 7.9 million dollars on IRAs at nine sites/SWMUs/areas of concern. SWMU 7 was one of the SWMUs where an IRA was performed.

The recommended alternative for this site is Alternative 2 – Institutional Controls with Monitoring. Under this alternative, groundwater, sediment, and surface water would be sampled and analyzed at a frequency yet-to-be determined by the NAS Key West Partnering Team. Further, exposure to soils in areas not removed by the IRA would be managed by implementing appropriate access restrictions. The institutional control alternative is further described below.

By separate MOA with the U.S. EPA and the FDEP, NAS Key West, on behalf of the Department of the Navy, agreed to implement periodic site inspection, condition certification, and agency notification procedures designed to ensure the maintenance by Station personnel of any site-specific land-use controls (LUC) deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of that agreement was that through the Navy's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to the U.S. EPA and FDEP as to the permanency of those remedies, which included the use of specific LUCs.

Although the terms and conditions of the MOA are not specifically incorporated herein by reference, it is understood and agreed by the Navy, U.S. EPA, and FDEP that the contemplated permanence of the remedy reflected herein shall be dependent on the Station's substantial good-faith compliance with the specific LUC maintenance commitments reflected therein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

The proposed alternative, Institutional Controls with Monitoring, is protective of human health and the environment under current industrial land use, complies with State and Federal ARARs, and is cost effective.

1.0 INTRODUCTION

Tetra Tech NUS, Inc. (TtNUS), formerly Brown & Root Environmental (B&R Environmental), prepared a corrective measures study (CMS) of solid waste management unit (SWMU) 7, Boca Chica Building A-824, NAS Key West under Contract Number N62467-94-D-0888, Contract Task Order 0007, for the U.S. Navy, Naval Facilities Engineering Command (NAVFACENGCOM)-Southern Division. SWMU 7 (Building A-824), located north of US 1 on Boca Chica Key, is a former temporary hazardous waste storage area. The site consists primarily of Building A-824, a grassy area enclosed by a chain-link fence that surrounds the building, and two small ponds. Navy records indicate that Building A-824 was previously used to store supplies and small electrical transformers, and it also served as a temporary staging area for 55-gallon drums of hazardous waste. Base personnel indicate that transformer oil was occasionally dumped on the ground immediately north of the building. Samples collected in 1991 and 1993 indicated the presence of hydrocarbons and metals in the soils around the building and polychlorinated biphenyls (PCBs), pesticides, and metals in sediments west of the building. Subsequently, a cleanup of possible hazardous materials was performed. The building currently houses a solvent recovery operation and is used for storage of empty 55-gallon drums, old transformers, and other equipment.

This CMS was based on the results of previous investigations/activities as listed below.

Investigation/Activity	Date	Regulatory Driver
Visual Site Inspection conducted by the United States Environmental Protection Agency (U.S. EPA)	1988	Resource Conservation and Recovery Act (RCRA)
Clean-up activities performed by Blasland, Bouck, & Lee	1991	RCRA
RCRA Facility Investigation (RFI)/Remedial Investigation (RI) conducted by IT Corporation	1994	RCRA/Comprehensive Environmental Response Compensation and Liability Act (CERCLA)
Interim Remedial Action (IRA) at SWMU 7 conducted by Bechtel Environmental, Inc.	1995	RCRA/CERCLA
Supplemental RFI/RI for Eight Sites, conducted by B&R Environmental	1997	RCRA/CERCLA

1.1 PURPOSE

The purpose of this CMS is to identify Corrective Action Objectives (CAOs), identify and screen corrective measure technologies, develop corrective measure alternatives, evaluate corrective measure alternatives, and justify and recommend a final corrective action for surface soil, sediment, and surface water contamination within SWMU 7.

1.2 REPORT ORGANIZATION

Section 1.0 of this report provides a brief description of the background and purpose of this CMS for SWMU 7, Boca Chica Building A-824, NAS Key West. Section 2.0 presents the Description of Current Conditions, including a discussion on the nature and extent of contamination, site conditions, and summaries of the human health and ecological risk assessments. The CAOs for SWMU 7 are described in Section 3.0. The volume of contaminated media is also presented in Section 3.0. Section 4.0 describes the identification, screening, and development of corrective measure alternatives. Section 5.0 presents the detailed evaluation of the corrective measure alternatives. Section 6.0 provides a comparative analysis of the corrective action alternatives and provides the recommendation for the final corrective measure.

1.3 BACKGROUND

RCRA corrective action, as mandated by the Hazardous and Solid Waste Amendments (HSWA), is a process by which a hazardous waste treatment, storage, and disposal facility (TSDF)/solid waste disposal unit is investigated and remediated, where necessary, to address routine and systematic releases of hazardous waste or hazardous waste constituents at the facility. RCRA corrective action is generally required for a TSDF/SWMU as part of the Part B Permit activities conducted by authorized states or U.S. EPA, or through enforcement actions [i.e., RCRA Section 3008(h) orders] by the U.S. EPA. The Corrective Action Program (CAP) assists the U.S. EPA in developing CAOs [3008(h)] and corrective action requirements in permit applications and permits [3004(u)&(v)]. The objective of a CAP at a TSDF/SWMU is to evaluate the nature and extent of the release of hazardous waste or constituents; to evaluate facility characteristics; and to identify, develop, and implement the appropriate corrective measure or measures adequate to protect human health and the environment.

The CAP involves three distinct steps: RFI, CMS, and corrective measures implementation. The objective of an RFI is to thoroughly evaluate the nature and extent of the release of hazardous waste and hazardous constituents and to gather necessary data to support the CMS. The objective of a CMS is to develop and evaluate a corrective measure alternative or alternatives and to recommend the final corrective measure or measures. The objective of the corrective measures implementation is to design, construct, operate, maintain, and monitor the performance of the corrective measure or measures selected.

In addition to RCRA/HSWA sites at NAS Key West, there are several Installation Restoration Program (IRP) sites. Clean-up activities for the IRP are implemented in accordance with the National Contingency

Plan (NCP) and CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA). CERCLA establishes the approach to address and clean up hazardous waste sites at both private and federal facilities. These remedial investigations are commonly known as RIs.

IT Corporation conducted the Phase I RFI/RI from 1992 through 1994 (IT Corporation, 1994). This investigation confirmed the presence of contamination at certain NAS Key West sites. A Supplemental RFI/RI was conducted in accordance with HSWA Permit No. FL6-170-022-952, issued by U.S. EPA. A Corrective Action Management Plan (CAMP) was prepared to describe the strategy for implementing the RCRA CAP at NAS Key West (ABB, 1995).

From August to October 1996, B&R Environmental implemented the Supplemental RFI/RI sampling and analysis plan (SAP), in accordance with the regulatory-approved planning documents (ABB, 1995) at SWMU 7. The RFI/RI sample results were used for chemical and toxicological analyses to determine risks to human health and ecological receptors. A limited validation effort was performed for the analytical data collected by B&R Environmental. The data provided in the initial RFI/RI (IT Corporation, 1994) were also used to assess site risks. The Supplemental RFI/RI recommended that a CMS be conducted for SWMU 7, Boca Chica Building A-824.

The data obtained from the August to October 1996 field sampling at SWMU 7 were partially validated using the industry-accepted process described in Section 2.0 of Appendix C of the RFI/RI (B&R Environmental, 1998). In general, this data assessment process followed Contract Laboratory Program (CLP) protocol and Naval Facilities Engineering Service Center data quality assessment guidance. In 1996, data received a limited validation review; approximately 10 percent of 1996 data was fully validated. Historical data were not subjected to any data quality assessment. Data assumed to have been assessed during their investigation activities and were accepted at face value since records of validation were not available.

1.4 INSTALLATION DESCRIPTION

NAS Key West is in southern Monroe County, Florida, on Boca Chica Key. Key West, one of the two westernmost major islands of the Florida Keys, is approximately 150 miles southwest of Miami. Key West is connected to the mainland by the Overseas Highway (U.S. Highway No. 1). Figure 1-1 presents a regional map showing the location of Boca Chica Key and Key West within the Florida Keys. Figure 1-2 presents the location of SWMU 7. Several installations in various parts of the lower Florida Keys comprise the Naval Complex at Key West. Most of these are on Key West and Boca Chica Key. Other parts of the complex include Trumbo Point, Sigsbee Key (formerly Dredgers Key), Fleming Key, Demolition Key, Truman Annex on Key West, and Big Coppitt Key. The entire complex encompasses an area of approximately 5,000 acres. Boca Chica Key is approximately 3 miles wide and 3 miles long, and the air station encompasses 3,250 acres. With the exception of filled areas that underlie the Overseas Highway, the elevations of Boca Chica Key are less than 5 feet above mean sea level (msl) (IT Corporation, 1994).

At present, NAS Key West maintains aviation operations, a research laboratory, communications intelligence, counter-narcotics air surveillance operations, a weather service, and several other related activities. In addition to the Naval activities and units, other Department of Defense (DOD) and federal agencies at NAS Key West include U.S. Air Force squadrons, a U.S. Army Special Forces Division, the U.S. Coast Guard, and a Defense Property Disposal Office.

The city of Key West, which is the county seat of Monroe County, has a residential population of 24,832 (USCBS, 1990). The principal industry is tourism, with about 1,500,000 tourists visiting annually. The major sources of employment in Key West are tourism, fishing, wholesale and retail trade, services, construction, finance, insurance, real estate, federal, state, and local government and transportation industries.

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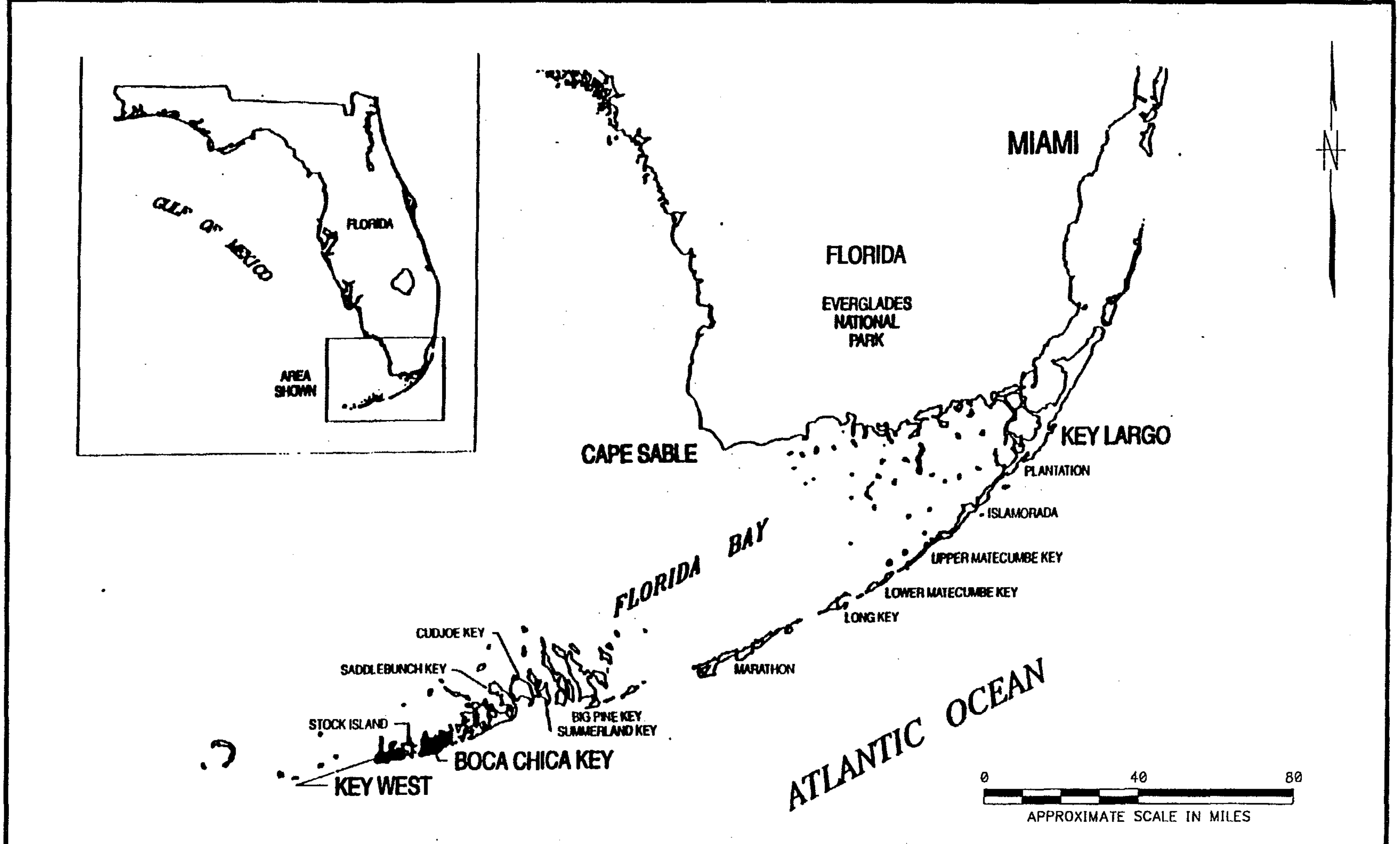

DRAWN BY HJP — DATE 2/10/98	FACILITY LOCATION MAP NAVAL AIR STATION KEY WEST BOCA CHICA KEY, FLORIDA	CONTRACT NO. 7046
CHECKED BY — DATE		APPROVED BY — DATE
COST/SCHED-AREA		APPROVED BY — DATE
SCALE AS NOTED		DRAWING NO. FIGURE 1-1 — REV. 0

FORM CADD NO. SDV_AH12.DWG - REV 0 - 1/20/98

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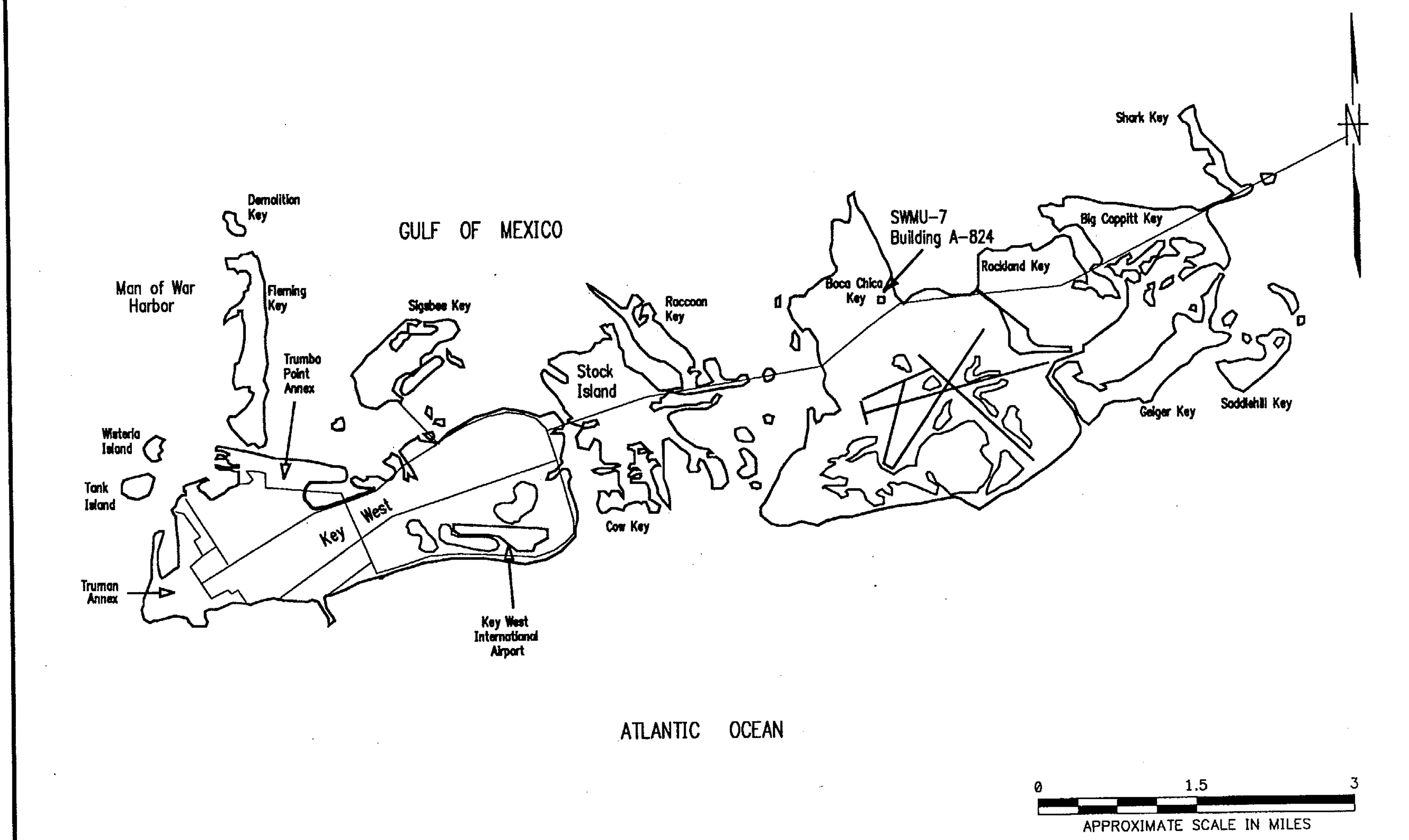

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COST/SCHED-AREA	
SCALE AS NOTED	

SWMU 7 LOCATION
BOCA CHICA KEY, FLORIDA

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FORM CADD NO. SDV_AH12.DWG - REV 0 - 1/20/98

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Rev. 1
12/11/98

2.0 DESCRIPTION OF CURRENT CONDITIONS

2.1 SITE DESCRIPTION

SWMU 7 (Building A-824), located north of US 1 on Boca Chica Key (Figure 2-1), is a former temporary hazardous waste storage area. The site consists primarily of Building A-824, a grassy area enclosed by a chain-link fence that surrounds the building, and two small ponds north and south of the building. The northern pond is approximately 30 feet by 30 feet in size and 3 to 4 feet deep. A ditch extends southward from the northern pond. The ditch is approximately 18 inches deep and 18 inches wide. The ditch extends southward and connects with a smaller pond approximately 150 feet south of Building A-824. The southern pond is approximately 15 feet by 20 feet in size and 2 feet deep. The ditch branches to the southwest at a point approximately midway between these two small ponds and terminates near a road around the perimeter of the area. The sediment in the ditch is material that has eroded from the limestone and fill material present at the site. Material used as fill at the site was brought in from any of three locations, Boca Chica Channel, Key West Harbor, or Flagler railroad. Water in the ditch consists of runoff from the site and overflow from the pond.

Navy records indicate that Building A-824 was previously used to store supplies and small electrical transformers, and it also served as a temporary staging area for 55-gallon drums of hazardous waste. Although no reported releases of contaminants were recorded, IT Corporation identified in 1994 a potential roadside diesel fuel spill (e.g., east of the building beyond the roadway). Also, base personnel indicate that transformer oil was occasionally dumped on the ground immediately north of the building. Samples collected in 1991 and 1993 indicated the presence of hydrocarbons and metals in the soils around the building and PCBs, pesticides, and metals in sediments west of the building. Subsequently, a cleanup of possible hazardous materials was performed. The building currently houses a solvent recovery operation and is used for storage of empty 55-gallon drums, old transformers, and other equipment.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The site-specific geology and hydrogeology of the unit were determined from soil boring and monitoring well installation during the RFI/RI (IT Corporation, 1994) and the Supplemental RFI/RI (Brown & Root Environmental, 1998). The site consists of compacted fill material to a depth of approximately 6 inches below land surface (bls) followed by dense oolitic limestone. The fill material runs along the perimeter of the building extending beyond the road to the east and south of the site. The water table is present at 1.09 to 3.24 feet bls, and the water is very near the surface in the western portion of the site. Groundwater elevation varies from 3.29 feet to 1.60 feet above mean sea level (msl). Water-level measurements indicate that the groundwater flow underlying the site may be significantly influenced by tidal fluctuations.

2.3 INVESTIGATIVE HISTORY

In 1991, Blasland, Bouck, and Lee (BB&L) collected samples from sandbags stacked near Building A-824, from soil around the building, and wipe samples from the floor of the building. Prior to the 1993 RI/RFI, IT Corporation evaluated these data, but the data were not available for inclusion in the Supplemental RFI/RI. After sampling, BB&L performed a final series of clean-up activities of the structure and surrounding area in March 1991.

IT Corporation conducted soil, sediment, surface water, and groundwater sampling during the RFI/RI at this site in 1993. Characterization of releases from the site indicated metals and hydrocarbon contamination in soil around the building. In addition, samples of sediments in the ditch west of the building contained PCBs, pesticides, and metals (e.g., cadmium, lead, mercury) (IT Corporation, 1994). The final RFI/RI prepared by IT Corporation recommended additional surface water and sediment sampling to delineate the extent of contamination, receptor identification of potential ecological risks, an interim remedial action (IRA) to remove petroleum contaminated soils, and a baseline human health risk assessment based on post-IRA sampling data.

In August 1995, Bechtel Environmental, Inc. (BEI) conducted delineation sampling at SWMU 7 to define PCB-contaminated soil (BEI, 1995). An IRA was then conducted to remove the contaminated soil at the northern end of the building and prevent further migration of PCBs into other media. The remedial goal was to remove all soil with PCB contamination above 1 mg/kg. BEI subsequently excavated and transported 26 cubic yards of PCB-contaminated soil to an appropriate treatment/disposal facility. BEI also performed confirmation sampling to determine whether the IRA goal had been reached. The excavated area was then backfilled with crushed stone to match the existing grade. Since SWMU 7 is a graveled area, revegetation was not required.

In 1997, a Supplemental RFI/RI Report (for eight sites including SWMU 7) was conducted by B&R Environmental (B&R Environmental, 1998). The conclusions of this investigation are summarized in the following sections.

2.4 SUMMARY OF THE NATURE AND EXTENT OF CONTAMINATION

Building A-824 at SWMU 7 currently houses a solvent recovery operation and is used for storage of empty 55-gallon drums and old transformers. The building was previously a temporary hazardous waste storage area used to store supplies, small electrical transformers, and temporary staging of 55-gallon drums of hazardous waste. No reported releases of contaminants are recorded, but samples collected in 1991 indicated the presence of hydrocarbons in the soils around the building. Base personnel also indicate that transformer oil was occasionally dumped on the ground immediately north of the building. A cleanup of possible hazardous material was performed in March 1991. IT Corporation previously concluded that a roadside diesel fuel spill had apparently occurred east of the road on the eastern side of Building A-824, based on organic vapor analyzer (OVA) readings and the presence of naphthalene in one subsurface soil sample (IT Corporation, 1994). Supplemental field activities at SWMU 7 included surface soil sampling to delineate the extent of hydrocarbon contamination, surface water and sediment sampling to quantify the contaminants detected in earlier activities, and groundwater sampling to evaluate previously detected contamination.

The Supplemental RFI/RI Report for the Eight Sites (B&R Environmental, 1998) characterized the roadside diesel fuel spill east of the road that parallels Building A-824 as part of the nature and extent of contamination section and subsequent summary sections on human health risk and ecological risk assessments. The nature and extent of this fuel spill is further summarized in this CMS report; however, this CMS will not address remedial alternatives for this area because it will be remediated under the base underground storage tank (UST) program.

The following discussions summarize the nature and extent of contamination. All the chemicals that were detected were screened against applicable or relevant and appropriate requirements (ARARs) and screening action levels (SALs) for each medium. These nature and extent of contamination screening values are discussed in Section 2.3.1 of the Supplemental RFI/RI (B&R Environmental, 1998).

2.4.1 Subsurface Soil

Data from the 1993 IT Corporation RFI/RI and the 1995 BEI Delineation Study were considered in the analysis of subsurface soil contamination at SWMU 7. Figure 2-2 shows the occurrence of analytes that exceeded the nature and extent of contamination screening values and indicated possible contamination. Metals accounted for most of the chemicals detected in the subsurface soil at SWMU 7. In general, inorganics were detected throughout the site, while semivolatile organic compounds (SVOCs) and volatile organic compounds (VOCs) were limited to S7SB-16, east of Building A-824, and S7SB-10, at the southeastern corner of the building. No pesticides or PCBs were detected in subsurface soils at SWMU 7.

Although inorganics were detected in the soil samples on all sides of Building A-824, only four inorganics were detected in excess of screening criteria in subsurface soil at SWMU 7. Antimony was detected in excess of its 0.79 mg/kg screening criterion at the southeastern corner of the building (S7SB-10, 3.8 mg/kg). This was the only detection of antimony in subsurface soil at SWMU 7. Arsenic exceeded its 2.6 mg/kg screening criterion at a location east of the building (S7SB-16, 3.9 mg/kg). It was also detected in six other subsurface samples around SWMU 7 but at levels below the screening criteria. Sulfide was also detected in excess of its 98 mg/kg screening value at S7SB-16 (1,600 mg/kg). Beryllium was detected at its 0.15 mg/kg screening value at S7SB-17 and slightly below the screening value at three other sample locations. Other inorganics detected in the subsurface soil at SWMU 7 included barium, chromium, lead, mercury, and zinc. These were detected at multiple locations but were below screening values in all cases. Barium, chromium, and zinc were the most widespread contaminants, detected at all eight sample locations but were consistently below the screening values.

Two VOCs were detected in excess of their screening criteria in subsurface soil at S7SB-16, east of Building A-824. Ethylbenzene exceeded its 100 µg/kg screening value, with a concentration of 210 µg/kg. Xylene was detected in excess of its 100 µg/kg screening value, at a concentration of 2,000 µg/kg. Other VOCs detected in the subsurface soil at SWMU 7 included 2-butanone, acetone, cis-1,2-dichloroethene, and methylene chloride. Although these compounds were each detected at two locations, S7SB-10 and S7SB-16, none exceeded the screening values. Toluene was also detected below its screening value at S7SB-16.

Five SVOCs exceeded their screening criteria at S7SB-16, east of Building A-824. All five SVOCs had a screening value of 100 µg/kg and were detected at the following concentrations: acenaphthene at 660 µg/kg, anthracene at 220 µg/kg, fluorene at 790 µg/kg, naphthalene at 7,900 µg/kg, and phenanthrene at 1,200 µg/kg. Several other SVOCs, including 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, and dibenzofuran, were also detected at S7SB-16 but were all well below their screening values. Benzoic acid, detected at S7SB-10 (on the southeastern corner of Building A-824), was the only SVOC detected in a boring other than S7SB-16; however, it was below screening criteria.

2.4.2 <u>Surface Soil</u>

Data from the 1993 IT Corporation RFI/RI, the 1995 BEI Delineation Study, and the 1996 B&R Environmental Supplemental RFI/RI were considered in the analysis of surface soil contamination at SWMU 7. Figure 2-3 shows the occurrence of analytes that exceeded the nature and extent of contamination screening values and indicated possible surface soil contamination. Inorganics accounted for most of the chemicals detected in the surface soil. In general, inorganic contamination occurred throughout the site, and semivolatiles were usually limited to samples collected east of Building A-824.

Inorganics were detected at surface soil sample locations all around Building A-824 (excluding the north side, where no inorganic testing occurred). A number of inorganics were detected in excess of screening criteria. Maximum concentrations commonly occurred on the east side of Building A-824. Maximum concentrations of aluminum, arsenic, copper, iron, lead, mercury, nickel, silver, sulfide, and vanadium were detected at S7SB-23. Maximum concentrations located at the southern side of the building included antimony at S7SB-9 and chromium and zinc at S7SB-7. The maximum concentration of beryllium was detected at S7SB-11 at the southeastern corner of the building. Other inorganics detected in the surface soil at SWMU 7 included barium, cadmium, cobalt, manganese, and selenium. Overall frequency of detection was greatest for barium, chromium, and zinc, all detected at 13 of 13 sample locations.

Two VOCs exceeded their (100 μg/kg) screening criteria at one sample location east of Building A-824 (S7SB-23). Chlorobenzene and xylene were detected at concentrations of 117 μg/kg and 958 μg/kg, respectively. VOCs detected at levels below screening values at SWMU 7 included acetone, cis-1,2-dichlorethene, ethylbenzene, methylene chloride, and toluene. All VOC detections occurred in three samples, two to the east of Building A-824 (S7SB-23 and S7SB-13A) and one to the southwest (S7SB-5).

Several SVOCs were detected in excess of the screening criteria in the surface soil at SWMU 7. SVOCs were detected in the same portions of the site that exhibited VOC contamination. With the exception of one detection at the southwestern corner of the building [S7SB-5, bis(2-ethylhexyl)phthalate], SVOC contamination was limited to the eastern portion of SWMU 7. All SVOCs that were detected in excess of their screening criteria had a screening value of 100 μg/kg. A majority of maximum concentrations were detected at S7SB-24, including benzo(a)anthracene (1,640 μg/kg), benzo(a)pyrene (2,040 μg/kg), benzo(b)fluoranthene (3,340 μg/kg), benzo(g,h,i)perylene (1,460 μg/kg), chrysene (1,950 μg/kg), fluoranthene (3,020 μg/kg), indeno(1,2,3-cd)pyrene (1,480 μg/kg), phenanthrene (106 μg/kg), and pyrene (2,410 μg/kg). Other exceedances were detected at one of two sample locations: S7SB-23 [1,2-dichlorobenzene (2,415 μg/kg) and 1,4-dichlorobenzene (352.3 μg/kg)] and S7SB-13A [benzo(k)fluoranthrene (310 μg/kg)]. Two SVOCs were also detected below their screening values: bis(2-ethyhexyl)phthalate and 1,3-dichlorobenzene.

No pesticides were detected in excess of surface soil screening criteria at SWMU 7. Several pesticides, including 2,4,5-T, 2,4,5-TP (silvex), 2,4-D, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, endosulfan I, endosulfan II, endrin, endrin aldehyde, heptachlor, and heptachlor epoxide, were detected during the B&R Environmental Supplemental RFI/RI at levels below the screening values.

Aroclor 1260 was detected in excess of its 96.3 µg/kg screening value at four BEI confirmation sample locations at the northern end of Building A-824. Concentrations ranged from 230 to 16,500 µg/kg. There were no other detections of PCBs in soil at SWMU 7.

2.4.3 Sediment

Inorganic contamination in sediment appears fairly widespread along the mosquito ditch at SWMU 7. Maximum concentrations commonly occurred at the southeastern end of the mosquito ditch at S7SS-4(IT), S7SS-4, or S7SS-6. Maximum concentrations detected in excess of the screening criteria included cadmium (2.8 mg/kg), copper (127 mg/kg), lead (209 mg/kg), mercury (1.8 mg/kg), silver (29.1 mg/kg), and zinc (487 mg/kg). The maximum concentration of beryllium in sediment (0.46 mg/kg) was detected at the junction of the two southern portions of the mosquito ditch at S7SS-3(IT). Arsenic was detected in excess of its screening value at S7SS-5 (5.8 mg/kg). Cyanide was detected in excess of its 0.1 mg/kg screening criterion at only one sample location, S7SS-1(IT) (13 mg/kg), at the northern end of the ditch. Barium, chromium, copper, lead, and zinc, detected at all nine sample locations, were the most frequently detected inorganics in sediment at SWMU 7. Lead and zinc exceeded the screening criteria in eight of the nine samples. Barium and chromium were consistently below the screening values. Other inorganics detected at SWMU 7 below the screening criteria included aluminum, antimony, iron, manganese, nickel, sulfide, tin, and vanadium. Figure 2-4 includes analytical results from the IT Corporation RFI/RI and the Supplemental RFI/RI that exceed the most restrictive nature and extent of contamination screening values. These screening values are also illustrated in Figure 2-4.

A single VOC, acetone, was detected in excess of screening criteria in sediment at SWMU 7. Acetone was detected in excess of its 64 µg/kg criterion in sediment at S7SS-4(IT) (190 µg/kg) toward the southeastern end of the mosquito ditch. Acetone was detected below the screening criteria at S7SS-1 (IT) (60 µg/kg) at the northern end of the mosquito ditch near the pond. Other volatiles at SWMU 7 were detected at only one of two sample locations, S7SS-1(IT) or S7SS-4(IT), and included 2-butanone, cis-1,2-dichloroethene, and methylene chloride. VOC analyses were not performed on SWMU 7 sediment samples collected during the 1996 Supplemental RFI/RI, as per the approved SAP (ABB, 1995).

All SVOCs detected in sediment at SWMU 7 were isolated detections, except bis(2-ethylhexyl)phthalate. Bis(2-ethylhexyl)phthalate was detected in excess of its 182 µg/kg screening value at opposite ends of the mosquito ditch: S7SS-1(IT) (580 µg/kg) at the northern end and S7SS-4(IT) (620 µg/kg) at the southeastern end. Several individual exceedances were detected at the southeastern end of the mosquito ditch at S7SS-6, sampled by B&R Environmental in 1996. SVOCs detected in excess of screening criteria at S7SS-6 included benzo(a)anthracene (1,910 µg/kg), benzo(b)fluoranthene (3,500 µg/kg), benzo(g,h,i)perylene (992 μg/kg), chrysene (2,120 μg/kg), fluoranthene (4,000 μg/kg), and pyrene (4,000 μg/kg). In addition, phenanthrene was detected in excess of its 86.7 μg/kg screening value at a concentration of 900 μg/kg at S7SS-2.

A single PCB, Aroclor 1260, was detected in sediment at SWMU 7 at three sample locations. In 1993 IT Corporation sampling, Aroclor 1260 exceeded its 22.7 μg/kg screening criterion at S7SS-2 (220 μg/kg) and S7SS-3 (510 μg/kg). Aroclor 1260 was also detected in excess of its screening value in the 1996 B&R Environmental sampling at S7SS-5 (56.4 μg/kg), collected at the pond.

Several pesticides were detected in excess of sediment screening values at SWMU 7. Several locations along the mosquito ditch and in the southern pond contained pesticide concentrations in excess of screening values. Maximum concentrations of 4,4'-DDD and 4,4'-DDE were detected by IT Corporation in 1993 sampling at S7SS-4(IT) toward the southeastern end of the ditch. The maximum concentration of 4,4'-DDT was detected in the same area at S7SS-6. The maximum concentration of dieldrin was detected at S7SS-5 in the pond at the northern end of the mosquito ditch. Maximum concentrations of delta-BHC and gamma-BHC (lindane) were detected at S7SS-8, in the southwestern branch of the mosquito ditch. Gamma-chlordane was detected once in sediment at S7SS-4. Other pesticides that were detected below screening criteria included alpha-BHC and endrin.

2.4.4 Surface water

Inorganics were the dominant class of contaminants detected in surface water samples. No SVOCs, pesticides, or PCBs were detected in surface water at SWMU 7. Figure 2-5 includes analytical results that exceeded the most restrictive screening values. These screening values are also shown in the figure.

Inorganics were detected in excess of screening values at several sample locations along the main line of the mosquito ditch at SWMU 7. Antimony was detected in excess of its 67 μg/L screening value at the three northern sample locations along the mosquito ditch [S7SS-1(IT), S7SS-2(IT), and S7SS-3(IT)]. The maximum concentration was 220 μg/L, detected at S7SS-1(IT). Tin exceeded its 0.01 μg/L screening criterion at the same three sample locations. However, the maximum concentration of tin (180 μg/L) occurred at S7SS-2(IT). Manganese was detected in excess of its 10 μg/kg screening criterion at two sample locations in the southeastern portion of the ditch [S7SW-4 (10.3 μg/L) and S7SW-6 (13.2 μg/L)]. It was also detected in several other surface water samples, although all other detections were below the screening value. Zinc was detected at four sample locations in the main mosquito ditch but only exceeded its 19 μg/L screening value at S7SS-1(IT), the 1993 IT surface water sample closest to the area excavated in 1995. The only other inorganics that exceeded their screening values were beryllium and cyanide, each detected in a single sample [beryllium at S7SS-1(IT) and cyanide at S7SW-4]. Arsenic, barium, chromium, mercury, and sulfide were detected at levels below the screening values in one or more samples. The most widespread inorganic contaminant was barium, detected at all eight sample locations at levels below the screening criteria. Several of the inorganic compounds including chromium, cyanide, iron, manganese, and mercury were not detected during the 1993 RFI/RI investigation but occurred at low levels throughout surface water in the 1996 supplemental investigation at SWMU 7.

No VOCs exceeded the screening criteria in any of the surface water samples at SWMU 7. A single VOC, methylene chloride, was detected at a concentration of 2 µg/L at both S7SS-1(IT) and S7SS-4(IT). This was below the 5 µg/L proposed RCRA action level for surface water that was used as a screening value for methylene chloride.

2.4.5 Groundwater

Data from the 1993 IT Corporation RFI/RI and the 1996 B&R Environmental Supplemental RFI/RI were considered in the analysis of groundwater contamination at SWMU 7. Groundwater samples were collected by IT Corporation in 1993 and by B&R Environmental in 1996; however, no exceedances were detected in B&R Environmental's 1996 sampling. Figure 2-6 shows the occurrence of analytes that exceeded the nature and extent of contamination screening values and indicated possible groundwater contamination. No pesticides or PCBs were detected. Groundwater contamination beneath the site is predominantly attributable to inorganics.

Several inorganics were detected in the groundwater at SWMU 7; however, only antimony was detected in excess of its 6 µg/L screening criterion. IT Corporation detected antimony in 1993 at a concentration of 46 µg/L at S7MW-3. Antimony was not detected in 1996. Manganese and mercury were detected (below the screening values) in samples collected by B&R Environmental in 1996 at sample locations where they were not previously detected (S7MW-1 and S7MW-3). Other inorganics detected at levels below the screening criteria in 1993 included arsenic, chromium, cyanide, lead, sulfide, and zinc. Arsenic, barium, chromium, lead, manganese, and zinc were detected in both wells in 1993; however, barium was the only one of these compounds that was also detected in 1996.

No VOCs exceeded the screening criteria in any of the groundwater samples at SWMU 7. However, three VOCs, 2-butanone, acetone, and methylene chloride, and one SVOC, bis(2-ethyhexyl)phthalate, were detected in S7MW-1 by IT Corporation in 1993.

2.5 RISK ASSESSMENT SUMMARY AND SELECTION OF CHEMICALS OF CONCERN

This section summarizes the results of the human health risk assessment (HHRA) conducted at SWMU 7 (Section 2.5.1) and describes the process of selecting chemicals of concern (COCs) (Section 2.5.2) for use in this CMS.

2.5.1 Human Health Risk Assessment (HHRA) Summary

The baseline HHRA in the Supplemental RFI/RI is a qualitative and quantitative assessment of actual or potential risks for SWMU 7. A discussion of the SWMU 7 baseline HHRA is presented in the Supplemental RFI/RI. A list of chemicals of potential concern (COPCs) was developed for each medium covered by this CMS report. Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment.

The COPCs were selected for each environmental medium sampled at SWMU 7, except groundwater, which was determined not to be a medium of potential concern to human receptors. The potential receptors that apply to media sampled at SWMU 7 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, future excavation workers, and future residents. All potential receptors and exposure pathways were evaluated quantitatively.

The estimated cumulative carcinogenic and noncarcinogenic risks for hypothetical future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers at SWMU 7 are listed in Table 2-1. The total risk for each exposure route and the cumulative risk across pathways are also included. The HHRA was prepared in four parts: carcinogenic risks, noncarcinogenic risks, a comparison of groundwater results to the screening criteria, and a special note concerning fish.

2.5.1.1 Carcinogenic Risks

The estimated carcinogenic risk for the future resident (3E-04) is greater than the U.S. EPA "target risk range" of 1E-04 to 1E-06. Four soil/sediment exposure routes contributed a significant portion to the incremental cancer risk (ICR) for the future resident. Estimated cancer risks attributed to exposure to surface soil were 9E-05 (ingestion) and 2E-04 (dermal contact). Estimated cancer risks attributed to exposure to sediment were 6E-06 (ingestion) and 1E-05 (dermal contact). The principal COPCs contributing to these cancer risks were Aroclor 1260 in surface soil and arsenic in surface soil and sediment. Aroclor 1260 was detected in surface soil at high concentrations (i.e., greater than 10,000 µg/kg) in two samples (S7CONF2 and S7CONF-5). Arsenic was detected at levels in surface soil that slightly exceeded background levels (site concentrations ranged from 0.29 mg/kg to 4.9 mg/kg;

background concentrations ranged from 0.63 mg/kg to 2.7 mg/kg). Arsenic was detected at levels in sediment soil that were within the range of background levels (site concentrations ranged from 3.6 mg/kg to 5.75 mg/kg; background concentrations ranged from 1.5 mg/kg to 7.0 mg/kg).

The estimated carcinogenic risks for the trespasser adult (1E-05), trespasser adolescent (1E-05), maintenance worker (6E-06), excavation worker (1E-07) and occupational worker (5E-05) are within the U.S. EPA target risk range. For all exposure pathways, the principal COPCs contributing to these cancer risks were Aroclor 1260 and arsenic.

2.5.1.2 Noncarcinogenic Risks

The estimated noncarcinogenic hazard index (HI) for the future resident (3.2) exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in an exposure assessment. Two surface water and two surface soil exposure routes contributed the significant portion to the HI for the future resident. Estimated hazard quotients (HQs) attributed to exposure to surface water were 1.3 (ingestion) and 0.9 (dermal contact). Estimated HQs attributed to exposure to surface soil were 0.5 (ingestion) and 0.3 (dermal contact). The principal COPC in surface water contributing to the noncarcinogenic risk is antimony (2.2). The principal COPCs in surface soil contributing to the noncarcinogenic risk are antimony (0.2), arsenic (0.5), and iron (0.2). The target organs for these chemicals are as follows: antimony (heart), arsenic (skin), and iron (pancreas and liver). The HI does exceed 1.0 for the heart as a target organ. Antimony was present at levels in surface water that were within the range of background concentrations (one detection was found at 2.5 µg/L; background concentrations ranged from 2.6 µg/L to 5.2 µg/L). Antimony was also present in sediment at one sampling location that exceeded background (one detection was found at 7.0 mg/kg; no background detections were observed).

2.5.1.3 Quantitative and Qualitative Risk Assessment for Groundwater

Groundwater was not evaluated as part of the baseline HHRA because it is classified as Class G-III, nonpotable water by FDEP. As discussed in the Supplemental RFI/RI Report (B&R Environmental, 1998), groundwater obtained from the surficial aquifer at Key West has a high salinity and the public water supply obtained from the mainland is officially designated as the only potable source. No public registered domestic freshwater wells exist, although domestic wells are reportedly used for purposes such as flushing water. Although treatment could possibly be used to improve water quality, the local water authority has the authority to regulate all potable supplies in the keys. A preliminary comparison of unfiltered groundwater concentrations at SWMU 7 versus tap water risk-based concentrations (RBCs) (U.S. EPA, 1996a) and MCLs (U.S. EPA, 1996b) is presented in Tables 2-2 and 2-3 to provide a benchmark of the magnitude of contamination in groundwater. As illustrated on these tables, antimony was detected at a concentration of 46 µg/L which exceeds the MCL of 6 µg/L for antimony. Additional, RBCs were exceeded for antimony, arsenic, chromium (total), and cyanide.

2.5.1.4 Fish and the Quantitative Risk Assessment

Fish and shellfish at SWMU 7 were not considered a human health concern because the surface water contained within the ponds is not large enough to sustain edible fish. A more complete discussion of this subject is presented in Section 3 of the supplemental RFI/RI report (B&R Environmental, 1998).

2.5.2 Chemicals Of Concern

Chemicals of concern (COCs) for use in this CMS are selected based on two sets of Criteria, U.S. EPA Region IV and FDEP soil cleanup goals. Other sources of risk-based criteria include RCRA Corrective Action Levels and ARARs.

2.5.2.1 Chemicals of Concern Based on U.S. EPA Region IV Criteria

From the COPCs chosen for each medium in the baseline HHRA, COCs were selected based on U.S. EPA Region IV criteria. The U.S. EPA Region IV criteria for selecting COCs are based on those chemicals that contribute a significant cancer risk (1E-06 or more) or a non-cancer HQ above 0.1 in conjunction with a receptor scenario having a total risk (combined across pathways) above the level of concern (1E-04 cancer risk or an HI of 1.0). The COCs selected based on U.S. EPA Region IV criteria at SWMU 7 are as follows.

When the risk assessment was prepared, beryllium was evaluated as a carcinogen. In April 1998, the EPA withdrew the cancer slope factor for beryllium from the IRIS database. Therefore, at this time, beryllium would only be evaluated as a noncarcinogen. However, because beryllium does not significantly affect risk to human health and for the sake of consistency with the RFI, beryllium is still identified as a carcinogen in this CMS.

Surface Soils

Based on Future Residential Exposure Scenario

- Antimony [noncancer risk (heart)]
- Aroclor 1260 (cancer risk)

- Arsenic (cancer risk)
- Benzo(a)anthracene (cancer risk)
- Benzo(a)pyrene (cancer risk)
- Benzo(b)fluoranthene (cancer risk)
- Beryllium (cancer risk)
- Indeno(1,2,3-cd)pyrene (cancer risk)

Sediment

Based on Future Resident (Recreational Use)

- Aroclor 1260 (cancer risk)
- Arsenic (cancer risk)
- Benzo(b)fluoranthene (cancer risk)

Surface Water

Based on Future Resident (Recreational Use)

- Antimony [noncancer risk (heart)]
- Beryllium (cancer risk)
- Mercury (selection based on AWQC exceedence for Water and Aquatic Organisms)

2.5.2.2 Chemicals of Concern Based on FDEP Criteria

From the COPCs chosen for each medium in the baseline HHRA, COCs were selected based on FDEP's recommended approach. The FDEP approach for selecting COCs are those chemicals that contributed a significant cancer risk (1E-06 or more) or a non-cancer HI above 1.0 (affected the same target organ). The COCs selected based on the FDEP approach at SWMU 7 are as follows.

Surface Soils

Based on Future Residential Exposure Scenario

- Antimony [noncancer risk (heart)]
- Aroclor 1260 (cancer risk)

- Arsenic (cancer risk)
- Benzo(a)anthracene (cancer risk)
- Benzo(a)pyrene (cancer risk)
- Benzo(b)fluoranthene (cancer risk)
- Beryllium (cancer risk)
- Indeno(1,2,3-cd)pyrene (cancer risk)

Based on Future Trespasser Adult and Adolescent, Maintenance Worker, and Occupational Worker

- Aroclor 1260 (cancer risk)
- Arsenic (cancer risk)
- Benzo(a)pyrene (cancer risk)

Sediment

Based on Future Resident (Recreational Use)

- Aroclor 1260 (cancer risk)
- Arsenic (cancer risk)
- Benzo(b)fluoranthene (cancer risk)

Based on Future Trespasser Adult and Adolescent, Maintenance Worker, and Occupational Worker

- Arsenic (cancer risk)

Surface Water

Based on Future Resident (Recreational Use)

- Antimony [noncancer risk (heart)]
- Beryllium (cancer risk)
- Mercury (selection on AWQC exceedence for water and aquatic organisms)

Based on Future Trespasser Adult & Adolescent

- Arsenic (cancer risk)

2.5.3 Revised Surface Soil COCs Based on the Exclusion of Samples East of the Road Next to SWMU 7

Surface soil COCs (based on the risk assessment presented in the Supplemental RI/RFI) developed in Section 2.4.2 in this CMS were revised because surface soil samples east of the road that runs next to SWMU 7 are being excluded from this CMS and will be evaluated separately. The excluded surface soil samples include SBS7-13A, SBS7-16, SBS7-21, SBS7-22, SBS7-23, and SBS7-24. Table 2-4 presents the chemicals detected in surface soil at SWMU 7 based on the exclusion of these samples. All PAHs detected in surface soil at SWMU 7 were found in the excluded samples. Therefore, PAHs were eliminated as COCs from surface soil. For the other risk drivers at SWMU 7, metals and Aroclor 1260, there was no significant change to the representative concentrations resulting from the exclusion of these six surface soil samples. Therefore, the revised surface soil COCs selected based on two sets of criteria, U.S. EPA Region IV and FDEP soil cleanup goals, are as follows:

2.5.3.1 Revised Surface Soil COCs Based on U.S. EPA Region IV Criteria

Surface Soils

Based on Future Residential Exposure Scenario

- Antimony [noncancer risk (heart)]
- Aroclor 1260 (cancer risk)
- Arsenic (cancer risk)
- Beryllium (cancer risk)

2.5.3.2 Revised Surface Soil COCs Based on FDEP Criteria

Surface Soils

Based on Future Residential Exposure Scenario

- Antimony [noncancer risk (heart)]
- Aroclor 1260 (cancer risk)
- Arsenic (cancer risk)

- Beryllium (cancer risk)

Based on Future Trespasser Adult & Adolescent, Maintenance Worker, and Occupational Worker

- Aroclor 1260 (cancer risk)
- Arsenic (cancer risk)

2.6 ECOLOGICAL RISK ASSESSMENT SUMMARY

The maximum contaminant concentrations in surface soils, sediment, surface water, and groundwater were used as representative exposure point concentrations for screening against threshold values. Potential exposure routes considered in the Supplemental RFI/RI for aquatic and terrestrial receptors are ingestion of contaminated food, incidental ingestion of soil, sediments, and contaminated surface water, direct contact with sediments, soil, and surface water, and root translocation and direct aerial deposition. Ecological COPCs were identified in the ecological risk assessment (ERA) at SWMU 7 for groundwater, surface water, sediment, and surface soil. Tables 2-4 through 2-7 identify these COPCs and include the range of detected values, ecological threshold values, HQs, and the reason the contaminant was retained or eliminated as a COPC.

The Supplemental ERA for SWMU 7 concluded that contaminants that are present do not pose significant environmental risks. Soil contaminants do not appear to have bioaccumulated in vegetation to any significant extent. The aquatic habitat at the site is limited, resulting in minimal use of the site and the vicinity by aquatic receptors. Overall potential risk to aquatic and terrestrial receptors appears to be low. Soil COCs consist of semivolatile and volatile compounds that were detected east of the road that parallels Building A-824; however, as previously discussed, these COCs will be addressed by the base UST program. Therefore, no ecological COPCs were retained as final COCs in the ecological assessment for this CMS report.

TABLE 2-1

CUMULATIVE HUMAN HEALTH RISKS
SWMU 7*
NAS KEY WEST, KEY WEST, FLORIDA
PAGE 1 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Dermal Contact	2E-4	7E-6	7E-6	5E-6	NA	4E-5
Incidental Ingestion	9E-5	2E-6	2E-6	1E-6	NA	1E-5
Inhalation of Fugitive Dust	1E-12	9E-15	6E-15	1E-14	NA	2E-13
Subtotal of Medium	**3E-4**	9E-6	9E-6	6E-6	NA	5E-5
Subsurface Soil						
Dermal Contact	NA	NA	NA	NA	7E-8	NA
Incidental Ingestion	NA	NA	NA	NA	3E-8	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	1E-15	NA
Subtotal of Medium	NA	NA	NA	NA	1E-7	NA
Sediment						
Dermal Contact	1E-5	2E-6	2E-6	NA	NA	NA
Incidental Ingestion	6E-6	3E-7	4E-7	NA	NA	NA
Subtotal of Medium	2E-5	2E-6	2E-6	NA	NA	NA
Surface Water						
Dermal Contact	7E-7	9E-8	8E-8	NA	NA	NA
Incidental Ingestion	2E-6	2E-7	2E-7	NA	NA	NA
Subtotal of Medium	2E-6	2E-7	3E-7	NA	NA	NA
Shellfish						
Incidental Ingestion	NA	NA	NA	NA	NA	NA
Subtotal of Medium	NA	NA	NA	NA	NA	NA
TOTAL	**3E-4**	1E-5	1E-5	6E-6	1E-7	5E-5

TABLE 2-1

CUMULATIVE HUMAN HEALTH RISKS
SWMU 7*
NAS KEY WEST, KEY WEST, FLORIDA
PAGE 2 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
HAZARD INDEX						
Surface Soil						
Dermal Contact	3E-1	1E-2	2E-2	7E-3	NA	6E-2
Incidental Ingestion	5E-1	4E-3	8E-3	2E-3	NA	2E-2
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal of Medium	8E-1	2E-2	3E-2	9E-3	NA	8E-2
Subsurface Soil						
Dermal Contact	NA	NA	NA	NA	5E-3	NA
Incidental Ingestion	NA	NA	NA	NA	1E-2	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal of Medium	NA	NA	NA	NA	2E-2	NA
Sediment						
Dermal Contact	1E-1	2E-2	2E-2	NA	NA	NA
Incidental Ingestion	1E-1	3E-3	6E-3	NA	NA	NA
Subtotal of Medium	2E-1	2E-2	3E-2	NA	NA	NA
Surface Water						
Dermal Contact	9E-1	4E-2	6E-2	NA	NA	NA
Incidental Ingestion	1E+0	7E-2	1E-1	NA	NA	NA
Subtotal of Medium	**2E+0**	1E-1	2E-1	NA	NA	NA
Shellfish						
Incidental Ingestion	NA	NA	NA	NA	NA	NA
Subtotal of Medium	NA	NA	NA	NA	NA	NA
TOTAL	**3E+0**	1E-1	3E-1	9E-3	2E-2	8E-2

* = Chemical-specific risks are presented in Appendix A
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
A bolded value indicates that an ICR of 1.0E-6 or an HI of 1 has been exceeded.
NA = Not applicable, pathway is not applicable for the respective medium.

TABLE 2-2

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLS AND RBCS INORGANICS IN GROUNDWATER AT SWMU 7 (µg/L) NAS KEY WEST

Chemical	Background			Site				Maximum Contaminant Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values				
Antimony	0/12	Not detected	–	1/4	46	45.95	16.24	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	2/4	4.3 - 4.7	4.5	5.39	50	N	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	4/4	10 - 39.5	22.18	22.18	2,000	N	260	N
Chromium*	3/13	0.71 - 13	2.51	2/4	13.9 - 22.1	18	9.50	100	N	18	Y
Cyanide	2/8	2.4 - 5.525	1.47	1/3	190 - 190	190	63.80	200	N	73	Y
Lead	1/12	2.5 - 2.5	1.39	2/4	5.9 - 9.5	7.7	4.60	15***	N	15	N
Manganese	7/10	2 - 10	3.78	2/2	6 - 9	7.6	7.60	–	NA	84	N
Mercury	4/13	0.13 - 0.24	0.10	1/4	0.24	0.24	0.12	2	N	1.1	N
Sulfide	3/3	10,000 - 52,000	28000	1/1	4,000	4,000	4,000	–	NA	–	NA
Zinc	3/13	3.425 - 15.3	2.82	2/4	16.7 - 17.8	17.23	9.11	–	NA	1,100	N

Notes:

Maximum Contaminant Levels (MCLs) are from Drinking Water Regulations and Health Advisories (EPA, 1996a).

Risk-based screening levels (RBCs) represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Applicable RBCs originate from EPA Region 3 RBCs for residential exposure, tap water ingestion, with non-cancer risk adjusted to 0.1 hazard index.

An RBC for lead based on cancer risk or hazard index is not available. The 15 µg/L EPA MCL is used as an applicable RBC for tap water ingestion.

NA = Not Applicable

*As Total chromium

***Lead Action Level

TABLE 2-3

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs
ORGANICS IN GROUNDWATER AT SWMU 7 (µg/L)
NAS KEY WEST

	Background			Site							
Chemical	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values	Maximum Contaminant Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	0/7	Not detected	–	1/1	2 - 2	2	2	6	N	4.8	N
VOLATILE ORGANIC COMPOUNDS											
2-butanone	2/4	7 - 32	11.63	1/1	2 - 2	2	2	–	NA	190	N
Acetone	1/4	5 - 5	5.00	1/1	5 - 5	5	5	–	NA	370	N
Methylene chloride	2/4	1 - 1	1.75	1/2	1 - 1	1	4.25	5	N	4.1	N

Notes:
Maximum Contaminant Levels (MCLs) are from Drinking Water Regulations and Health Advisories (EPA, 1996a).
Risk-based screening levels (RBCs) represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Applicable RBCs originate from EPA Region 3 RBCs for residential exposure, tap water ingestion, with non-cancer risk adjusted to 0.1 hazard index.
NA = Not Applicable.

TABLE 2-4

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 7
NAS KEY WEST
PAGE 1 OF 2

Location	Source(1)	Parameter	Result	Qual.(2)
INORGANICS (mg/kg)				
S7SB-9	IT 1993	Antimony	4.9	B_1
S7SB-7	IT 1993	Antimony	4.7	B_1
S7SB-11	IT 1993	Antimony	3.7	B_1
S7SB-14	IT 1993	Arsenic	4.9	
S7SB-18	IT 1993	Arsenic	4.5	
S7SB-9	IT 1993	Arsenic	1.8	B_1
S7SB-5	IT 1993	Arsenic	1.2	
S7SB-11	IT 1993	Arsenic	0.97	B_1
S7SB-3	IT 1993	Arsenic	0.71	B_1
S7SB-7	IT 1993	Arsenic	0.57	B_1
S7SB-12	IT 1993	Arsenic	0.29	B_1
S7SB-11	IT 1993	Barium	9.3	B_1
S7SB-3	IT 1993	Barium	7.6	B_1
S7SB-5	IT 1993	Barium	6.8	B_1
S7SB-9	IT 1993	Barium	5.8	B_1
S7SB-18	IT 1993	Barium	4.9	B_1
S7SB-7	IT 1993	Barium	4.8	B_1
S7SB-12	IT 1993	Barium	4.6	B_1
S7SB-14	IT 1993	Barium	4	B_1
S7SB-11	IT 1993	Beryllium	0.18	B_1
S7SB-3	IT 1993	Beryllium	0.14	B_1
S7SB-5	IT 1993	Beryllium	0.14	B_1
S7SB-7	IT 1993	Beryllium	0.13	B_1
S7SB-7	IT 1993	Chromium	31.5	
S7SB-11	IT 1993	Chromium	22.1	
S7SB-5	IT 1993	Chromium	5.2	
S7SB-14	IT 1993	Chromium	4.2	
S7SB-3	IT 1993	Chromium	3.9	
S7SB-9	IT 1993	Chromium	3.6	
S7SB-18	IT 1993	Chromium	3.3	
S7SB-12	IT 1993	Chromium	2.6	
S7SB-7	IT 1993	Copper	5.7	
S7SB-11	IT 1993	Copper	4.4	
S7SB-7	IT 1993	Lead	36.5	
S7SB-11	IT 1993	Lead	12.7	
S7SB-14	IT 1993	Lead	4.5	
S7SB-9	IT 1993	Lead	4.5	
S7SB-5	IT 1993	Lead	0.48	B_1
S7SB-18	IT 1993	Lead	0.3	B_1
S7SB-5	IT 1993	Mercury	0.06	
S7SB-7	IT 1993	Mercury	0.03	
S7SB-14	IT 1993	Mercury	0.03	
S7SB-11	IT 1993	Mercury	0.03	
S7SB-11	IT 1993	Nickel	2.9	B_1
S7SB-11	IT 1993	Vanadium	3.5	B_1
S7SB-5	IT 1993	Vanadium	2	B_1
S7SB-7	IT 1993	Vanadium	1.3	B_1
S7SB-7	IT 1993	Zinc	208	
S7SB-11	IT 1993	Zinc	119	
S7SB-14	IT 1993	Zinc	6.7	
S7SB-9	IT 1993	Zinc	3.8	
S7SB-5	IT 1993	Zinc	2.2	
S7SB-18	IT 1993	Zinc	1.5	B_1
S7SB-3	IT 1993	Zinc	1.1	B_1
S7SB-12	IT 1993	Zinc	0.75	B_1
PESTICIDES/PCBs (µg/kg)				
S7CONF-2(C)	BEI(C) 1995	Aroclor-1260	16,500	
S7CONF-5(C)	BEI(C) 1995	Aroclor-1260	10,000	P
S7CONF-4(C)	BEI(C) 1995	Aroclor-1260	730	
S7CONF-1(C)	BEI(C) 1995	Aroclor-1260	230	

TABLE 2-4

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 7
NAS KEY WEST
PAGE 2 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
S7SB-5	IT 1993	Bis(2-ethylhexyl)phthalate	120	B_2J
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
S7SB-5	IT 1993	Acetone	83	
S7SB-5	IT 1993	Cis-1,2-dichloroethene	2	J
S7SB-5	IT 1993	Methylene chloride	28	B_2
S7SB-5	IT 1993	Toluene	1	J

Shading indicates a concentration in excess of the screening values (See Table C.3-1).

1 Data Sources:
IT 1994 - RFI/RI conducted in 1993 by IT Corporation
B&RE 1998 - Supplemental RFI/RI conducted in 1996 by B&R Environmental
Sample locations SBS7-13A, SBS7-16, SBS7-21, SBS7-22, SBS7-23, and SBS7-24 have been removed from these data sources.

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
J - The associated value is an estimated quantity.
P - Qualifier definition not available.
B_2 - Analyte was found in the blank as well as the sample.

TABLE 2-5

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER (µg/L) - SWMU 7
NAS KEY WEST

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
INORGANICS						
Barium	2/2	10.2	10 - 13	10,000	0.00	Eliminated - does not exceed 2 X background
Manganese	2/2	3.78	6.2 - 9	10	0.90	Eliminated - does not exceed threshold
Mercury	1/2	0.1	0.24	0.025	9.60	Retained - exceeds 2 X background and HQ > 1

TABLE 2-6

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L) - SWMU 7
NAS KEY WEST

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
INORGANICS						
Antimony	3/8	33.71	90.5 - 220	4,300	0.05	Eliminated - does not exceed threshold
Arsenic	1/9	3.97	2.5	50	0.05	Eliminated - does not exceed 2 X background
Barium	8/8	6.93	8 - 40.4	10,000	0.004	Eliminated - does not exceed threshold
Beryllium	1/9	0.22	1.1	0.13	8.5	Retained - exceeds 2 X background and HQ > 1
Chromium	4/9	2.62	2.3 - 2.7	50	0.05	Eliminated - does not exceed 2 X background
Cyanide	1/6	ND	2.6	1	2.6	Retained - HQ > 1
Iron	1/5	24.7	168	300	0.6	Eliminated - does not exceed threshold
Manganese	5/5	2	8.7 - 13.2	10	1.3	Retained - exceeds 2 X background and HQ > 1
Mercury	4/9	0.52	0.12 - 0.34	0.025	13.6	Eliminated - does not exceed 2 X background
Tin	3/4	ND	30 - 180	73	2.5	Retained - HQ > 1
Zinc	3/9	7.19	3.8 - 31.2	86	0.4	Eliminated - does not exceed threshold
VOLATILE ORGANIC COMPOUNDS						
Methylene chloride	2/4	1.5	2 - 2	2,560	0.0007	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 2-7

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - SWMU 7
NAS KEY WEST
PAGE 1 OF 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	5/5	1331.89	1,630 - 4,330	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Antimony	1/9	ND	7	12	0.6	Eliminated - does not exceed threshold
Arsenic	6/9	2.63	3.6 - 5.8	7.24/70	0.8	Eliminated - does not exceed threshold
Barium	9/9	9.27	5.6 - 14.9	40	0.4	Eliminated - does not exceed 2 X background
Beryllium	4/9	0.06	0.28 - 0.46	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	6/9	0.22	0.77 - 2.8	0.676/9.6	4.1/0.3	Retained - exceeds 2 X background and HQ > 1
Chromium	9/9	5.01	6.9 - 32.3	52.3	0.6	Eliminated - does not exceed threshold
Copper	9/9	8.88	11.6 - 127	18.7/270	6.8/0.5	Retained - exceeds 2 X background and HQ > 1
Cyanide	1/2	ND	13	0.1	130	Retained - HQ > 1
Lead	9/9	17.97	29.5 - 209	30.2/218	6.9/0.96	Retained - exceeds 2 X background and HQ > 1
Manganese	5/5	15.39	14.6 - 30.5	460	0.07	Eliminated - does not exceed 2 X background
Mercury	6/9	0.05	0.13 - 1.8	0.13/0.71	13.8/2.5	Retained - exceeds 2 X background and HQ > 1
Nickel	6/9	2.15	3.6 - 11	15.9	0.7	Eliminated - does not exceed threshold
Silver	5/9	0.27	0.7 - 29.1	0.733/3.7	39.7/7.9	Retained - exceeds 2 X background and HQ > 1
Tin	3/4	2.85	23.5 - 200	NA	–	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	8/9	5.08	2.4 - 16.6	NA	–	Retained - exceeds 2 X background and no suitable threshold available
Zinc	9/9	25.74	83.7 - 487	124/410	3.9/1.2	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3/5	13.03	10.1 - 58	1.22/7.81	47.5/7.4	Retained - HQ > 1
4,4'-DDE	6/7	19.85	12.9 - 450	2.07/27	217/16.7	Retained - HQ > 1
4,4'-DDT	2/5	13.02	5.7 - 674	1.19/4.77	566/141	Retained - HQ > 1
alpha-BHC	2/4	7.11	2.5 - 5.6	6/100	0.9/0.06	Eliminated - does not exceed threshold
Aroclor-1260	3/6	70.57	56.4 - 510	5/240	102.0/2.1	Retained - HQ > 1

TABLE 2-7

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - SWMU 7
NAS KEY WEST
PAGE 2 OF 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
delta-BHC	3/5	7.35	5 - 13	3	4.3	Retained - HQ > 1
Dieldrin	1/4	ND	6	0.715/95	8.4/0.06	Retained - HQ > 1
Endrin	2/5	12.89	6.6 - 8.1	3.3/3.5	2.5/2.3	Retained - HQ > 1
gamma-BHC (lindane)	1/4	6.72	11.6	0.32/0.99	36.3/11.7	Retained - HQ > 1
gamma-chlordane	1/2	ND	51	0.5/0.6	102.0/8.5	Retained - HQ > 1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)anthracene	1/9	ND	1,910	74.8/1,600	25.5/1.2	Retained - HQ > 1
Benzo(b)fluoranthene	1/9	966.92	3,500	655/1,700	5.3/2.1	Retained - HQ > 1
Benzo(g,h,i)perylene	1/9	ND	992	655/1,700	1.5/0.6	Retained - HQ > 1
Bis(2-ethylhexyl)phthalate	2/7	1992.17	580 - 620	182/2,647	3.4/0.23	Retained - HQ > 1
Chrysene	1/9	961.38	2,120	108/2800	19.6/0.8	Retained - HQ > 1
Fluoranthene	1/9	982.38	4,000	113/5100	35.4/0.8	Retained - HQ > 1
Phenanthrene	1/9	ND	900	86.7/1100	10.4/0.8	Retained - HQ > 1
Pyrene	1/9	968.46	4,000	153/2600	26.1/1.5	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
2-butanone	1/2	8.49	8	NA	-	Retained - no suitable threshold available
Acetone	2/2	30.9	60 - 190	64	3.0	Retained - HQ > 1
Cis-1,2-dichloroethene	1/4	ND	3	23	0.1	Eliminated - does not exceed threshold
Methylene chloride	2/4	7.5	34 - 49	427	0.1	Eliminated - does not exceed threshold

NA = No suitable ecological threshold value was available.
ND = Not detected.

TABLE 2-8

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - SWMU 7
NAS KEY WEST
PAGE 1 OF 3

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	4/4	1,887.29	1,780 - 5,195	600	8.7	Retained - exceeds 2 X background and HQ > 1
Antimony	5/13	0.39	1.1 - 4.9	NA	—	Retained - exceeds 2 X background and no suitable threshold available
Arsenic	10/13	1.29	0.29 - 5.3	60	0.09	Eliminated - does not exceed threshold
Barium	13/13	10.51	4 - 18.8	440	0.04	Eliminated - does not exceed 2 X background
Beryllium	5/13	0.05	0.13 - 0.18	NA	–	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	2/13	0.15	0.42 - 0.75	20	0.04	Eliminated - does not exceed threshold
Chromium	13/13	6.02	2.6 - 31.5	0.4	78.8	Retained - exceeds 2 X background and HQ > 1
Cobalt	3/13	0.29	0.29 - 0.38	200	0.002	Eliminated - does not exceed 2 X background
Copper	7/13	5.43	4.4 - 67.2	50	1.3	Retained - exceeds 2 X background and HQ > 1
Lead	11/13	15.66	0.3 - 252.5	500	0.5	Eliminated - does not exceed threshold
Manganese	4/4	17.65	15.2 - 32.2	100	0.3	Eliminated - does not exceed 2 X background
Mercury	9/13	0.03	0.03 - 0.075	0.1	0.8	Eliminated - does not exceed threshold
Nickel	5/13	1.67	1.8 - 3.7	200	0.02	Eliminated - does not exceed threshold
Selenium	3/13	0.65	0.79 - 1.5	70	0.02	Eliminated - does not exceed threshold
Silver	1/13	ND	0.34	50	0.007	Eliminated - does not exceed threshold
Vanadium	8/13	3.97	1.3 - 8.5	20	0.4	Eliminated - does not exceed threshold
Zinc	13/13	15.22	0.75 - 208	200	1.0	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCB (µg/kg)						
4,4'-DDD	4/6	22.46	2.7 - 32.2	100	0.3	Eliminated - does not exceed threshold
4,4'-DDE	4/6	63.23	4 - 31.7	100	0.3	Eliminated - does not exceed threshold
4,4'-DDT	4/6	46.78	2.1 - 25.7	100	0.3	Eliminated - does not exceed threshold

TABLE 2-8

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - SWMU 7
NAS KEY WEST

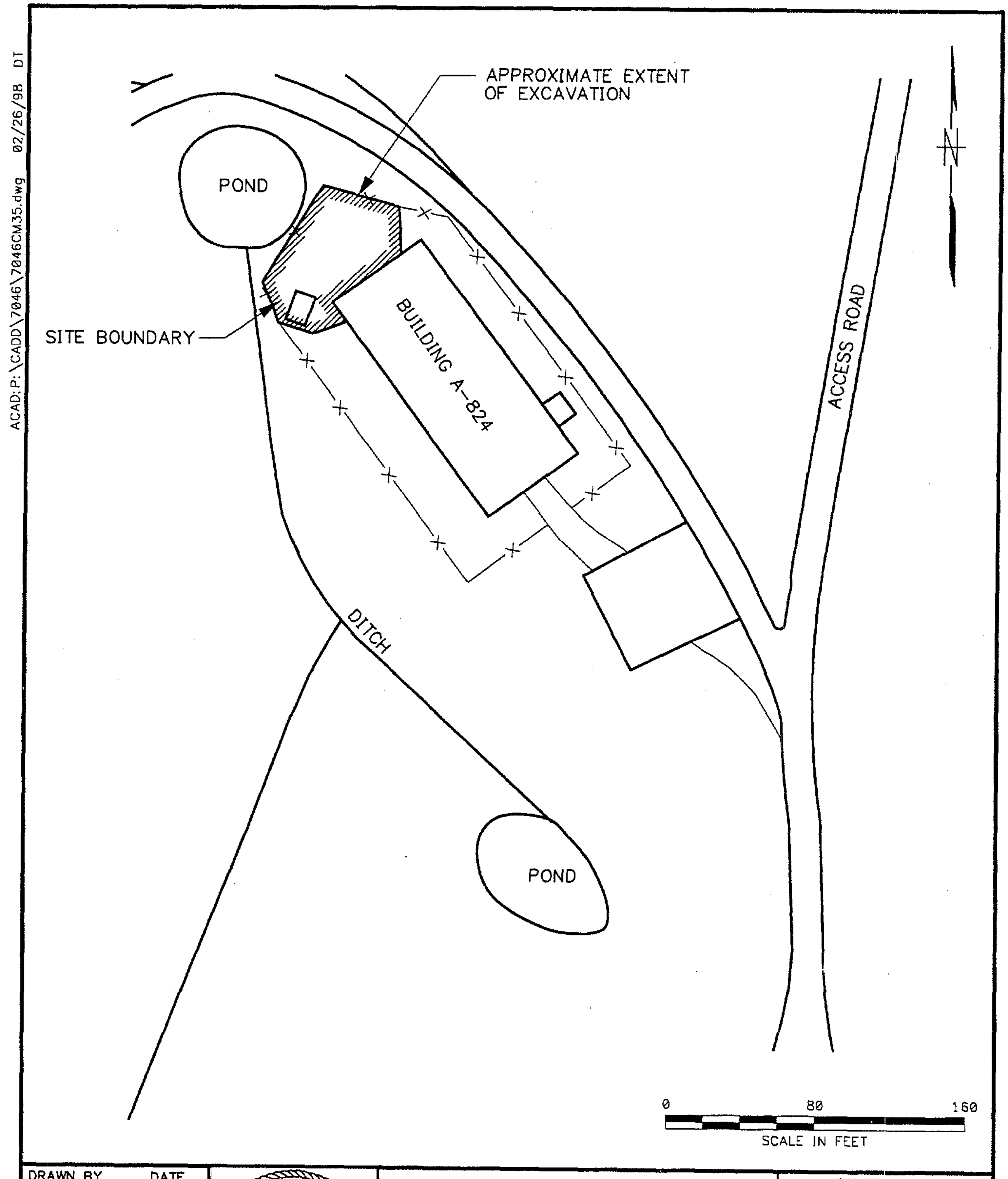
Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
2,4,5-T	1/6	ND	7	NA	–	Retained - no suitable threshold available
2,4,5-TP(Silvex)	1/6	ND	4.0	NA	–	Retained - no suitable threshold available
2,4-D	1/6	ND	7.43	NA	–	Retained - no suitable threshold available
alpha-BHC	1/6	ND	21.6	100	0.2	Eliminated - does not exceed threshold
Aroclor-1260	4/13	43.28	230 - 16,500	NA	–	Retained - no suitable threshold available
Endosulfan I	3/6	5.99	2.3 - 14.9	100	0.1	Eliminated - does not exceed threshold
Endosulfan II	1/6	ND	1.2	100	0.01	Eliminated - does not exceed threshold
Endrin	2/6	11.46	7.1 - 23.8	100	0.2	Eliminated - does not exceed threshold
Endrin aldehyde	1/4	ND	2.5	100	0.03	Eliminated - does not exceed threshold
Heptachlor	1/6	ND	2.8	100	0.03	Eliminated - does not exceed threshold
Heptachlor epoxide	1/6	ND	0.9	100	0.009	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
1,2-dichlorobenzene	2/12	ND	1.6 - 2,415	20,000	0.1	Eliminated - does not exceed threshold
1,3-dichlorobenzene	1/12	ND	481.5	20,000	0.02	Eliminated - does not exceed threshold
1,4-dichlorobenzene	1/12	ND	352.25	20,000	0.02	Eliminated - does not exceed threshold
Benzo(a)anthracene	3/13	ND	270 - 1,640	100	16.4	Retained - HQ > 1
Benzo(a)pyrene	2/13	ND	360 - 2,040	100	20.4	Retained - HQ > 1
Benzo(b)fluoranthene	3/13	414.89	380 - 3,340	100	33.4	Retained - HQ > 1
Benzo(g,h,i)perylene	2/13	ND	260 - 1,460	100	14.6	Retained - HQ > 1
Benzo(k)fluoranthene	1/13	ND	310	100	3.1	Retained - HQ > 1
Bis(2-ethylhexyl)phthalate	2/2	470.55	120 - 680	NA	–	Retained - no suitable threshold available
Chrysene	3/13	407.04	380 - 1,950	100	19.5	Retained - HQ > 1
Fluoranthene	3/13	434.18	380 - 3,020	100	30.2	Retained - HQ > 1
Indeno(1,2,3-cd)pyrene	2/13	ND	240 - 1,480	100	14.8	Retained - HQ > 1

TABLE 2-8

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - SWMU 7
NAS KEY WEST
PAGE 3 OF 3

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Retention or Elimination as an Ecological Chemical of Potential Concern (COPC)
Phenanthrene	1/13	ND	106	100	1.1	Retained - HQ > 1
Pyrene	3/13	420.61	350 - 2,410	100	24.1	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS (μg/kg)						
Acetone	2/2	3.67	42 - 83	NA	–	Retained - no suitable threshold available
Chlorobenzene	1/12	ND	117	40,000	0.003	Eliminated - does not exceed threshold
Cis-1,2-dichloroethene	2/8	ND	1 - 2	300	0.007	Eliminated - does not exceed threshold
Ethylbenzene	1/12	1.58	91.3	100	0.9	Eliminated - does not exceed threshold
Methylene chloride	2/8	2.8	18 - 28	300	0.09	Eliminated - does not exceed threshold
Toluene	1/12	1.62	1	100	0.01	Eliminated - does not exceed threshold
Xylenes, total	1/12	3.73	958	100	9.6	Retained - HQ > 1

NA = No suitable ecological threshold value was available.
ND = Not detected.



DRAWN BY DLT	DATE 2/25/98		SITE LOCATION MAP SWMU 7 NAVAL AIR STATION KEY WEST, FLORIDA	CONTRACT NO. 7046	
CHECKED BY	DATE			APPROVED BY	DATE
COST/SCHED-AREA				APPROVED BY	DATE
SCALE AS NOTED				DRAWING NO. FIGURE 2-1	REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

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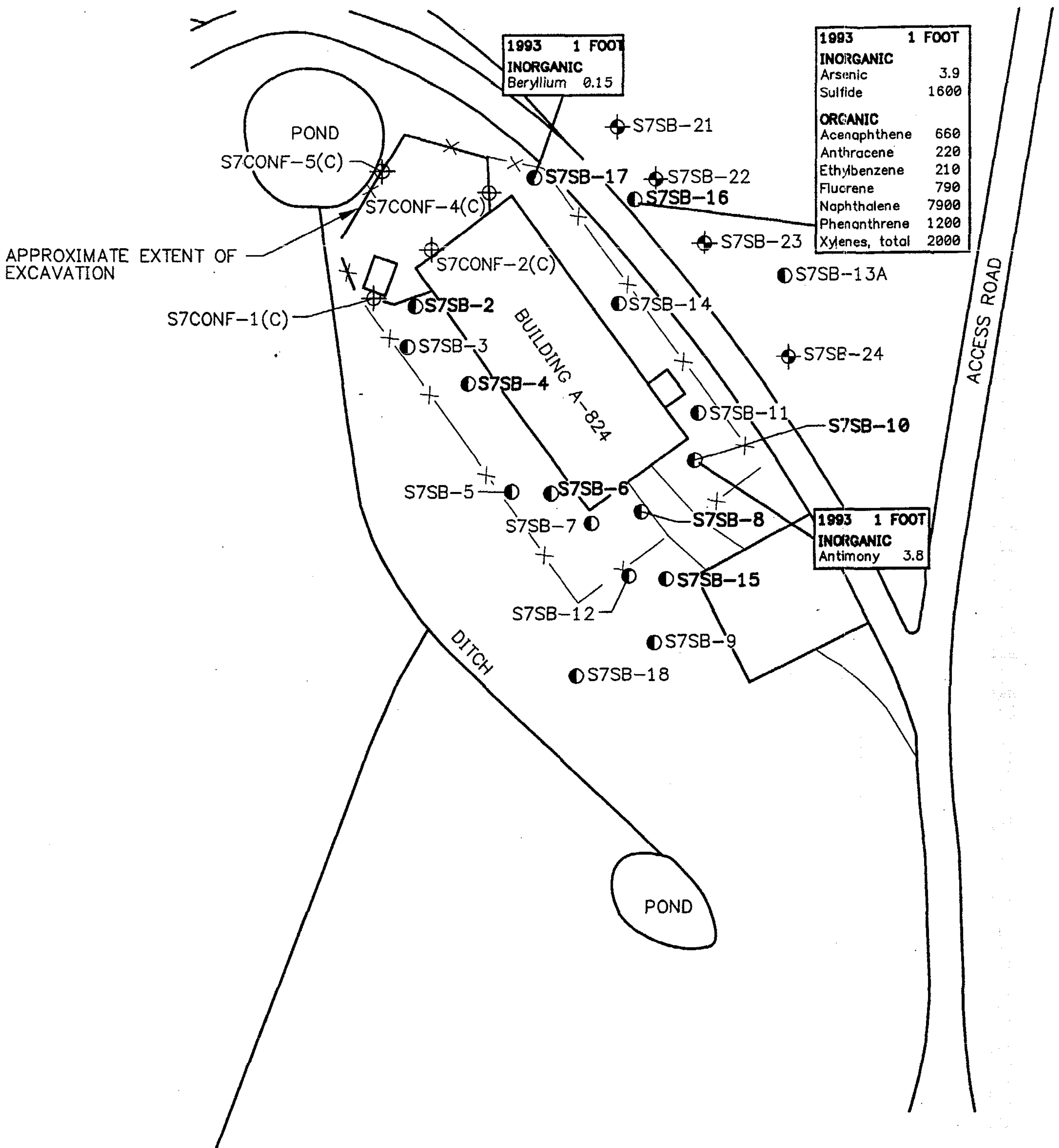

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Sulfide	98
ORGANIC	
Acenaphthene	100
Anthracene	100
Ethylbenzene	100
Fluorene	100
Naphthalene	100
Phenanthrene	100
Xylenes, total	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN THE SUPPLEMENTAL RFI/RI (B&R ENVIRONMENTAL, 1998)

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.
NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.
NOTE: THE DEPTHS IN THE RESULT BOXES INDICATE THE TOP OF THE INTERVAL SAMPLED.
NOTE: SUBSURFACE SOIL SAMPLE LOCATIONS ARE BOLD.

LEGEND:

- S7SB-2 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)
- S7CONF-1(C) ⌖ SOIL SAMPLE LOCATION BEI (1995)
- S7SB-21 ⌖ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

0 50 100
SCALE IN FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DLT DATE 2/24/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SUBSURFACE SOIL CHEMICAL CONCENTRATIONS EXCEEDING SCREENING VALUES
SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-2
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

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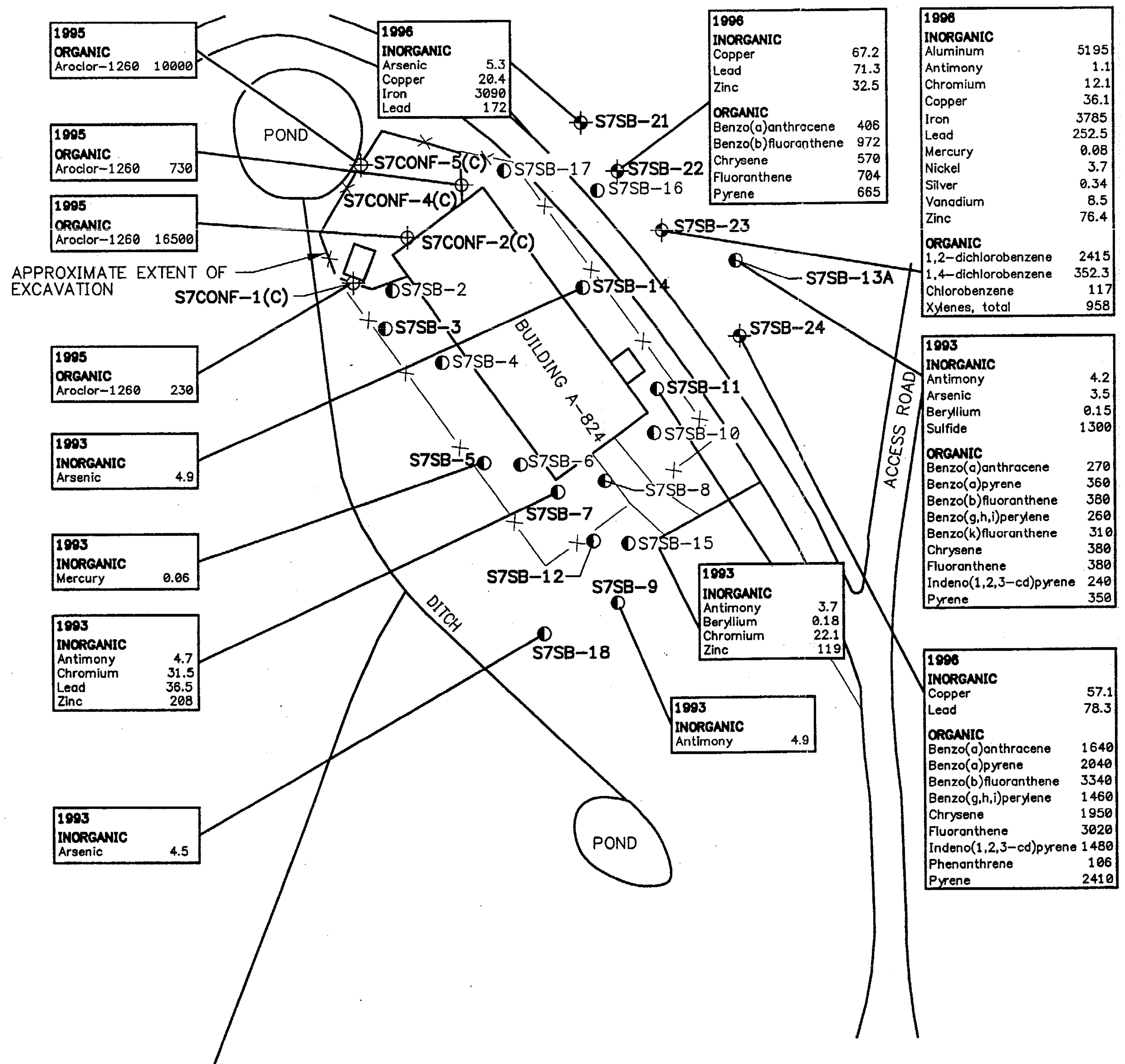

PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	3800
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Chromium	12
Copper	15
Iron	2300
Lead	31
Mercury	0.06
Nickel	3.4
Silver	1E-05
Sulfide	98
Vanadium	7.9
Zinc	30
ORGANIC	
1,2-dichlorobenzene	100
1,4-dichlorobenzene	100
Aroclor-1260	96
Benzo(a)anthracene	100
Benzo(a)pyrene	88
Benzo(b)fluoranthene	100
Benzo(g,h,i)perylene	100
Benzo(k)fluoranthene	100
Chlorobenzene	100
Chrysene	100
Fluoranthene	100
Indeno(1,2,3-cd)pyrene	100
Phenanthrene	100
Pyrene	100
Xylenes, total	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN THE SUPPLEMENTAL RFI/RI (B&R ENVIRONMENTAL, 1998)

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: SURFACE SOIL SAMPLE LOCATIONS ARE BOLD.

LEGEND:

S7SB-2 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)

S7CONF-1(C) ⊕ SOIL SAMPLE LOCATION BEI (1995)

S7SB-21 ⊕ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

0 50 100
SCALE IN FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DLT DATE 2/25/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SURFACE SOIL CHEMICAL CONCENTRATIONS EXCEEDING SCREENING VALUES
SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-3 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

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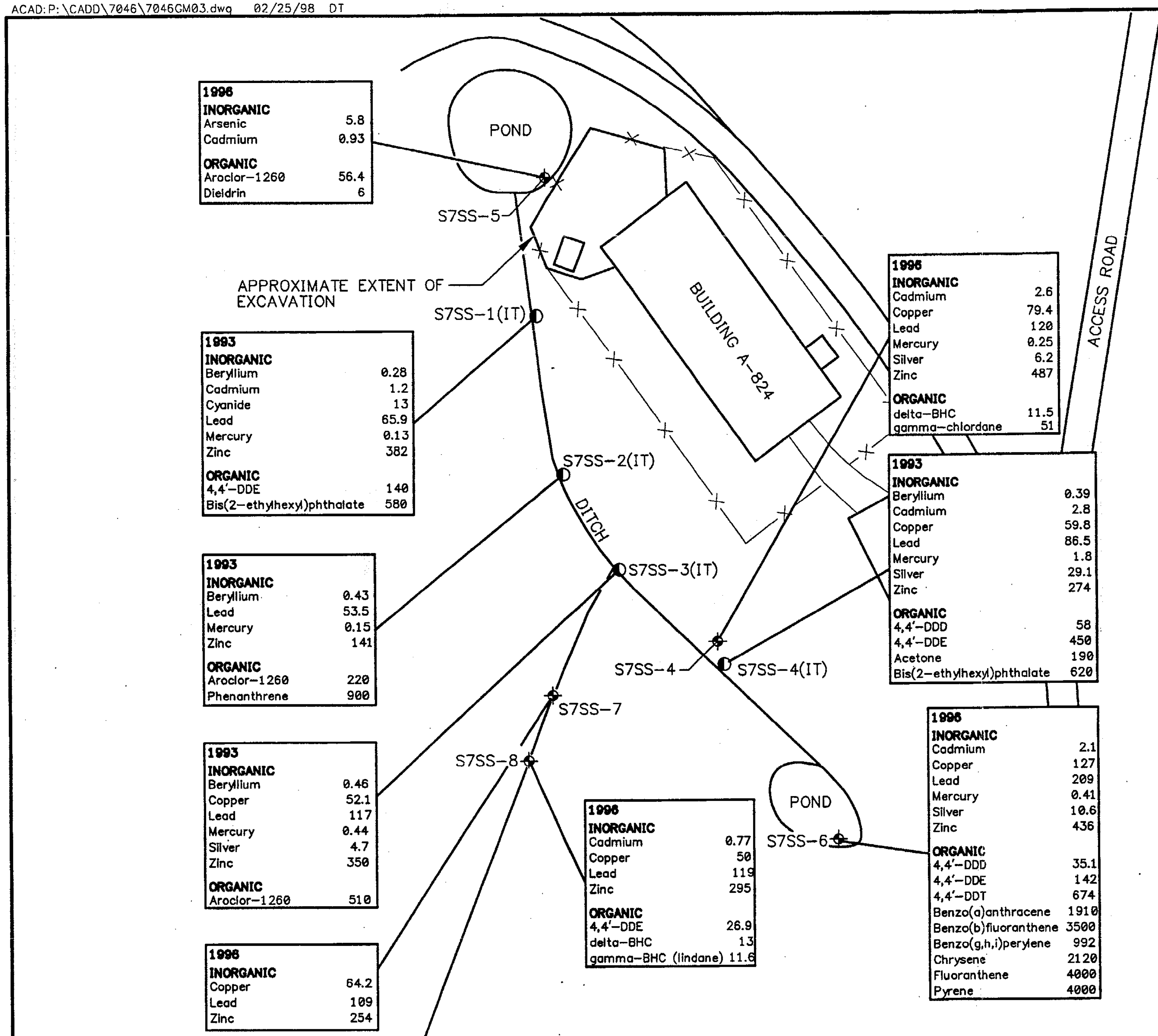

PARAMETER	SCREENING VALUE +
INORGANIC	
Arsenic	5.2
Beryllium	0.15
Cadmium	0.676
Copper	18.7
Cyanide	0.1
Lead	35
Mercury	0.13
Silver	0.733
Zinc	124
ORGANIC	
4,4'-DDD	13
4,4'-DDE	19.9
4,4'-DDT	13
Acetone	64
Aroclor-1260	22.7
Benzo(a)anthracene	74.8
Benzo(b)fluoranthene	880
Benzo(g,h,i)perylene	670
Bis(2-ethylhexyl)phthalate	182
Chrysene	108
delta-BHC	7.4
Dieldrin	0.715
Fluoranthene	113
gamma-BHC (lindane)	6.7
gamma-chlordane	0.5
Phenanthrene	86.7
Pyrene	153

\+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN THE SUPPLEMENTAL RFI/RI (B&R ENVIRONMENTAL, 1998)

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.
NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

LEGEND:

S7SS-1(IT) ◐ SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)

S7SS-4 ⌖ SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

0 50 100
SCALE IN FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DLT DATE 2/25/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY ★ SOUTHERN DIV FACILITIES ENGINEERING COMD

SEDIMENT CHEMICAL CONCENTRATIONS EXCEEDING SCREENING VALUES SWMU 7 NAVAL AIR STATION KEY WEST, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-4 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

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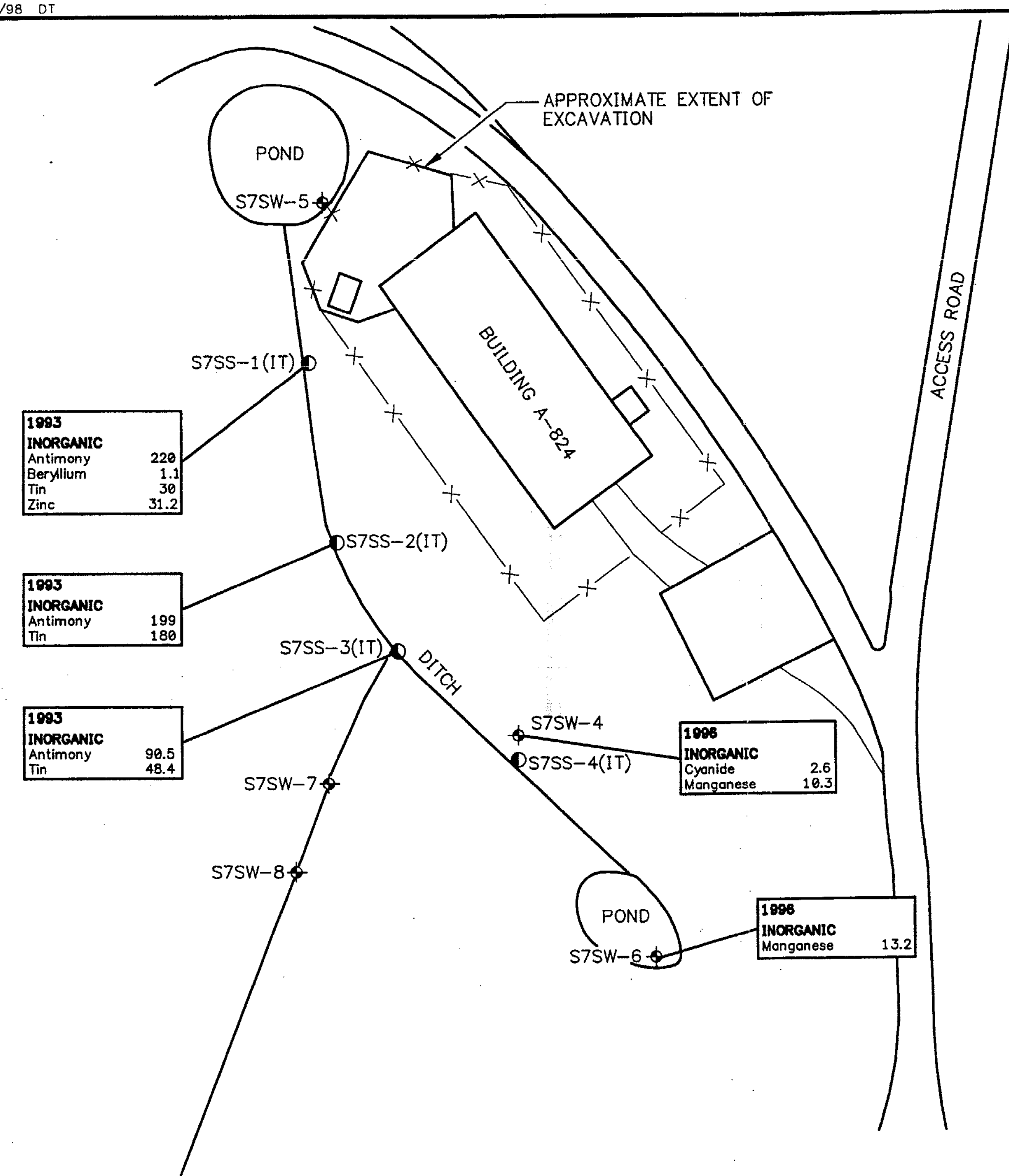

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	67
Beryllium	0.44
Cyanide	1
Manganese	10
Tin	0.01
Zinc	19

\+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN THE SUPPLEMENTAL RFI/RI

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

LEGEND:

S7SS-1(IT) ◐ SURFACE-WATER SAMPLE LOCATION IT CORPORATION (1993)

S7SW-5 ⌖ SURFACE-WATER SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

0 50 100
SCALE IN FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DLT DATE 2/24/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

**SURFACE-WATER CHEMICAL CONCENTRATIONS EXCEEDING SCREENING VALUES
SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA**

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-5 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

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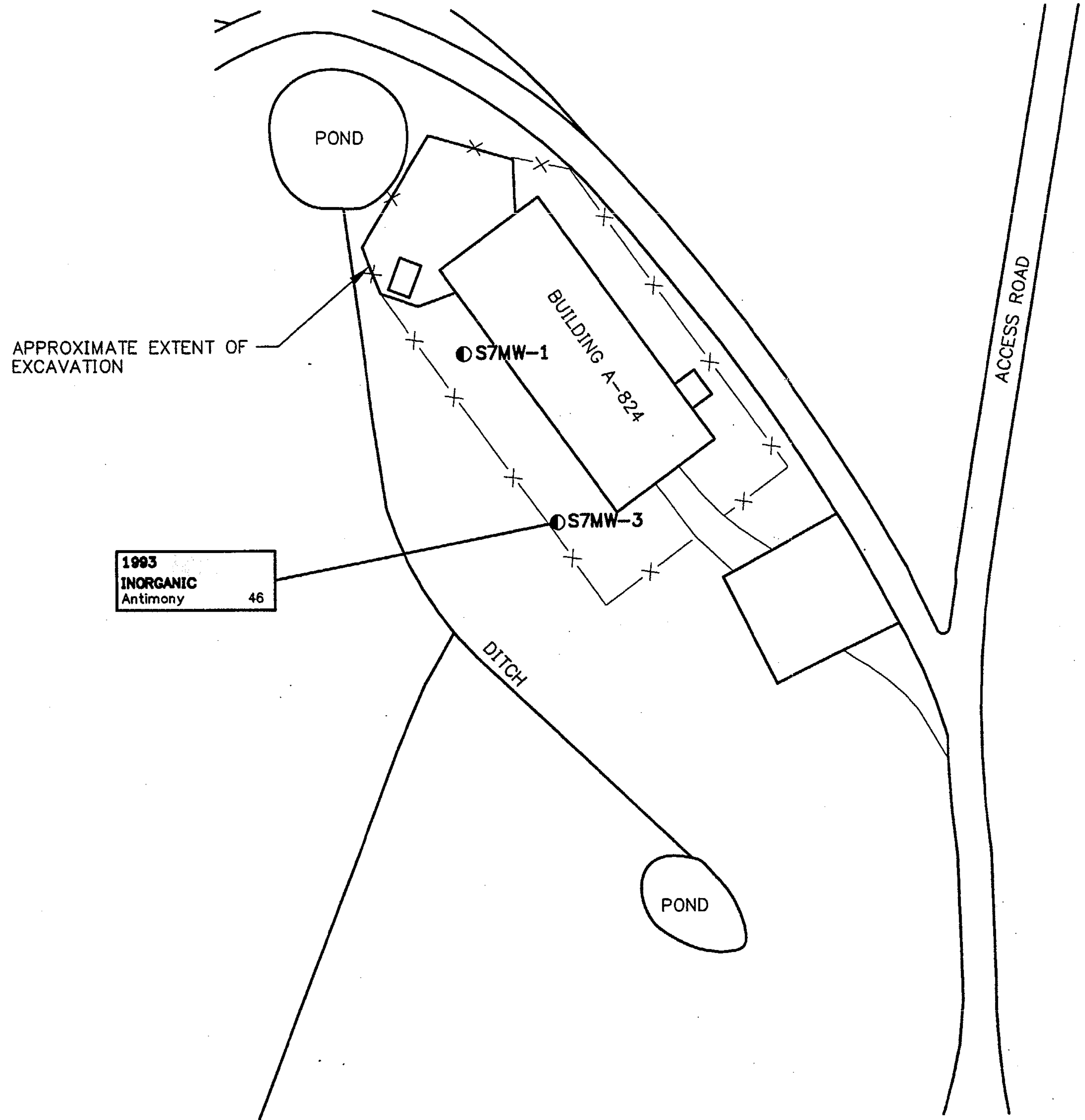

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6

\+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN THE SUPPLEMENTAL RFI/RI (B&R ENVIRONMENTAL, 1998)

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

NOTE: ALL SWMU 7 MONITORING WELLS WERE ALSO SAMPLED BY ENVIRONMENTAL IN 1996. SINCE NO DETECTED PARAMETERS EXCEEDED SCREENING VALUES, THERE IS NO FIGURE DEPIC 1996 GROUNDWATER CHEMICAL CONCENTRATIONS.

LEGEND:

S7MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DLT DATE 2/24/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

1993 GROUNDWATER CHEMICAL CONCENTRATIONS EXCEEDING SCREENING VALUES SWMU 7 NAVAL AIR STATION KEY WEST, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-6 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

3.0 CORRECTIVE ACTION OBJECTIVES

This section describes the development of the proposed CAOs for the NAS Key West SWMU 7, Boca Chica Building A-824. These CAOs and media clean-up standards are based on promulgated federal and state of Florida requirements, risk-derived standards, data and information gathered during the previous investigations, IRAs, the Supplemental RFI/RI, and additional applicable guidance documents. The development of the CAOs also includes the consideration of cross-media concentrations (concentrations in one medium that are protective of the migration of contaminants into another medium). The cross-media evaluation utilized modeling to determine contaminant fate and transport.

3.1 INTRODUCTION

CAOs are developed for each site as medium-specific and contaminant-specific objectives that will result in the protection of human health and the environment. Typically, CAOs are developed based on promulgated standards [e.g., Ambient Water Quality Criteria (AWQC)], background concentrations determined from a site-specific investigation, and human health and ecological risk-based concentrations developed in accordance with the U.S. EPA risk assessment guidance. The Supplemental RFI/RI (B&R Environmental, 1998) presents a complete description of the nature and extent of contamination, contaminant fate and transport, and baseline HHRA and ERA. In addition, conclusions and recommendations for potential SWMU 7 corrective measures are presented.

3.2 ARARS

3.2.1 Introduction

The applicable or relevant and appropriate requirements (ARARs), which include the requirements, criteria, or limitations promulgated under the Federal and state law that address a contaminant, action, or location at a site, are presented in this section.

The definition of ARARs is as follows:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-citing law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

One of the primary concerns during the development of corrective action alternatives for hazardous waste sites under RCRA is the degree of human health and environmental protection afforded by a given remedy. Consideration should be given to corrective measures that attain or exceed ARARs.

Definitions of the two types of ARARs, as well as other to be considered (TBC) criteria, are given below:

- Applicable Requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that directly and fully address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site.

- Relevant and Appropriate Requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that, while not "applicable," address problems or situations sufficiently similar (relevant) to those encountered at a site that their use is well suited (appropriate) to the particular site.

- TBC Criteria are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing remedial actions or necessary for determining what is protective of human health and/or the environment. Examples of TBC criteria include U.S. EPA Drinking Water Advisories, Carcinogenic Potency Factors, and Reference Doses.

These requirements are presented to provide the decision makers with a complete evaluation of potential ARARs in developing, identifying, and selecting a corrective measure alternative.

3.2.2 ARAR and TBC Categories

ARARs fall into three categories, based on the manner in which they are applied:

- Chemical Specific: Health/risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples of contaminant-specific ARARs include MCLs and Clean Water Act (CWA) water quality criteria. Contaminant-specific ARARs govern the extent of site cleanup.

- Location Specific: Restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. These may restrict or preclude certain remedial actions or may apply only to certain portions of site. Examples of location-specific ARARs include RCRA location requirements and floodplain management requirements. Location-specific ARARs pertain to special site features.

- Action Specific: Technology- or activity-based controls or restrictions on activities related to management of hazardous waste. Action-specific ARARs pertain to implementing a given remedy.

Table 3-1 presents a summary of potential federal and state ARARs and TBCs for corrective measures undertaken for SWMU 7 at NAS Key West. The following subsections present a brief description of each chemical- , location- , or action-specific ARAR and TBC contained in Table 3-1.

3.2.3 Chemical-Specific ARARs and TBCs

This section presents a summary of federal and state chemical-specific ARAR and TBC criteria for SWMU 7. These criteria provide medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants and are as follows:

The Safe Drinking Water Act (SDWA) promulgated National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) (40 CFR Part 141). MCLs are enforceable standards for contaminants in public drinking water supply systems. They consider not only health factors but also the economic and technical feasibility of removing a contaminant from a water supply system. Secondary MCLs (40 CFR Part 143) are not enforceable but are intended as guidelines for contaminants that may adversely affect the aesthetic quality of drinking water, such as taste, odor, color, and appearance, and may deter public acceptance of drinking water provided by public water systems.

The SDWA also established Maximum Contaminant Level Goals (MCLGs) for several organic and inorganic compounds in drinking water. MCLGs are set at levels of no known or anticipated adverse health effects, with an adequate margin of safety. The NCP [40 CFR Part 300.430(e)(2)(i)] states that MCLGs that are set at levels above zero shall be attained by remedial actions for groundwaters or surface waters that are current or potential sources of drinking water [where the MCLGs are relevant and appropriate under the circumstances of the release based on the factors in Section 300.400(g)(2) of the NCP]. If an MCLG is found not to be relevant and appropriate, the corresponding MCL shall be achieved where relevant and appropriate to the circumstances of the release. For MCLGs that are set at zero, the MCL promulgated for that contaminant under the SDWA shall be attained by the remedial actions. In cases involving multiple contaminants or pathways where attainment of chemical-specific ARARs will result in a cumulative cancer risk in excess of 1E-04, criteria in paragraph (e)(2)(i)(A) of Section 300.430

(i.e., risk-based criteria) may be considered when determining the clean-up level to be attained. The NCP explains that clean-up levels set at zero (generally the case for carcinogens) are not appropriate because complete elimination of risk is not possible and because "true zero" cannot be detected.

Since the groundwater at SWMU 7 is brackish and not used as a potable water supply, the SDWA is neither applicable nor relevant and appropriate.

The Clean Water Act (CWA) sets Ambient Water Quality Criteria (AWQC) that are non-enforceable guidelines developed for pollutants in surface waters pursuant to Section 304(a)(1) of the CWA. Although AWQCs are not legally enforceable, they should be considered as potential ARARs. AWQCs are available for the protection of human health from exposure to contaminants in surface water as well as from ingestion of aquatic biota and for the protection of freshwater and saltwater aquatic life. AWQCs may be considered for actions that involve groundwater treatment and/or discharge to nearby surface waters.

Florida Drinking Water Standards, Monitoring, and Reporting (Chapter 62-550 F.A.C.) set forth drinking water quality standards at least as stringent as the National Primary Drinking Water Regulations. MCLs that are promulgated by U.S. EPA are automatically incorporated into the Florida SDWA. If an MCL does not exist for a contaminant, the Florida SDWA requires that no contaminant that creates or has the potential to create an imminent and substantial danger to the public shall be introduced into a public water system.

Since the groundwater at SWMU 7 is brackish and not used as a potable water supply, the Florida SDWA is neither applicable nor relevant and appropriate.

The Clean Air Act (CAA) (42 USC 7401) consists of three programs or requirements that may be ARARs: National Ambient Air Quality Standards (NAAQS) (40 CFR Parts 50 and 53), National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61), and New Source Performance Standards (NSPS) (40 CFR Part 60). NESHAPs, which are emission standards for source types (i.e., industrial categories) that emit hazardous air pollutants, are not likely to be applicable or relevant and appropriate for NAS Key West because they were developed for a specific source.

U.S. EPA requires the attainment and maintenance of primary and secondary NAAQS to protect public health and public welfare, respectively. These standards are not source specific but rather are national limitations on ambient air quality. States are responsible for assuring compliance with the NAAQS. Requirements in the U.S. EPA-approved State Implementation Plan (SIP) for the implementation, maintenance, and enforcement of NAAQS are potential ARARs.

Requirements in the U.S. EPA-approved State Implementation Plan (SIP) for the implementation, maintenance, and enforcement of NAAQS are potential ARARs.

NSPS are established for new sources of air emissions to ensure that the new stationary sources minimize emissions. These standards are for categories of stationary sources that cause or contribute to air pollution that may endanger public health or welfare. Standards are based upon the best demonstrated available technology (BDAT)

Florida State Implementation Plan (SIP) (Chapter 62-204 F.A.C.) establishes maximum allowable levels of pollutants in the ambient air necessary to protect human health and public welfare and maximum allowable increases in ambient concentrations for subject pollutants to prevent significant deterioration of air quality. It provides three general classifications for determining which set of prevention of significant deterioration increments applies.

Proposed RCRA Action Levels (40 CFR Part 264) define the chemical concentration in a medium that would make that medium a RCRA-listed waste. Media contaminated at or above these levels would be considered hazardous waste and should be managed, transported, and disposed in accordance with Federal and RCRA requirements.

Biological Technical Assistance Group (BTAG) Screening Levels (U.S. EPA Region III, 1995b), Oak Ridge National Laboratory Benchmark Toxicity Values (Will & Suter, 1994), and Florida Soil Cleanup Goals (FDEP, 1995b and 1996) are published listings of ARARs and SALs for soil.

FDEP Sediment Quality Guideline (FDEP, 1994), U.S. EPA Region IV Sediment Screening Values (U.S. EPA, 1995a), Federal Sediment Quality Screening Values (U.S. EPA, 1996c) and U.S. EPA Sediment Quality Benchmark (U.S. EPA, 1996c) are published listings of ARARs and SALs for sediment.

Florida Surface-Water Quality Standards (Chapter 62-302 F.A.C.), U.S. EPA Region IV Chronic Surface-Water Screening Values (U.S. EPA, 1995a), National Ambient Water Quality Standards , U.S. EPA Region III Marine Standards (U.S. EPA, 1995b), and U.S. EPA Region III Fresh Water Standards (U.S. EPA, 1995b) are published listings of ARARs and SALs for surface water.

3.2.1.4 Location-Specific ARARs and TBCs

This section presents a summary of federal and state location-specific ARAR and TBC criteria of potential concern for SWMU 7. These potential ARARs and TBCs are as follows:

Federal Protection of Wetlands Executive Order (E.O. 11990) requires federal agencies, in carrying out their responsibilities, to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands (unless there is no practical alternative to that construction); minimize the harm to wetlands (if the only no practical alternative requires construction in the wetlands); and provide early and adequate opportunities for public review of plans involving new construction in wetlands.

Corrective measures at SWMU 7 may impact regulated wetland areas. Permits from both the state of Florida and the U.S. Army Corps of Engineers will be required if any corrective measures impact regulated wetland areas.

The Endangered Species Act of 1978 (16 USC 1531) (40 CFR Part 502) provides for consideration of the impacts on endangered and threatened species and their critical habitats. Several federal and state-listed threatened and endangered species have been observed at NAS Key West. Corrective measure actions, if required, would need to be conducted in a manner such that the continued existence of any endangered or threatened species is not jeopardized or its critical habitat is not adversely affected.

The Fish and Wildlife Coordination Act (16 USC 661) provides for consideration of the impacts on wetlands and protected habitats. The act requires that federal agencies, before issuing a permit or undertaking federal action for the modification of any body of water, consult with the appropriate state agency exercising jurisdiction over wildlife resources to conserve those resources. Consultation with the United States Fish and Wildlife Service is also required.

The Fish and Wildlife Improvement Act of 1978 (16 USC 742a) and The Fish and Wildlife Conservation Act of 1980 (16 USC 2901) require consideration of the impacts on wetlands and protected habitats.

Federal Floodplain Management, Executive Order (E.O. 11988) requires all Federal agencies to avoid, if possible, development and other activities in the 100-year base floodplain. Where the base floodplain cannot be avoided, special considerations and studies for new facilities and structures are needed.

Florida Surface Waters of the State (Chapter 62-301 F.A.C.) and Florida Delineation of Landward Extent of Wetlands and Surface Waters (Chapter 62-340 F.A.C.) define and provide the delineation methodology for determining the extent of surface waters and wetlands.

Florida Ground Water Classes, Standards, and Exemptions (Chapter 62-520 F.A.C.) provide for the designation of the present and future most beneficial uses of all the groundwaters in the state by means of a classification system. The state classification of the groundwater at Boca Chica Key is Class G-III (nonpotable water), which is water in an unconfined aquifer that has a total dissolved solids content of 10,000 milligrams per liter or greater.

3.2.1.5 Action-Specific ARARs and TBCs

This section presents a summary of federal and state action-specific ARAR and TBC criteria of potential concern for SWMU 7. These potential ARARs and TBCs are as follows:

RCRA Subtitle C regulates the treatment, storage, and disposal of hazardous waste from its generation until its ultimate disposal. In general, RCRA Subtitle C requirements for the treatment, storage, or disposal of hazardous waste will be applicable if

- The waste is a listed or characteristic waste under RCRA.
- The waste was treated, stored, or disposed (as defined in 40 CFR 260.10) after the effective date of the RCRA requirements under consideration.
- The activity at the CERCLA site constitutes current treatment, storage, or disposal as defined by RCRA.

RCRA Subtitle C requirements may be relevant and appropriate when the waste is sufficiently similar to a hazardous waste and/or the on-site corrective action constitutes treatment, storage, or disposal and the particular RCRA requirement is well suited to the circumstances of the contaminant release and site. RCRA Subtitle C requirements may also be relevant and appropriate when the corrective action constitutes generation of a hazardous waste. All RCRA Subtitle C requirements must be met if the cleanup is not under federal order or when the hazardous waste moves off-site.

The following requirements included in the RCRA Subtitle C regulations may pertain to the NAS Key West:

- Hazardous waste identification and listing regulations (40 CFR Part 261)
- Hazardous waste generator requirements (40 CFR Part 262)
- Transportation requirements (40 CFR Part 263)

- Standards for owners and operators of hazardous waste TSDFs (40 CFR Part 264)
- Interim status standards for owners and operators of hazardous waste TSDFs (40 CFR Part 265)
- Land disposal restrictions (LDR) (40 CFR Part 268)

Hazardous Waste Identification and Listing Regulations (40 CFR Part 261) define those solid wastes that are subject to regulation as hazardous waste under 40 CFR Parts 262 to 265 and Parts 124, 270, and 271.

A generator that treats, stores, or disposes of hazardous waste on site must comply with RCRA Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262). These standards include manifest, pre-transport (i.e., packaging, labeling, and placarding), recordkeeping, and reporting requirements. The standards are applicable to actions taken at NAS Key West that constitute generation of a hazardous waste (e.g., generation of water treatment residues or excavation of contaminated soil and/or sediment that may be hazardous).

Standards Applicable to Transporters of Hazardous Waste (40 CFR Part 263) are applicable to off-site transportation of hazardous waste from NAS Key West. These regulations include requirements for compliance with the manifest and recordkeeping systems and requirements for immediate action and cleanup of hazardous waste discharges (spills) during transportation.

Standards and Interim Status Standards for Owners and Operators of Hazardous Waste TSDFs (40 CFR Parts 264 and 265) are applicable to remedial actions taken at NAS Key West and to off-site facilities that receive hazardous waste from the site for treatment and/or disposal and have a RCRA Part B Permit. On-site facilities must also have a RCRA Part B Permit if the site is not a federally ordered CERCLA cleanup. Standards for TSDFs include requirements for preparedness and prevention, releases from SWMUs (i.e., corrective action requirements), closure and post-closure care, use and management of containers, and design and operating standards for tank systems, surface impoundments, waste piles, landfills, and incinerators.

RCRA LDR Requirements (40 CFR Part 268) restrict certain wastes from being placed or disposed on the land unless they meet specific BDAT treatment standards (expressed as concentrations, total or in the TCLP extract, or as specified technologies).

RCRA Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257) establish criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health and thereby constitute prohibited open dumps.

DOT Rules for Hazardous Materials Transport (49 CFR Parts 107 and 171-179) regulate the transport of hazardous materials, including packaging, shipping equipment, and placarding. These rules are considered applicable to wastes shipped off site for laboratory analysis, treatment, or disposal.

National Environmental Policy Act (40 CFR Part 6) requires consideration of potential environmental impacts at NAS Key West of corrective measure actions on wetlands and endangered species.

The CWA, as amended, governs point-source discharges through the NPDES, discharge, dredge, or fill material, and oil and hazardous waste spills to United States waters. NPDES requirements (40 CFR Part 122) will be applicable if the direct discharge of pollutants into surface waters is part of the remedial action.

The Occupational Health and Safety Act (29 USC, Sections 651 through 678) regulates worker health and safety during implementation of remedial actions.

Florida Hazardous Waste Regulations (Chapter 62-730 F.A.C.) essentially parallel RCRA Subtitle C hazardous waste management regulations. Similar to RCRA Subtitle C regulations, Florida regulations include requirements for the following:

- Generators of hazardous waste (Chapter 262)
- Transporters of hazardous waste (Chapter 263)
- New and existing hazardous waste management facilities applying for a permit (Chapter 264)
- Interim status hazardous waste management facilities applying for a permit (Chapter 265)

The above regulations may be relevant and appropriate to on-site remedial actions and applicable to the transport of hazardous waste off site.

Florida Pretreatment Requirements for Existing and New Sources of Pollution (Chapter 62-730 F.A.C.) implement the pretreatment requirements and establish a state NPDES permit program. These rules may be applicable for corrective measures involving a discharge to surface water.

Land Use Restrictions at Environmental Remediation Sites On Board U.S. Navy Installations (CNBJAXINST 5090.2N4) establish a systematic program to govern land use at environmental remediation sites at U.S. Navy Installations.

3.3 MEDIA OF CONCERN

The ecological risk assessment concluded that contaminants present in media at SWMU 7 do not pose environmental risk. However, based upon the calculated risks in the human health risk assessment to hypothetical future residents, trespassers, and occupational workers at SWMU 7, the Supplemental RFI/RI (B&R Environmental, 1998) recommended preparation of a CMS for this SWMU. Media of concern that contribute to this human health risk consist of soil and sediment.

Groundwater was not evaluated as part of the baseline HHRA because it is classified as Class G-III, non-potable water by FDEP, as summarized in Section 2.5. The surficial aquifer is the principal aquifer of concern at NAS Key West because of the potential groundwater to surface water contaminant migration pathway. Groundwater obtained from the surficial aquifer at Key West has a high salinity and is unsuitable for drinking, as documented in a 1990 groundwater quality sampling study by USGS (ABB, 1995b). The Monroe County Health Department recognizes the public water supply obtained from the mainland as the only potable water source available on Key West. Even though the groundwater is not potable, the groundwater concentrations at SWMU 7 were compared to Tap Water RBCs (U.S. EPA 1996a) and MCLs (U.S. EPA, 1996b) for comparison purposes, as presented in Tables 2-2 and 2-3.

Figure 2-6 in Section 2.4 illustrates that antimony is the only chemical in groundwater that exceeds its screening level. Therefore, it was selected as a COPC in the Supplemental RFI/RI report (B&R Environmental, 1998). This one detection of antimony (46 µg/L) exceeds its MCL of 6 µg/L. Although groundwater is not a current drinking water source and is unlikely to be designated as one in the future, contaminant fate and transport modeling was performed to determine the time required for antimony concentrations in groundwater to attain antimony's MCL through natural processes such as advection, adsorption, and dispersion. The time to achieve MCL attainment with these processes is estimated to be over 30 years. This estimate is discussed further in Appendix B.

In addition to groundwater, surface water will not be retained in this CMS as a medium of concern. Surface water at SWMU 7 is not large in volume and is composed of the water contained within two small ponds and the ditch found near Building A-824. Some portions of the ditch contained no standing water during sampling activities conducted in October 1996. It is anticipated that any corrective action for the sediment and/or soil will also address the surface water. For instance, excavation and disposal of soil would remove the source of the surface water contamination, which would result in a decrease in concentration of the contaminants in the surface water. Therefore, surface water at SWMU 7 will not be addressed in this CMS report with regard to corrective measure alternatives. However, surface water will be a component of any institutional controls and/or monitoring programs. Implementation of corrective measure alternatives for soil and sediment will be scheduled during the dry season (December through May) to minimize the presence of surface water.

3.4 CHEMICALS OF CONCERN

The following sections contain the COCs that are used to assess the volume of contaminated media at SWMU 7. Section 3.4.1 presents the human health COCs, Section 3.4.2 discusses ecological COCs, and Section 3.4.3 introduces the cross media COCs determined through predictive fate and transport modeling.

3.4.1 Human Health COCs

The nature and extent of contamination for SWMU 7 was determined in the Supplemental RFI/RI by analyzing samples from soil, sediment, surface water, and groundwater. The objectives of the Supplemental RFI/RI HHRA were to estimate the actual or potential risks to human health resulting from the presence of contamination in each medium and to provide the basis of determining the need for remedial issues in the CMS.

A summary of the Supplemental RFI/RI HHRA was provided in Section 2.5.1 of the CMS. COCs were selected in Section 2.5.2 for use in this CMS are selected based on two sets of criteria, U.S. EPA Region IV and FDEP soil cleanup goals. The U.S. EPA Region IV criteria for selecting COCs are based on those chemicals that contribute to a significant cancer risk (1E-06) or a non-cancer HQ above 0.1 in conjunction with a receptor scenario having a total risk (combined across pathways) above the level of concern (1E-04 cancer risk or an HI of 1.0). The FDEP approach for selecting COCs includes those chemicals that contribute to a significant cancer risk (1E-06) or a non-cancer HI above 1.0 based on a specific target organ.

3.4.1.1 Surface Soil

Figure 2-3 in Section 2.4 presents chemicals detected in surface soil at SWMU 7 in excess of the nature and extent of contamination screening values presented in the RFI/RI (B&R Environmental, 1998). COCs associated with various receptor exposure scenarios were selected from detected chemicals as explained in the Supplement RI/RFI and Section 2.5. For SWMU 7, the projected future land use is anticipated to be non-residential; therefore, only COCs determined under non-residential land use scenarios are considered in this CMS. If the future land use for SWMU 7 changes to a residential scenario, COCs and subsequent clean-up goals for SWMU 7 should be re-evaluated. The following surface soil COCs will be evaluated in the CMS for human health risks at SWMU 7.

Inorganics: Arsenic
Organics: Aroclor 1260

These arsenic concentrations fall within or slightly exceed the site-specific background. It is selected as a COC because the risks associated with arsenic exceed the 1E-06 risk level.

3.4.1.2 Sediment

Figure 2-4 in Section 2.4 presents chemicals detected in sediment at SWMU 7 in excess of the nature and extent of contamination screening values presented in the RFI/RI (B&R Environmental, 1998). COCs associated with various receptor exposure scenarios were selected from these detected chemicals, as explained in the Supplement RI/RFI and Section 2.4. For SWMU 7, the projected future land use is anticipated to be non-residential; therefore, only COCs determined under non-residential land use scenarios are considered in this CMS. If the future land use for SWMU 7 changes to a residential scenario, COCs and subsequent clean-up goals for SWMU 7 should be re-evaluated. The following sediment COC will be evaluated in the CMS for human health risks at SWMU 7.

Inorganics: Arsenic

These arsenic concentrations also fall within or slightly exceed the site-specific background concentration.

3.4.2 Ecological COCs

As discussed in the Supplemental RFI/RI, no ecological COPCs were retained as final COCs (B&R Environmental, 1998). This conclusion was based on a "weight of evidence" approach that consisted of an assessment of analytes detected in groundwater, surface water, sediment, soil, and plant foliage. Factors such as frequency of detection of COPCs, the spatial orientation of detections, and comparison to background values were considered. Overall, site-related contaminants do not appear to pose ecological risks. Therefore, no final ecological COCs were identified at SWMU 7.

3.4.3 Cross Media COCs.

COCs were identified that include the consideration of cross-media concentrations (concentrations in one medium that are protective of the migration of contaminants into another medium). COCs were developed for soil concentrations which could create unacceptable risk in surface water.

Modeling to develop RGOs to protect surface water bodies from overland transport of surface soil contaminants was not conducted. Instead of overland transport, the following transport route from soil to surface water was assumed. A portion of the rainwater that falls on the site reaches the groundwater by directly infiltrating into the soil. As the water infiltrates through the contaminated soil, contaminants leach out of the soil and are transported in dissolved form with the water through the unsaturated zone to the groundwater below. The contaminants can then be transported laterally in the groundwater and eventually migrate to a surface water body exposure point. It is assumed that the two small ponds located at SWMU 7 are not hydraulically connected to groundwater; therefore, the surface water body assumed as the exposure point was chosen to be the Gulf of Mexico located approximately 700 feet east-southeast from the southwestern corner of Building A-824.

Concentrations of chemicals detected in SWMU 7 surface and subsurface soil were screened against: (1) FDEP soil leaching criteria (FDEP, 1995b) and (2) the generic Soil Screening Levels (dilution attenuation factor 20) presented in the U.S. EPA Soil Screening Guidance: User's Guide, Appendix A (U.S. EPA, 1996d). Those soil concentrations that exceeded the most conservative values of these two criteria were retained as COCs and area as follows:

Organics: Methylene Chloride

However, methylene chloride, a common laboratory contaminant, was also detected in the blank (Table 2-4).

3.5 REMEDIAL GOAL OPTIONS

RGOs are developed to ensure that contaminant concentration levels remaining are at levels that are protective of human health and the environment. RGOs are established to:

- Protect human receptors from adverse health effects
- Protect surface water from detrimental impacts from soil contaminants
- Provide compliance with Federal and State ARARs

As discussed in Section 3.4.2, no ecological COCs were retained for SWMU 7. Remediation actions based on ecological risks are not necessary, and therefore, there are no ecological risk-based RGOs for this site.

3.5.1 Soil RGOs

Soil RGOs were determined for the COCs identified in Section 3.4. The soil RGOs were based on the following criteria.

- Protection of human health
- Protection of groundwater to reduce potential impact to offsite surface water.

3.5.1.1 Soil RGOs for the Protection of Human Health

SWMU 7 is located within a limited access area on Boca Chica Key and is part of the active military base. Due to the limited access, the residential human health pathway scenario remains unlikely at the site, as long as the installation is maintained as an active military base. Therefore, only non-residential exposure pathway RGOs were calculated at SWMU 7. The maintenance worker was eliminated based on recommendations of the NAS Key West Partnering Team. If the land use for the site changes in the future, RGO estimations should be re-evaluated.

RGOs are developed for any non-residential receptor for which any individual contaminant has an ICR greater than 1E-06 and/or an HI greater than 1.0 (for a specific target organ) including all exposure pathways (considering all non-residential receptors, media, and routes of exposure). For each scenario, individual chemicals which contributed at least 1E-06 to the ICR or 0.1 to the HI were selected. The RGOs were developed using the representative concentrations that were used in the Supplemental RI/RFI. To develop potential RGOs, the representative concentration was proportioned to yield concentrations with a target cancer risk equal to 1E-06 and a noncarcinogenic HI of 1.0.

At SWMU 7, Aroclor 1260 and arsenic were selected as the only soil COCs. Noncarcinogenic HIs for all non-residential exposure pathways at SWMU 7 were below 1.0. Therefore, RGOs for Aroclor 1260 and arsenic were developed based on carcinogenic risk and are presented in this CMS for the most sensitive non-residential receptor exposed to surface soil (i.e., the occupational worker) at a risk level of 1E-06 with the alternative selected being no-action. In addition, an Aroclor 1260 and arsenic RGO level was developed for restricted site access (institutional controls) for the occupational worker.

Using the standard RGO equation :

RGO = (EPC)(Risk Level)/(Calc Risk Level)

it was determined under the no action alternative if the exposure concentrations (EPCs) of Aroclor 1260 and arsenic in surface soil are less than risk-based RGOs of 437 µg/kg and 0.46 mg/kg, respectively, an acceptable risk of 1E-06 can be achieved for all non-residential exposure pathways. The estimated cancer risks and noncarcinogenic HIs (calculated risk level for the RGO equation) for each contributing route of exposure (ingestion, dermal contact, and inhalation) for the no action alternative are shown in Appendix A.

A modified RGO was developed using risks recalculated using revised exposure assumptions for restricted site access (institutional controls). (The recalculated risks and exposure assumptions are shown in Table A-1). Application of the standard RGO equation under these revised assumptions indicates that if the EPC of Aroclor 1260 and arsenic in surface soil are less than risk-based RGOs of 2,100 µg/kg and 2.2 mg/kg, respectively, an acceptable risk range of 1E-06 can be achieved for all non-residential exposure pathways. The estimated cancer risks and noncarcinogenic HIs (calculated risk level for the RGO equation) for each contributing route of exposure (ingestion, dermal contact, and inhalation) for the restricted site access (institutional controls) alternative are shown in Appendix A.

However, it should be noted that for arsenic, the risk-based RGOs of 0.46 mg/kg under the no action alternative and 2.2 mg/kg under restricted site access fall within the reported range of background arsenic concentrations in surface soil (0.63 mg/kg to 2.7 mg/kg). As such, the application of these RGOs as cleanup for arsenic is not practical. Consequently, the FDEP Industrial Soil Cleanup Goal of 3.7 mg/kg for arsenic will be used as an appropriate criterion for determining the need for remedial action. Because the current and likely use of SWMU 7 will be for industrial purposes under restricted site access, the modified RGO of 2,100 µg/kg for Aroclor 1260 will be used as an appropriate remedial action criterion.

3.5.1.2 Soil RGOs Protective of Surface Water

An RGO was developed for the one chemical in soil (methylene chloride) that exceeded soil to groundwater leaching criteria as described in Section 3.4.3. The RGO was developed using modeling to predict contaminant fate and transport. The RGO developed for methylene chloride is 1.0E+06 mg/kg. Because the maximum detected compound is 28 µg/kg, no unacceptable impact to surface water is anticipated. The development of this RGO is presented in Appendix B.

3.5.2 Sediment RGOs For Protection of Human Health

Sediment RGOs were determined for the COCs identified in Section 3.2.3.2 The sediment RGOs were based on the following criterion.

- Protection of human health

For the same reasons discussed above for soil RGOs, due to the site's military designation and restrictive access, the residential human health pathway scenario remains unlikely as long as the installation is maintained as an active military base. Therefore, as with surface soil, only non-residential exposure pathway RGOs were calculated for sediment at SWMU 7. If the land use for the site changes in the future, RGO estimations should be re-evaluated.

RGOs are developed for any non-residential receptor for which any individual contaminant has an ICR greater than 1E-06 and/or an HI greater than 1.0 (for a specific target organ) including all exposure pathways (considering all non-residential receptors, media, and routes of exposure). For each scenario, individual chemicals that contributed to at least 1E-06 to the ICR or 0.1 to the HI were selected. Sediment RGOs were developed using the representative concentrations from the Supplemental RI/RFI.

At SWMU 7, arsenic was selected as the only sediment COC based on carcinogenic risk levels that exceed 1E-06 in non-residential exposure pathways. Noncarcinogenic HIs for all non-residential exposure pathways at SWMU 7 were below 1.0. Therefore, only RGOs for arsenic based on carcinogenic risk are presented in this CMS. A single arsenic RGO level was developed for the most sensitive non-residential receptor exposed to sediment (i.e., the adolescent trespasser) at a risk level of 1E-06, with the alternative selected being no action. In addition, an arsenic RGO level was developed for restricted site access (institutional controls) for the adolescent trespasser.

Using the standard RGO equation, the RGO developed for sediment under the no action alternative is 2.7 mg/kg. If the EPC for arsenic in sediment does not exceed this level, an acceptable risk range of 1E-06 can be achieved for all non-residential receptors. The estimated cancer risks and noncarcinogenic HIs (calculated risk level for the RGO equation) for each contributing route of exposure (ingestion and dermal contact) for the no action alternative are shown in Appendix A.

A modified RGO was developed using risks recalculated with revised exposure assumptions for restricted site access (institutional controls). (The recalculated risks and exposure assumptions are shown in Table A-1.) Application of the standard RGO equation under these revised assumptions indicates that if the EPC of arsenic in sediment is less than a risk-based RGO of 10 mg/kg, an acceptable risk range of 1E-06 can be achieved for all non-residential exposure pathways. The estimated cancer risks and noncarcinogenic HIs (calculated risk level for the RGO equation) for each contributing route of exposure (ingestion and dermal contact) for the restricted site access (institutional controls) alternative are shown in Appendix A.

Because the current and likely use of SWMU 7 will be for industrial purposes under restricted site access, the modified RGO of 10 mg/kg will be used as an appropriate remedial action criterion.

It should be noted that concentrations of chemicals within sediment exceed several criteria from the Florida Sediment Quality Assessment Guidelines (FDEP, 1994). These values are based on the protection of ecological receptors. However, the Supplemental ERA for SWMU 7 concluded that contaminants present do not pose significant environmental risks. As such, Florida Sediment Quality Assessment Guidelines will not be applied as RGOs for SWMU 7.

3.5.3 Summary of RGOs Established for Surface Soil and Sediment and Cross-Media Protection

Table 3-2 provides the chemicals, detected maximum levels, and applicable RGOs for SWMU 7. Aroclor 1260 and arsenic in surface soil exceed criteria for protection of human health under various alternatives. Arsenic in sediment does not exceed criteria for protection of human health under institutional controls.

3.6 CAOs

Site-specific CAOs specify COCs, media of interest, exposure pathways, and clean-up goals or acceptable contaminant concentrations. CAOs may be developed to permit consideration of a range of treatment and containment alternatives. This CMS addresses soil, sediment, and surface water contamination within SWMU 7. To protect the public from potential current and future health risks, as well as to protect the environment, the following CAOs have been developed for SWMU 7 soil, sediment, and surface water to address the primary exposure pathways:

- Prevent human receptors from contacting contaminants in the soil, sediment, and surface water at concentrations that would result in adverse effects.

- Prevent soil contaminants from migrating to groundwater (via infiltration) and subsequently migrating to surface water.

- Compliance at SWMU 7 with contaminant-specific, location-specific, and action-specific federal and state ARARs

The RGOs that would attain these objectives have been discussed in Section 3.5 and are presented in Table 3-2.

3.7 VOLUMES OF CONTAMINATED MEDIA

The volume of contaminated surface soil was estimated based on a comparison of the RGOs and CAOs defined in Sections 3.3 and 3.4, respectively, using standard engineering practice. The values and assumptions used in estimating the volumes of contaminated media are presented in this section.

3.7.1 Contaminated Soil

Figure 3-1 presents the estimated area of contaminated soil. The area of excavation is based on the protection of industrial workers in a controlled setting and was determined by comparing the shaded RGOs presented in Table 3-2, Chemicals Detected in Surface Soil at SWMU 7 (Table 2-4). Four surface soil sample locations exceeded the RGOs. Aroclor 1260 was detected at soil sampling locations S7CONF-5 at 10,000 µg/kg and S7CONF-2 at 16,500 µg/kg, both of which exceeded Aroclor's RGO of 2,100 µg/kg. Arsenic was detected at soil sampling locations S7SB-14 at 4.9 mg/kg and S7SB-18 at 4.5 mg/kg, both of which exceeded arsenic's RGO of 3.7 mg/kg.

Four discrete areas were identified based on each four of the RGO exceedences. The area defined around each soil sample location depicted in Figure 3-1 was based on the following assumptions:

- S7CONF-5(C): The 1995 IRA did not remove soil underneath the fence. An area of 10 feet by 35 feet of PCB-contaminated soil is estimated for excavation.

- S7CONF-2(C): The 1995 IRA did not remove soil adjacent to the building. An area of 10 feet by 20 feet of PCB-contaminated soil is estimated for excavation.

- S7SB-14: Because COCs were not detected at concentrations that exceeded RGOs at soil sample locations S7SB-11 and S7SB-17, the extent of contamination was considered to be halfway between these samples and soil sample location S7SB-14. Additionally, the building and road were used as boundary edges.

- S7SB-18: The northwestern and southeastern edge were assumed to be 25 feet from soil sample location S7SB-18 and perpendicular to the ditch. The northeastern edge of contamination was assumed to be halfway between soil sample locations S7SB-9 and S7SB-18. Lastly, the ditch was used as a boundary edge.

The total estimated excavation area for these locations is 3,500 square feet of soil containing arsenic and 550 square feet of soil containing Aroclor 1260. The site consists of compacted fill material to a depth of approximately 6 inches below land surface followed by dense oolitic limestone. As such, a depth of 6 inches is used as the depth of excavation. This corresponds to an estimated volume of 60 cubic yards (yd^3) of soil containing arsenic and 10 yd^3 of soil containing PCBs that would require excavation. This estimate will be used for costing purposes in this CMS.

3.7.2 Contaminated Sediment

There is no sediment containing contaminant concentrations in excess of the RGOs, based on the Supplemental RFI/RI results. Therefore, no contaminated sediment volumes have been estimated.

TABLE 3-1

POTENTIAL ARARs
CORRECTIVE MEASURE STUDY FOR SWMU 7
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA
PAGE 1 OF 3

Chemical-Specific Requirements	Rationale
Safe Drinking Water Act MCLs and MCL Goals (MCLGs) (U.S. EPA, 1996b) Florida Drinking Water Standards, Monitoring and Reporting (MCLs) (Chapter 62-550 F.A.C.)	Corrective measures may include groundwater remediation to MCLs or MCLGs.
Clean Water Act (33 USC 1251-1376) Federal AWQCs (40 CFR Part 50)	Corrective measures may include surface water remediation to meet published levels.
Clean Air Act (42 USC 7401) National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61.60-61.71) New Source Performance Standards (NSPS) (40 CFR Part 60) Florida State Implementation Plan (SIP) (Chapter 62-204 F.A.C.)	Corrective measures may include treatment of media that could result in emissions to the atmosphere.
Threshold Limit Values, American Conference of Government Industrial Hygienists	May be applicable to air concentrations during implementation of corrective measures.
Proposed RCRA Action Levels (40 CFR Part 264)	Corrective measures may be driven by reducing chemical concentrations in any or all the media at SWMU 7 to meet the action levels.
Benchmark Toxicity Values (U.S. EPA Region III, 1995b) Oak Ridge National Laboratory Benchmark Toxicity Values (Will and Suter, 1994) FDEP Soil Cleanup Goals (FDEP, 1995b and 1996)	Corrective measures may be driven by reducing chemical concentrations in the soils at SWMU 7 to meet published levels.
FDEP Sediment Quality Guideline (FDEP, 1994) U.S. EPA Region IV Sediment Screening Values (U.S. EPA, 1995c) Federal Sediment Quality Screening Criteria (U.S. EPA, 1996c) U.S. EPA Sediment Quality Benchmark (U.S. EPA, 1996c)	Corrective measures may be driven by reducing chemical concentrations in the sediments at SWMU 7 to meet published levels.
Florida Surface Water Quality Standards (Chapter 62-302 F.A.C.)	Corrective measures may be driven by reducing chemical concentrations in the surface waters at SWMU 7 to meet published levels.
U.S. EPA Region IV Chronic Surface Water Screening Values (U.S. EPA, 1995c) National Ambient Water Quality Standards U.S. EPA Region III Marine Standards (U.S. EPA, 1995b) U.S. EPA Region III Fresh Water Standards (U.S. EPA, 1995b)	
Florida Department of Environmental Protection Guidance (FDEP, 1989)	Corrective measures may include cleanup to FDEP Guidance.

TABLE 3-1

POTENTIAL ARARs
CORRECTIVE MEASURE STUDY FOR SWMU 7
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA
PAGE 2 OF 3

Location-Specific Requirements	Rationale
Federal Protection of Wetlands Executive Order (E.O. 11990)	Wetland areas at SWMU 7 may have chemical contamination and may be affected by corrective measure.
Endangered Species Act of 1978 (16 USC 1531) (40 CFR 502)	Endangered and threatened species are present at NAS Key West.
Fish and Wildlife Coordination Act of 1980 (16 USC 661) Fish and Wildlife Conservation Act (16 USC 2901) Fish and Wildlife Improvement Act of 1978 (16 USC 742a)	Corrective measures may affect fish and wildlife habitat
Federal Floodplain Management E.O. 11988	Most of the NAS Key West facility is within the 100-year floodplain
Florida Surface Waters of the State (Chapter 62-301 F.A.C.)	Provides designation of landward extent of surface waters in the state.
Florida Delineation of Landward extent of Wetlands and Surface Waters (Chapter 62-340 F.A.C.)	Provides the delineation methodology of the extent of wetlands.
Florida Ground Water Classes, Standards, and Exemptions (Chapter 62-520 F.A.C.)	Provides designation criteria for the groundwater classes in the state.
Action-Specific Requirements	**Rationale**
Hazardous Waste Generator Requirements (40 CFR Part 262)	Standards applicable to generators of hazardous wastes that may have to be met depending on corrective measures implemented.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage or Disposal TSDFs (40 CFR Part 264) Interim Status Standards for Owners and Operators of Hazardous Waste or TSD Facilities (40 CFR Part 264)	Corrective measures may involve hazardous waste treatment, storage, and disposal facilities.
Land Disposal Restrictions (40 CFR Part 268)	Standards for the land disposal of hazardous waste. Corrective measures may involve disposal of hazardous and nonhazardous media.
Department of Transportation (DOT) Rules for Hazardous Materials Transport (49 CFR Parts 107, 171-179)	Corrective measures may include transport of waste for off-site treatment and disposal.
Hazardous Waste Transportation Requirements (40 CFR Part 263)	Crrective measures may require transportation of hazardous materials off site for treatment/disposal.
National Environmental Policy Act	Requires consideration of environmental effects due to federal actions.
CWA (40 CFR Part 122, NPDES)	Corrective measures may involve discharge to surface waters.

TABLE 3-1

POTENTIAL ARARs
CORRECTIVE MEASURE STUDY FOR SWMU 7
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

Location-Specific Requirements (continued)	Rationale
Clean Air Act (CAA) (42 USC 7401), NAAQS (40 CFR Parts 50 and 53), NESHAPs (40 CFR Part 61) and NSPS (40 CFR Part 60)	Corrective measures may include the treatment of media that could result in emissions to air.
Occupational Safety and Health Act (29 USC 651-678)	Regulates worker health and safety.
Action-Specific Requirements	**Rationale**
Florida Pretreatment Requirements for Existing and New Sources of Pollution (Chapter 62-625 F.A.C.)	Corrective measures may include discharge to surface waters or a waste water treatment plant.
Florida Hazardous Waste (Chapter 62-730 F.A.C.)	Applicable to corrective measures that may handle and/or transport hazardous waste.
Land Use Restrictions at Environmental Remediation Sites On Board U.S. Navy Installations (CNBJAXINST 5090.2N4) (U.S. Navy, 1997)	Establishes a systematic program to govern land use at environmental remediation sites at U.S. Navy Installations.

TABLE 3-2

SUMMARY OF RGOs FOR SWMU 7
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

Chemical	Reason for Evaluation	Maximum Concentration	FDEP Industrial Clean Up Goal	Protection of Human Health		Protection of Surface Water
				No Action	Institutional Controls	
Surface Soil - Inorganics (mg/kg)						
Arsenic	Human Health COC	4.9	3.7	0.46	2.2	Not Applicable
Surface Soil - Organics (µg/kg)						
Aroclor 1260	Human Health COC	16,500	3,500	437	2,100	Not Applicable
Methylene Chloride	Protection of Surface Water	28	Not Applicable	Not Applicable	Not Applicable	1.00E+06
Sediment - Inorganics (mg/kg)						
Arsenic	Human Health COC	5.75	7.2	2.7	10	Not Applicable

The RGOs that will be applied as remedial action criteria are shaded.

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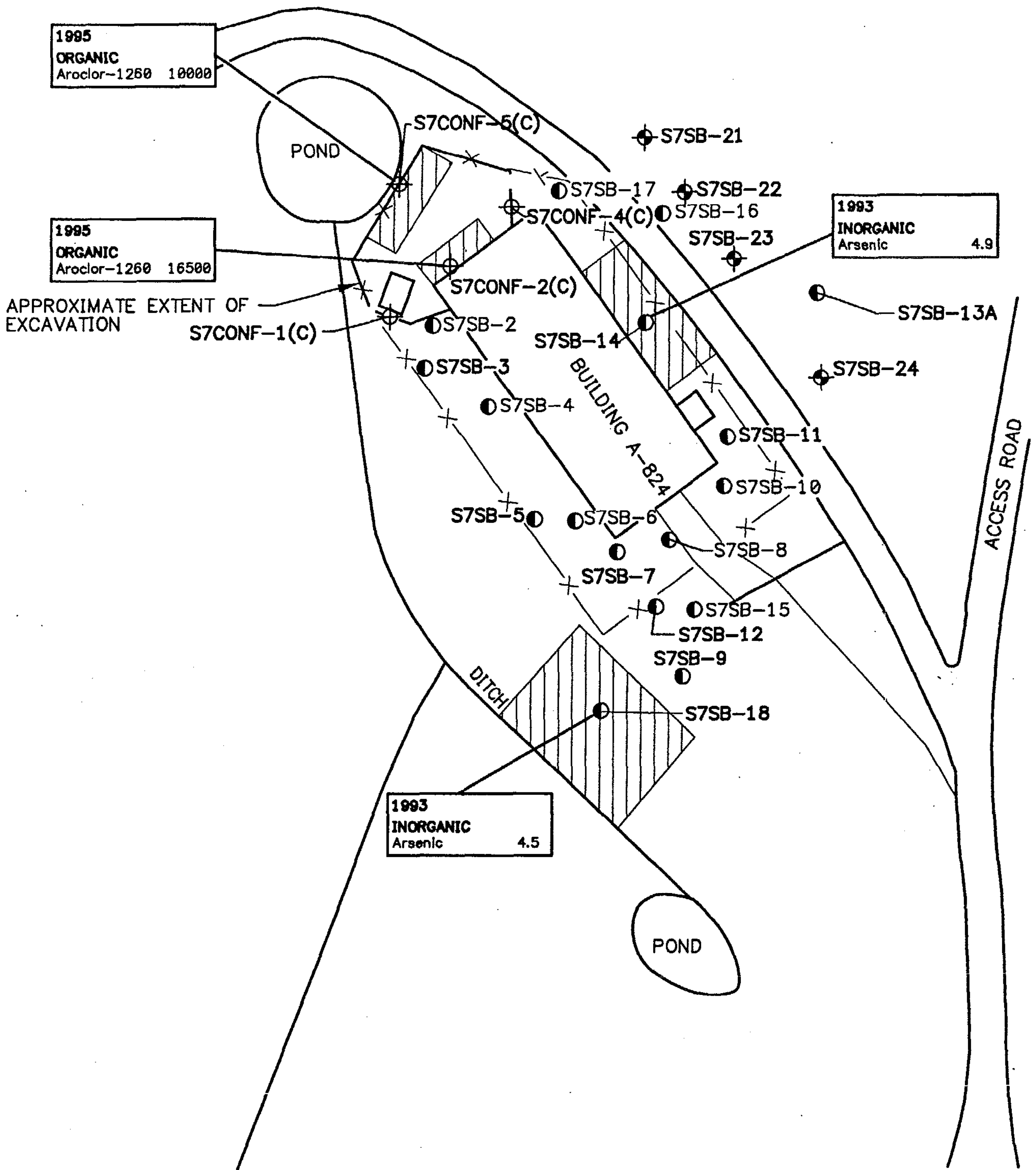

PARAMETER	RGO VALUE
INORGANIC	
Arsenic	3.7
ORGANIC	
Aroclor-1260	2,100
Methylene Chloride	1.0E+06

+ FDEP INDUSTRIAL CLEAN-UP GOAL

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.
NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.
NOTE: SURFACE SOIL SAMPLE LOCATIONS ARE BOLD.

LEGEND:

- S7SB-2 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)
- S7CONF-1(C) ⌖ SOIL SAMPLE LOCATION BEI (1995)
- S7SB-21 ⌖ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

0 50 100
SCALE IN FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 4/8/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY ★ SOUTHERN DIV FACILITIES ENGINEERING COMMAND

EXTENT OF CONTAMINATED SOIL
SWMU 7
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3-1 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

4.0 IDENTIFICATION, SCREENING, AND DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES

4.1 INTRODUCTION

This section presents the identification, screening, and development of the corrective measure alternatives formulated to achieve the CAOs for SWMU 7. The identification and screening of corrective measure technologies and the development of corrective measure alternatives are based upon the information presented in Section 3.0 and involve the following activities:

- Identification of corrective measure technologies and applicable process options.
- Screening of potential corrective measure technologies and applicable process options.
- Development of corrective measure alternatives by assembling applicable technologies into alternatives that have the potential to achieve the defined CAOs.

4.2 IDENTIFICATION AND SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens the corrective measure technologies and process options that may be used to achieve the CAOs for SWMU 7. This process was based on the review of current literature, vendor information, and previous experience in developing alternatives for sites with similar medium-specific concerns and releases.

Corrective measure technologies and process options can be grouped according to general response actions. The categories of general response actions that could be implemented to achieve or address the CAOs for SWMU 7 include

- No Action
- Institutional Controls
- Containment
- Removal
- Treatment
- Disposal

Each of the general response actions are discussed below (sections 4.2.1 through 4.2.6). Corrective measure technologies and process options for each of the general response actions that are potentially applicable to SWMU 7 are identified and screened in Tables 4-1 for soil. The criteria used for screening the technologies and process options are discussed in Section 4.2.7.

4.2.1 No Action

No action is a general response action wherein the status quo is maintained at the site. No action is normally retained to provide a baseline for comparison with other alternatives. No additional activities would be conducted at the site to address remaining contamination. There are no implementability concerns, because the contaminated media are considered to be left "as is." Institutional controls, containment, removal, treatment, or other mitigating actions are not provided to reduce the potential for exposure.

4.2.2 Institutional Controls

Access controls (e.g., physical barriers) and/or site development restrictions in the NAS Key West Master Plan are institutional control options that may be considered for implementation to reduce or eliminate pathways of exposure to hazardous substances at the site. The application of institutional controls alone does not reduce the volume, mobility, or toxicity of the contaminants. Site development restrictions would be implemented in accordance with CNBJAXINST 5090.2N4 (U.S. Navy, 1997). This instruction has been provided as Appendix D.

4.2.3 Containment

Containment involves the application of physical measures to reduce the potential for contaminant migration and thereby reduce the risk to the public and the environment. The contaminated media must be isolated from the primary transport mechanisms (i.e., wind, erosion, surface water, and groundwater) to reduce the migration of contaminants. Contaminated media are isolated by the installation of surface and subsurface barriers that either block or divert any transport media from the contaminants.

4.2.4 Removal

Removal action is a general response action wherein technologies are used to move contaminated media from their present location in order for them to be treated and/or disposed elsewhere. Treatment and/or disposal process options can be combined with removal process options to develop alternatives.

4.2.5 Treatment

The treatment response action, both in-situ and ex-situ, includes physical, chemical, biological, solidification, or thermal processes designed to reduce the mobility, toxicity, and/or volume of the contaminants present. Treatment can be used with removal and disposal process options to develop alternatives.

4.2.6 Disposal

Disposal technologies include placement of removed or treated materials in an on-site or an off-site permanent disposal facility. Removal options and possibly treatment options can be used with disposal process options to develop alternatives. The toxicity, mobility, or volume of the contaminants is not reduced through the singular application of disposal. This response action would reduce or eliminate exposure pathways related to direct human contact with contaminated material.

4.2.7 Screening Criteria for Corrective Measure Technologies and Process Options

Corrective measure technologies and process options are screened to eliminate those that are not feasible to implement, that rely on technologies unlikely to perform satisfactorily or reliably, or that do not achieve the CAOs within a reasonable time. The corrective measure technologies and process options are also eliminated based on SWMU 7 site-specific and waste-specific conditions.

The screening process focuses on eliminating those technologies and process options that have severe limitations for a given set of waste-specific and site-specific conditions. The screening step also eliminates technologies and process options based on inherent technology limitations. Site, waste, and technology characteristics that were used as screening criteria are described below. Table 4-1 identifies and screens the technologies and process options for soil. Table 4-2 provides a summary of retained technologies for soil.

4.2.7.1 Site Characteristics

Site characteristics include an evaluation of RGOs for SWMU 7 or contaminant concentrations to identify site conditions that may limit or support the use of certain technologies. Technologies and process options are evaluated for their applicability and limitations to site conditions, including compatibility with site hydrogeology or soils.

4.2.7.2 Waste Characteristics

Waste characteristics may limit the effectiveness or feasibility of technologies. Technologies and process options are evaluated for their applicability and limitations to the waste characteristics at the site, including contaminant type and concentrations and contaminated media.

4.2.7.3 Technology Limitations

Technology limitations include the level of technology development, performance record, and inherent construction, operation, and maintenance problems. Technologies and process options are evaluated based on their reliability, performance, and proven effectiveness.

4.3 IDENTIFICATION OF CORRECTIVE MEASURE ALTERNATIVES FOR SWMU 7

This section describes the development of the corrective measure alternatives for SWMU 7 considering the information provided in the previous sections. Additional site-specific information and assumptions are provided in this section to further explain the alternative development process. In addition, alternatives are briefly described in this section. A detailed description and analysis of alternatives is provided in Section 5.0.

Alternatives were developed that address the COCs and exposure pathways in order to achieve the CAOs. Alternatives were developed to provide a range of corrective measure alternatives to address all contaminants that could potentially affect receptors. Based on the results of the risk assessment in the Supplemental RFI/RI, several assumptions were used to develop alternatives:

- Groundwater at the Florida Keys is classified as nonpotable by the state. Therefore, no corrective measures for groundwater contamination at SWMU 7 are proposed.

- SWMU 7 is located within a restricted access area. Only military personnel have access to this location and the site is not subject to any pedestrian traffic. Because of the restrictive site access, residential exposure to contaminants at SWMU 7 is highly unlikely as long as the installation is maintained as an active military base.

The following alternatives have been developed for SWMU 7:

Alternative 1: No Action
Alternative 2: Institutional Controls with Monitoring

Alternative 3: Remove and Treat and/or Dispose of Soil that Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls

A brief description of each alternative is provided in Sections 4.3.1 through 4.3.4.

4.3.1 Alternative 1 - No Action

This is a "walk-away" alternative retained to provide a baseline for comparing the other alternatives and, therefore, does not address existing contamination at the site. There would be no reduction in toxicity, mobility, or volume of the contaminants from treatment at SWMU 7 other than that which would result from natural processes (e.g., advection, dispersion, adsorption, or other attenuating factors).

4.3.2 Alternative 2 - Institutional Controls with Monitoring

Land-use controls would be maintained to prohibit unauthorized personnel (e.g., base residents) from obtaining entry to the site. Site development restrictions would be added to the NAS Key Wet Master Plan in accordance with CNBJAXINST 5090.2N4 (U.S. Navy, 1997). These restrictions would implement administrative actions to prohibit future residential site use. Educational programs would be created to inform the public of hazards related to site contaminants.

To assess whether natural processes are diminishing the concentration of site contaminants over time, surface water, groundwater, sediment sampling would be conducted (quarterly for the first year and annually for the next nine years). Per the NAS Key West MOA with the U.S. EPA and FDEP (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site.

4.3.3 Alternative 3 - Remove and Treat and/or Dispose of Soil That Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls

This alternative consists of three major components: (1) removal of contaminated soil, (2) transport of contaminated soil for off-site treatment and/or disposal, and (3) institutional controls.

Approximately 70 yd^3 of contaminated soil in excess of the industrial RGOs (2,100 µg/kg for Aroclor 1260 and 3.7 mg/kg for arsenic) would be excavated from the areas identified in Figure 3-1. Confirmation sampling would be conducted to ensure that the removal of contaminated soil in excess of the industrial RGOs is completed. Excavated soil would be transported to an off-site RCRA permitted TSDF for treatment, if required, and disposal. If soil is determined to be a RCRA hazardous waste, off-site treatment options would include stabilization/solidification.

Land-use controls would be maintained to prohibit unauthorized personnel (e.g., base residents) from obtaining entry to the site. Site development restrictions would be added to the NAS Key Wet Master Plan in accordance with CNBJAXINST 5090.2N4 (U.S. Navy, 1997). These restrictions would implement administrative actions to prohibit future residential site use. To assess the effectiveness of the soil removal and to determine whether natural processes are diminishing the concentration of any remaining site contaminants over time, surface water, groundwater, sediment sampling would be conducted (quarterly for the first year and annually for the next 9 years). Per the MOA (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site and will determine whether changes to the controls are required.

TABLE 4-1
PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES FOR SOIL
CORRECTIVE MEASURES STUDY
SWMU 7, BOCA CHICA BUILDING A-824
NAVAL AIR STATION KEY WEST, BOCA KEY, FLORIDA
PAGE 1 OF 4

TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS	OPTION RETAINED
GENERAL RESPONSE ACTION: NO ACTION				
No Action	No Action	No activities proposed at SWMU 7 to address contamination	Retained as baseline for comparison.	Yes
GENERAL RESPONSE ACTION: INSTITUTIONAL CONTROLS				
Institutional Controls [1]	Limited Site Access	Physical barrier used to restrict access to the site.	Effective in preventing direct human exposure to contaminated soil.	Yes
	Site Development Restrictions	Administrative action used to restrict future site use as documented in the NAS Key West Master Plan.	Administrative action is used to prevent direct human exposure to contaminated soil.	Yes
	Monitoring	Sampling and analysis of environmental media to assess contaminant migration and future environmental impacts.	Effective only to assess contaminant levels on site and migration off site. Can be used to determine if conditions are changing in order to indicate the need for further corrective measures.	Yes
	Educational Programs	Educate public concerning site hazards.	Helps to inform the public concerning possible site hazards. However, does not reduce the exposure potential for human receptors. Information for risks can be provided at Restoration Advisory Board meetings.	Yes
GENERAL RESPONSE ACTION: CONTAINMENT				
Soil Cover	Native Soil	Layer of native soil is placed over site to prevent direct contact and ingestion and migration to surface water.	Not effective in reducing toxicity of contaminants, but will provide a barrier for primary exposure pathways. Long-term monitoring and maintenance would be required. Would reduce the mobility of contaminants or leaching of contaminants to groundwater.	Yes
Capping	Clay Cap/Synthetic Membrane/ Asphalt/ Concrete	Use of impermeable or semipermeable materials constructed over the site to provide a barrier to water infiltration and also prevent direct contact with and ingestion of chemicals, as well as migration to surface water.	Not effective in reducing toxicity of contaminants, but will provide a barrier for primary exposure pathways. Would reduce mobility of contaminants and leaching to groundwater. Long-term monitoring and maintenance would be required.	Yes
Vertical Barrier	Slurry Wall [2,3,4]	Soil/bentonite or soil/cement barriers are installed around waste area to isolate waste materials. This low permeable barrier restricts contaminant migration.	Not compatible with site hydrogeology. At SWMU 7, bedrock is shallow (1.09 to 3.24 feet bgs) with unrestricted groundwater flow to a depth of several hundred feet.	No
	Sheet Piling [2,3]	Use of barrier sheets driven into the subsurface to mitigate groundwater migration or to provide shoring/erosion control during excavation.	Not compatible with site hydrogeology. At SWMU 7, bedrock is shallow (1.09 to 3.24 feet bgs) with unrestricted groundwater flow to a depth of several hundred feet.	No
Horizontal Barrier	Grout Injection [2,3,5,6]	Pressure injection of cement at depth through closely spaced drill holes to prevent contaminant migration into groundwater.	Not compatible with site hydrogeology. At SWMU 7, bedrock is shallow (1.09 to 3.24 feet bgs) with unrestricted groundwater flow to a depth of several hundred feet.	No
GENERAL RESPONSE ACTION: REMOVAL				
Bulk Excavation	Bulk Excavation [2,4]	Mechanical removal of solid materials using common construction equipment such as bulldozers and highlifts.	Effective in removing contaminated soil. Used in combination with ex situ or off site treatment or disposal.	Yes

TABLE 4-1
PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES FOR SOILS
CORRECTIVE MEASURES STUDY
SWMU 7, BOCA CHICA BUILDING A-824
NAVAL AIR STATION KEY WEST, BOCA CHICA KEY, FLORIDA
PAGE 2 OF 4

TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS	OPTION RETAINED
GENERAL RESPONSE ACTION: EX SITU TREATMENT				
Thermal	Onsite Incineration (4,5,7)	Soil is excavated and treated by a mobile or on site incinerator that employs thermal decomposition via thermal oxidation at high temperature to destroy organics.	Would be effective for the destruction of PCBs. However, site concentrations of PCBs are below 50 mg/kg and do not require this technology. Some arsenic may be volatilized.	No
	Offsite Incineration (4,5,7)	Excavated soil is transported to a licensed incinerator that has applicable local, state, and federal permits and that thermally destroys organics in a direct fire unit.	Would be effective for the destruction of PCBs. However, site concentrations of PCBs are below 50 mg/kg and do not require this technology. Some arsenic may be volatilized.	No
	Vitrification (4)	Excavated soil is melted at high temperature to form a glass and crystalline structure with very low leaching characteristics and destroys organics.	Technology is not cost effective nor practical for the concentrations and volume of contaminants.	No
	Low-Temperature Thermal Desorption (4)	Application of heat at relatively low temperature to remove organics from excavated soil by volatilization. Vapor phase, typically is treated by incineration or carbon adsorption.	Not effective for treatment of inorganic contaminants. Reduced effectiveness for treatment of PCBs	No
Physical/ Chemical	Soil Washing/ Solvent Extraction (4,8)	Separation of contaminants from a medium by contact with a liquid with a higher affinity for the COCs. Converts organic and inorganic contaminants to a more concentrated or less toxic form.	Effective for treating PCBs; however, questionable effectiveness for treating inorganics. Extensive wastewater treatment would be required. Would not offer an advantage over other proven technologies.	No
	Supercritical Extraction (6)	Extraction of organics using gases at a certain temperature and pressure (critical point) such that their solvent properties are greatly altered.	Not a proven technology for PCBs. Ineffective for inorganic COCs. Would not offer an advantage over other proven technologies.	No
	Stabilization/ Solidification (2,4)	Excavated soil is mixed with cement lime, fly ash, or other pozzolanic materials to form a cement-like or soil-like product. Contaminants are physically bound or enclosed within a stabilized mass (solidification) or chemical reactions between stabilizing agent and contaminants to reduce their mobility (stabilization).	Would be effective in creating a solidified mass to prevent incidental ingestion. Would reduce contaminant mobility and, to some extent, toxicity. There would be some increase in volume of contaminated material.	Yes

TABLE 4-1
PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES FOR SOILS
CORRECTIVE MEASURES STUDY
SWMU 7, BOCA CHICA BUILDING A-824
NAVAL AIR STATION KEY WEST, BOCA CHICA KEY, FLORIDA

TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS	OPTION RETAINED
		GENERAL RESPONSE ACTION: EX SITU TREATMENT		
Physical/ Chemical (Continued)	Chemical Oxidation [3,4,5]	Oxidation chemical reactions are used to reduce toxicity or transform the contaminant to a compound that is more stable, less mobile, and/or inert. Commonly used oxidizing agents include ozone, chlorine, and hydrogen peroxide.	Ineffective for treating PCBs. Would not offer an advantage over other more implementable technologies.	No
Biological	Landfarming [4]	Controlled application of contaminated soil, nutrients, and microbes to land area that is tilled.	Questionable effectiveness for PCBs. Ineffective for inorganics.	No
		GENERAL RESPONSE ACTION: IN SITU TREATMENT		
Thermal	Vitrification [4,6]	Electrodes for applying electricity are used to melt contaminated soil, producing a glass and crystalline structure with very low leaching characteristics and destroys organics.	Technology is not cost effective nor practical for a site where groundwater is at a shallow depth.	No
Physical/ Chemical	Soil Flushing [4,8]	Soil contaminants are extracted with water or other suitable aqueous solutions. Extraction fluid passes through in-place soils using an injection or infiltration process. Contaminants are leached into the groundwater, which are then removed via extraction wells.	Although effective in removing a wide range of organic and inorganic contaminants from coarse-grained soil, there is the potential for uncontrolled migration of contaminants to groundwater. Also, the technology is not as cost-effective as compared to other technologies because a complex treatment train is required for washing fluid.	No
	Soil Vapor Extraction [4]	Vacuum is applied through extraction wells to create a pressure/concentration gradient that induces gas-phase volatiles to diffuse through soil to extraction wells.	Ineffective for treating PCB and inorganic contaminants.	No
	Solidification/ Stabilization [2,3,4]	Process where cement, lime, or other pozzolanic materials are mixed with soil in the vadose zone to immobilize contaminants.	The small volume of contaminated soil may not warrant the mobilization costs of on site treatment costs.	No
Biological	Biodegradation [4,9]	By circulating water-based nutrient solutions through contaminated soils, enhance naturally occurring microbes biological degrading of organic contaminants.	Technology is not effective for treatment of inorganics. Questionable effectiveness for PCBs.	No

TABLE 4-1
PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES FOR SOILS
CORRECTIVE MEASURES STUDY
SWMU 7, BOCA CHICA BUILDING A-824
NAVAL AIR STATION KEY WEST, BOCA CHICA KEY, FLORIDA
PAGE 4 OF 4

TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS	OPTION RETAINED
		GENERAL RESPONSE ACTION: DISPOSAL		
Landfill	On-site Landfill (3,7)	Soil is excavated and characterized as required by land disposal restrictions. Hazardous wastes are treated to meet either RCRA or non-RCRA treatment standards prior to land disposal. Soil is then disposed of in a secure, on site, RCRA-permitted facility.	There is no approved disposal facility currently on site.	No
	Off-site Landfill (3,4,7)	Soil is excavated and characterized as required by land disposal restrictions. Hazardous wastes are treated to meet either RCRA or non-RCRA treatment standards prior to land disposal. Soil is then disposed of in a secure, off site, RCRA-permitted facility.	RCRA land disposal restrictions may limit wastes eligibility for disposal without treatment. Widely used and easily implemented technology.	Yes

(1) United States Environmental Protection Agency. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, October 1988.
(2) Rogosnewski, P., Bryson H., and Wagner, K., 1995. JRB Associates, Inc. for the U.S. EPA. Remedial Action Technology for Waste Disposal Sites, Noyes Data Corporation.
(3) Corbitt, Robert A. Standard Handbook of Environmental Engineering, McGraw-Hill Publishing Company, 1990.
(4) United States Department of Defense Environmental Technology Transfer Committee. Remediation Technologies Screening Matrix and Reference Guide, Second Edition, October 1994.
(5) Kiang, Yen-Hsiung and Metry, Amir A. Hazardous Waste Processing Technology, Butterworth Publishers, 1982.
(6) EM Database, January 1995. US Department of Energy Office of Environmental Management Information Posted on The Internet, January 19, 1995.
(7) Dillon, A.P. Pesticide Disposal and Detoxification, Noyes Data Corporation, 1981.
(8) ATTIC (Alternative Treatment Technology Information Center), November 1991. EPA/600/M-91/049, US Environmental Protection Agency.
(9) Matsumura, Fumio and Murti, C.R. Biodegradation of Pesticides, Plenum Press New York, 1982.

TABLE 4-2

SUMMARY OF RETAINED TECHNOLOGIES FOR SOILS
CORRECTIVE MEASURES STUDY
SWMU 7, BOCA CHICA BUILDING A-824
NAVAL AIR STATION KEY WEST, BOCA KEY, FLORIDA

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION
No Action	No Action	No Action
Institutional Controls	Institutional Controls	Limited Site Access
		Site Development Restrictions
		Monitoring
		Educational Programs
Containment	Soil Cover	Native Soil
		Capping
Removal	Bulk Excavation	Bulk Excavation
Ex-Situ Treatment	Physical/Chemical	Stabilization/Solidification
Disposal	Landfill	Off Site Landfill

5.0 EVALUATION OF THE CORRECTIVE MEASURES ALTERNATIVES FOR SWMU 7

This section presents a detailed description of each corrective measures alternative developed in Section 4.0, the rationale used to evaluate each corrective measures alternative, and the results of the evaluation for each specific evaluation standard. The evaluation of corrective measures alternatives was conducted in accordance with the U.S. EPA RCRA Corrective Action Plan Guidance (Final) (U.S. EPA, 1994).

5.1 CORRECTIVE MEASURES ALTERNATIVES

This section describes in detail the corrective measures alternatives developed in Section 4.0.

5.1.1 Alternative 1 - No Action

This is a "walk-away" alternative retained to provide a baseline for comparing the other alternatives and therefore, does not address existing contamination at the site. There would be no reduction in toxicity, mobility, or volume of the contaminants from treatment at SWMU 7 other than that which would result from natural processes (e.g., advection, dispersion, adsorption, or other attenuating factors).

5.1.2 Alternative 2 - Institutional Controls with Monitoring

This alternative consists of one major component, institutional controls (i.e., land-use controls, monitoring, and educational programs).

Land-use controls would be maintained to eliminate or reduce the pathways of human exposure to contaminants at the site. Educational programs would be created to inform the public of hazards related to site contaminants. Alternative 2 is based upon the assumption that SWMU 7 would continue to be owned and operated by the NAS. In this scenario, the SWMU would continue to exist in a secured, federal facility with perimeter fencing and access restrictions. The existing fencing at SWMU 7 would be modified so that it encircles all soil with concentrations of COCs that exceed RGOs. This fencing would prevent base residents and other unauthorized personnel from illegal entry to the site. Signs would be posted to warn of hazards associated with exposure to contaminated soil.

To assess whether natural processes are diminishing the concentration of site contaminants over time and to monitor potential soil contamination migration to surface water and sediment, surface-water, groundwater, and sediment sampling would be conducted. Samples would be collected quarterly for the first year and annually for the next 9 years from three groundwater, surface water, and sediment sampling locations. Surface water and sediment sample locations would correspond to the locations of the following previously sampled locations: S7SW-5, S7SW-6, and S7SW-8 for surface water and S7SS-5, S7SS-6, and S7SS-8 for sediment. Groundwater samples would be collected from the three existing monitoring wells at SWMU 7. The location of these samples are shown on Figure 5-1. Samples from each location would be analyzed for PCBs and inorganic compounds. Quality assurance/quality control (QA/QC) samples would also be collected. Per the MOA (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site and will determine whether changes to the controls are required. The site review is required because this alternative allows contaminants to remain at levels that exceed RGOs.

Site development restrictions would be implemented as stipulated in CNBJAXINST 5090.2N4 (U.S. Navy, 1997) and appropriate changes would be made to the NAS Key West Master Plan. Records of the contamination at SWMU 7 would be maintained in the NAS Key West Master Plan to ensure that, at the time of future land development, the base would be able to take adequate measures to minimize adverse human health and environmental effects. Any future construction activity at SWMU 7 would be conducted in compliance with health and safety requirements so as to minimize the potential for contaminants to enter the exposure pathways (incidental ingestion and dermal contact of soil) for construction workers on site.

Educational programs to inform the public concerning site hazards would be conducted through Restoration Advisory Board (RAB) meetings, public workshops, and other community relations activities.

5.1.3 Alternative 3 - Remove and Treat and/or Dispose of Soil That Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls

This alternative consists of three major components: (1) removal of contaminated soil, (2) transport of contaminated soil for off-site treatment and/or disposal, and (3) institutional controls. This alternative is based upon the assumption that SWMU 7 would continue to be used for industrial land use. The block flow diagram for Alternative 3 is shown in Figure 5-2.

Component 1: Soil Removal

Soil containing concentrations of COCs that exceed industrial RGOs would be excavated from the site. The areas of soil to be excavated are identified in Figure 3-1. The estimated areas and volumes of soil excavation are based upon chemical concentrations that exceed industrial RGOs. The area would be mowed and cleared of any vegetation prior to excavation. Soil would be excavated using conventional construction equipment. Typically, mechanical equipment such as backhoes, bulldozers, and front-end loaders are used for excavation. Excavations would be conducted in accordance with the provisions of a site-specific health and safety plan. It is estimated that 70 yd^3 of soil would require excavation and treatment and/or disposal from SWMU 7. During removal, excavated soil would be stockpiled, if necessary, within the limits of the SWMU. Confirmation sampling would be conducted to ensure that all contaminated soil is removed.

Northwest of Building A-824, approximately 10 yd^3 of soil in excess of Arcolor 1260's industrial soil RGO (2,100 µg/kg) would be excavated. A portion of the area to be excavated is currently located in the vicinity of the fence that surrounds Building A-824. Prior to excavation activities, this section of fence would be removed so the soil of concern could be excavated. Once excavation activities have been completed and the excavated area has been backfilled with clean soil, the fence would be replaced to existing conditions. The other section of soil containing concentrations in excess of Aroclor 1260's RGOs is located adjacent to the northwestern side of Building A-824. Because only 6 inches of soil will be removed during this excavation, the structural integrity of the building should not be of concern during excavation.

Approximately 60 yd^3 of soil containing concentrations in excess of arsenic's industrial RGO for soil (3.7 mg/kg) would be excavated and removed from areas northeast and southwest of Building A-824. The soil to be excavated northeast of Building A-824 is also located within the vicinity of the fencing that surrounds the building. Prior to excavation activities, this section of fence would be removed so the soil of concern could be excavated. Once excavation activities have been completed and the excavated area has been backfilled with clean soil, the fence would be replaced to existing conditions.

After the contaminated soil is excavated, a 6-inch layer of topsoil would be placed atop the backfilled material and revegetated to existing conditions. The final grade would meet the original elevations measured during the initial excavation area survey.

The topsoil layer would be retained by covering the site with erosion control blankets. These temporary controls would be implemented until revegetation by recolonization is established.

Component 2: Transport of Contaminated Soil for Off-Site Treatment and/or Disposal

For arsenic-contaminated soil, soil in excess of the industrial RGO for arsenic would be loaded into suitable container, a sample of this soil would be collected, and toxicity characteristic leaching procedure (TCLP) analysis would be conducted. If TCLP analysis indicates that the soil is a hazardous waste because it exceeds TCLP land disposal requirements, the soil will be transported to an approved TSDF with the capability to treat the soil prior to disposal. The most likely treatment technologies would be stabilization/solidification. If the soil does not exceed TCLP land disposal requirements, it will be sent to a nonhazardous waste facility for disposal. Approximately 60 yd^3 of soil containing arsenic are expected to be transported off site for treatment and/or disposal.

Soil containing Aroclor 1260 in excess of its industrial RGO would be loaded into a container separate from the soil containing arsenic. Because the confirmation samples taken from this area indicate that the concentration of Aroclor 1260 in the soil is less than 50 mg/kg (Bechtel, 1995), this soil will be managed as a non-hazardous waste. Approximately 10 yd^3 of soil containing Aroclor 1260 is expected to be transported off-site for treatment and/or disposal.

For cost estimating purposes, it is assumed that all excavated soil (containing arsenic and Aroclor 1260) would be managed as nonhazardous waste.

Component 3: Institutional Controls

For the institutional controls associated with Alternative 3, it is assumed that SWMU 7 would continue to be used for industrial purposes and would continue to exist in a secured, federal facility with perimeter fencing and access restrictions. Fencing around SWMU 7 would prevent base residents and other unauthorized personnel from illegal entry to the site. Site development restrictions would be implemented as stipulated in CNBJAXINST 5090.2N4 (U.S. Navy, 1997), and appropriate changes would be made to the NAS Key West Master Plan to ensure that the site would remain zoned for industrial land use.

To assess the effectiveness of the soil removal and to determine whether natural processes are diminishing the concentration of any remaining site contaminants over time, surface water, groundwater, and sediment sampling would be conducted. Samples would be collected quarterly for the first year and annually for the next 9 years from three groundwater, surface water, and sediment sampling locations and analyzed for PCBs and inorganics. Surface water and sediment sample locations would correspond to the locations of the following previously sampled locations: S7SW-5, S7SW-6, and S7SW-8 for surface water and S7SS-5, S7SS-6, and S7SS-8 for sediment (as shown in Figure 5-1). Groundwater samples would be collected from the three existing monitoring wells at SWMU 7. Samples from each location would be analyzed for inorganic compounds. Quality assurance/quality control (QA/QC) samples would also be collected.

Per the MOA (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site and will determine whether changes to the controls are required.

5.2 EVALUATION STANDARDS

The corrective measures alternatives were evaluated in accordance with the Guidance for RCRA Corrective Action Plan (OSWER Directive 9902.3-2A, U.S. EPA May, 1994). This section describes the specific standards to be used in evaluating each of the corrective measures alternatives. The five standards are as follows:

- Protection of human health and the environment
- Media clean-up standards
- Source control
- Waste management standards
- Other factors
- Long-term reliability and effectiveness
- Reduction in toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost

5.2.1 Protection of Human Health and the Environment

The protection of human health and the environment provides an overall evaluation of the remedies that would be appropriate for SWMU 7. This standard considers the extent to which the corrective measures alternative mitigates potential short- and long-term exposure to residual contamination and how the remedy protects human health and the environment both during and after implementation of the alternative. In addition, the levels and characterization of contaminants remaining on site, potential exposure pathways, potentially affected populations, the level of exposure to contaminants, and the associated reduction of exposure over time are considered. For management of mitigation measures, the relative reduction of environmental impact for each alternative is determined by comparing residual levels for each alternative with the existing criteria, standards, and guidelines. The ecological considerations for this evaluation standard included potential short- and long-term beneficial and adverse effects of the corrective measure, adverse effects on environmentally sensitive areas, and an analysis on how to mitigate adverse effects.

5.2.2 Media Clean-Up Standards

The media clean-up standard considers whether the corrective measures alternative would achieve the defined CAOs. In addition, this standard includes an assessment of relevant institutional needs for each corrective measures alternative. The effects of federal, state, and local environmental and public standards, regulations, guidance, advisories, ordinances, or community relations on the design, operation, and timing of each alternative are considered.

5.2.3 Source Control

The source control standard evaluates how the corrective measures alternative addresses the source of the release in order to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment. This criterion addresses whether source control measures are necessary and what type of source control actions would be appropriate. In addition, any source control measures that are proposed should include a discussion on how well the method is expected to work given the site situation and previous experiences with the specific technology.

5.2.4 Waste Management Standards

The corrective measures alternative must comply with applicable standards for the management of wastes. This includes a description of how the specific waste management activities would be conducted in order to maintain compliance with all applicable state and federal regulations.

5.2.5 Other Factors

In addition to the first four standards, there are five general factors that are to be addressed as part of the evaluation of corrective measures alternatives. The five general decision factors to be considered under this standard are:

- Long-term reliability and effectiveness
- Reduction in toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost

5.2.5.1 Long-Term Reliability and Effectiveness

Evaluation of the long-term reliability and effectiveness of the alternatives must consider the corrective measures alternatives performance. Performance considerations include the effectiveness and useful life of the corrective measures. The reliability of a corrective measures includes the O&M requirements and demonstrated reliability.

5.2.5.2 Reduction in Toxicity, Mobility, or Volume

This factor includes the ability of the corrective measures to reduce the toxicity, mobility, or volume of the contaminants or media through treatment.

5.2.5.3 Short-Term Effectiveness

This factor includes an evaluation of the corrective measures effectiveness in the short term (less than 6 months), in comparison to the long-term effectiveness, and in particular potential risks to human health and the environment during implementation.

5.2.5.4 Implementability

This factor includes the relative ease of installation (constructability) and the time required to achieve a given level of response.

5.2.5.5 Cost

A cost estimate of the corrective measures includes both estimated capital and O&M costs. Capitals costs include both direct and indirect costs. O&M costs are post-construction activities that may be necessary to ensure the continued effectiveness of a corrective measures.

5.3 EVALUATION OF ALTERNATIVES

This section presents the results evaluation conducted for each corrective measures alternative based on the standards described in Section 5.2.

5.3.1 Alternative 1 - No Action

5.3.1.1 Protection of Human Health and the Environment

Alternative 1 is considered primarily for comparative purposes to the other corrective measures. This alternative would not be protective of human health or the environment. COCs would remain in the soil and potential human exposure through intake routes would continue to exist.

Under a no action alternative, ICR from site contaminants for occupational workers is less than 1E-04 but still exceeds 1E-06. Most of the risk arises from dermal contact with surface soil. The calculated ICR for occupational workers is 4.9E-05. ICR from site contaminants for both adult and adolescent trespassers are also less than 1.0E-04 but would still exceed 1.0E-06 under the no action alternative. Calculated ICRs for these receptors would range from 1.0E-05 for adolescents to 1.0E-05 for adults.

Based upon the ERA conducted as part of the Supplemental RI/RFI (B&R Environmental, 1998), existing conditions at SWMU 7 do not pose significant potential risks to ecological receptors.

5.3.1.2 Media Clean-Up Standards

Alternative 1 would not comply with the media clean-up standards for soil under an industrial use scenario.

5.3.1.3 Source Control

Alternative 1 would not involve source control because no action would be performed at SWMU 7.

5.3.1.4 Waste Management Standards

No actions would be implemented for Alternative 1; therefore, no waste would be generated.

5.3.1.5 Other Factors

Long-Term Reliability and Effectiveness

Given existing conditions, the current threat to human health would remain because there would be no access controls for removal or treatment of the contaminants. Except through decreases by natural processes such as advection, dispersion and adsorption, contaminant concentrations would remain in the soil at SWMU 7 at levels greater than the media clean-up standards. However, site risks could actually increase in the long term since there would not be any restrictions against residential development.

Based on 1993 data, antimony exceeds its MCL in groundwater at one monitoring well location. Modeling indicates that the time necessary for antimony to attenuate from its current concentration in groundwater (46 µg/L) to its MCL (6 µg/L) is over thirty years. This estimate is based on the fate and transport model and includes all natural processes such as dilution due to infiltration and upgradient water, dispersion, and sorption. The details of this modeling is presented in Appendix B.

Additionally, methylene chloride was detected at one surface soil sample location (S7SB-5 at 28 µg/kg) in excess of the FDEP soil to groundwater leaching criteria of 10 µg/kg (FDEP, 1995). Modeling indicates that the time necessary for methylene chloride to attenuate from its current concentration in surface soil to the FDEP leaching criteria is 2 years.

No long-term management controls would be applied to SWMU 7 under this alternative. Therefore, the adequacy and reliability of controls are not applicable. Also, there would be no long-term monitoring programs to assess the migration of contaminants from the site.

Reduction in Toxicity, Mobility, and Volume

Alternative 1 would not reduce the toxicity, mobility, or volume of the contaminants at SWMU 7 other than that which would result from natural dispersion, dilution, or other attenuating factors. Treatment processes would not be employed; therefore, contaminants would not be treated or destroyed.

Short-term Effectiveness

Alternative 1 would involve no action and, therefore, the no-action alternative would not pose risks to on-site workers during implementation and no environmental impacts would be expected. This alternative would not achieve any of the CAOs.

Implementability

Since no actions would occur, this alternative would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable.

Cost Analysis

No costs are associated with the no-action alternative.

5.3.2 Alternative 2 - Institutional Controls with Monitoring

5.3.2.1 Protection of Human Health and the Environment

Alternative 2 would be partially protective of human health by restricting site access and land use within and around SWMU 7. Based upon the ERA conducted as part of the Supplemental RI/RFI (B&R Environmental, 1998), existing conditions at SWMU 7 do not pose significant risks to ecological receptors.

This alternative restricts site access and use and would employ several security measures. From a human health risk perspective, these actions would reduce but not prevent exposure to the site contaminants. Fencing would restrict unauthorized personnel from coming into contact with soil. Signs would be posted to warn of hazards associated with ingestion or dermal contact with contaminated soil. Workers that come into contact with soil (e.g., excavation workers) would be required to use personal protective equipment (PPE).

ICR from site contaminants for occupational workers is less than 1E-04 but would still exceed 1E-06 under the institutional controls alternative. Most of the risk arises from dermal contact with surface soil. Calculated ICR for occupational workers is 1.0E-05. ICRs from site contaminants for both adult and adolescent trespassers are also less than 1.0E-04 but would still slightly exceed 1.0E-06 under the institutional controls alternative. Most of the risk arises from dermal contact with and ingestion of surface soil and dermal contact with sediment. Calculated ICRs for these receptors range from 3.8E-06 for adolescents to 4.5E-06 for adults. There would be no HIs (non-cancer risk values) greater than 0.1 when calculated under Alternative 2 conditions. The details of these modified human health risks are presented in Appendix A. These risks are primarily attributed to arsenic, which is present in soil and sediment at concentrations within or slightly greater than background concentrations.

Sampling of sediment and surface water would be included to monitor potential soil contamination migration to the surface water and sediment. Groundwater monitoring is proposed to assess whether MCL exceedances are being reduced through natural processes. Periodic review of the site would be necessary to ensure that contaminant concentrations are not increasing and to determine whether additional measures are necessary to protect human health and the environment.

5.3.2.2 Media Clean-Up Standards

Alternative 2 would not comply with the media clean-up standards for soil under industrial use. However, it would include long-term monitoring to determine whether contaminant concentrations are increasing or diminishing over time. Institutional controls would be used to prevent exposure to media with contaminant concentrations above clean-up standards.

5.3.2.3 Source Control

Alternative 2 would not involve source control because only institutional controls would be implemented.

5.3.2.4 Waste Management Standards

Soil, sediment, or surface water would not be removed; therefore, this alternative would not generate waste.

5.3.2.5 Other Factors

Long-Term Reliability and Effectiveness

Although no removal would occur in Alternative 2, the current threat to human health would be reduced. This alternative would use institutional controls to restrict future use of the site [in accordance with CNBJAXINST 5090.2N4 (U.S. Navy, 1997)]. Therefore, human exposure to the soil could be limited by prohibiting future development of SWMU 7.

Based on 1993 data, antimony exceeds its MCL in groundwater at one monitoring well location. Modeling indicates that the time necessary for antimony to attenuate from its current concentration in groundwater (46 µg/L) to its MCL (6 µg/L) is over thirty years. This estimate is based on the fate and transport model and includes all natural processes such as dilution due to infiltration and upgradient water, dispersion, and sorption. The details of this modeling is presented in Appendix B.

Additionally, methylene chloride was detected at one surface soil sample location (S7SB-5 at 28 µg/kg) in excess of the FDEP soil to groundwater leaching criteria of 10 µg/kg (FDEP, 1995). Modeling indicates that the time necessary for methylene chloride to attenuate from its current concentration in surface soil to the FDEP leaching criteria is 2 years.

Institutional controls have uncertain long-term effectiveness. The protection of receptors in the long term would depend on effective administration and management of the Master Plan. Per the NAS Key West MOA, between the U.S. EPA and FDEP (NASKW, 1998), the facility will perform quarterly inspections and make an annual report to U.S. EPA and FDEP verifying the integrity of institutional controls placed at the site.

Reduction in Toxicity, Mobility, and Volume

Alternative 2 would not result in reduction in toxicity, mobility, or volume through treatment of the hazardous substances at SWMU 7 other than that which would result from natural processes such as advection, dispersion, or adsorption.

Short-Term Effectiveness

Alternative 2 would involve surface water, sediment, and groundwater monitoring, administration of institutional controls, and potential restriction of residential land use. The short-term risks associated with these remedial activities would be minimal. Sampling personnel would wear the required PPE and receive the appropriate health and safety training. There would be no potential risk to the community or environmental impacts associated with the implementation of institutional controls. Land use restrictions could be implemented within a range of 3 months to 1 year. Sampling would be conducted quarterly for the first year and annually thereafter. Results would adequately demonstrate to U.S. EPA and FDEP that protection of human receptors and the environment is achieved. Each sampling event would take 1 day to complete.

Implementability

Alternative 2 would be readily implementable because SWMU 7 is located within a military facility where rules and local ordinances can be strictly enforced. Restrictions for future residential property use would involve legal assistance and regulatory approval. Provisions in the NAS Key West Master Plan would be defined and enforced relatively easily because the site is located within a federal facility. Sampling and analysis are also readily implemented.

Cost Analysis

The following costs are estimated for Alternative 2.

Capital Costs: $13,400
O&M Costs: $11,500 per year - $46,000 per year.
Present-Worth: $151,000 estimated over 10 years

Detailed cost estimates are included in Appendix C. To date, the Navy has spent approximately 7.9 million dollars on IRAs at nine sites/SWMUs/areas of concern.

5.3.3 Alternative 3 - Remove and Treat and/or Dispose of Soil That Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls

5.3.3.1 Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment. This alternative would remove the soil with concentrations in excess of the industrial RGOs. Confirmation samples would be collected from the perimeter of the excavation to ensure that soil with contaminant concentrations greater than industrial RGOs is removed.

ICR from site contaminants for adult and adolescent trespassers would be less than 1.0E-06 under this alternative. Calculated ICRs for these pathways range from 8.7E-07 for adolescent trespassers to 9.8E-07 for adult trespasser. However, the ICR from site contaminants for the occupational worker would slightly exceed 1.0E-06. Calculated ICR for this receptor would be 1.2E-06. There would be no HIs (non-cancer risk values) greater than 0.1 when calculated under Alternative 3 conditions.

The potential for human exposure to contaminated soil would be significantly reduced through implementation of this alternative. To assess the effectiveness of the soil removal and to determine whether natural processes are diminishing the concentration of any remaining site contaminants over time, surface water, groundwater, and sediment sampling would be conducted. Every year, the sampling results would be reviewed to determine if further monitoring would be required.

5.3.3.2 Media Clean-Up Standards

Alternative 3 would achieve industrial RGOs for soil through removal of the contaminated soil from SWMU 7. Samples would be collected from the soil remaining after removal to confirm the soil meets cleanup standards. If required, the contaminated soil would be treated, if required, prior to disposal to comply with LDRs and the TSDF permit. The treatment process would be selected to convert the hazardous contaminants to nonhazardous or less toxic compounds, allowing the soil to meet applicable LDRs. Sediment and surface water sampling would be conducted to verify the effectiveness of the soil removal and to assess the decrease of contaminant concentrations in the environment. Groundwater monitoring is proposed to assess whether MCL exceedances are being reduced through natural processes.

5.3.3.3 Source Control

This alternative would excavate approximately 70 yd^3 of soil in excess of industrial RGOs from four hot-spot locations. This action would reduce the potential threat to human health.

5.3.3.4 Waste Management Standards

During implementation of Alternative 3, waste management practices would be used to control stormwater runoff from spreading contamination. Contaminated soil would be excavated and stockpiled, if necessary, within the limits of the excavation. The excavated soil would be loaded into suitable containers for transportation to a RCRA-permitted TSDF. If treatment is required, the excavated soil would be transported to an appropriate facility to convert the hazardous contaminants to nonhazardous or less toxic compounds. The treated soil, which would meet LDRs and the TSDF permit, would then be placed in a RCRA-permitted landfill for final disposal.

Equipment used on site may come in contact with potentially hazardous chemicals (contaminated media). The equipment would be decontaminated prior to leaving site. Decontamination water would be collected, sampled, and, if required, properly treated and disposed. Any treatment residuals from implementation of this alternative would be sampled and properly disposed.

5.3.3.5 Other Factors

Long-Term Reliability and Effectiveness

Alternative 3 would provide for moderate long-term effectiveness since excavation can be very effective at removing the most contaminated soil. Sediment and surface water sampling would be conducted to assess the decrease of contaminant concentrations in the environment and groundwater monitoring is proposed to assess whether MCL exceedances are being reduced through natural processes.

The effectiveness of this alternative would be monitored through confirmation sampling after removal. The effectiveness of the soil treatment would be confirmed by sampling and testing before the material is placed in a RCRA-permitted landfill. During excavation, PPE would be used and monitoring would be conducted to ensure that exposure of the workers to potentially contaminated material is minimized.

Based on 1993 data, antimony exceeds its MCL in groundwater at one monitoring well location. Modeling indicates that the time necessary for antimony to attenuate from its current concentration in groundwater (46 μg/L) to its MCL (6 μg/L) is over thirty years. This estimate is based on the fate and transport model and includes all natural processes such as dilution due to infiltration and upgradient water, dispersion, and sorption. The details of this modeling is presented in Appendix B.

Additionally, methylene chloride was detected at one surface soil sample location (S7SB-5 at 28 μg/kg) in excess of the FDEP soil to groundwater leaching criteria of 10 μg/kg (FDEP, 1995). Modeling indicates that the time necessary for methylene chloride to attenuate from its current concentration in surface soil to the FDEP leaching criteria is 2 years.

Reduction in Toxicity, Mobility, and Volume

Alternative 3 may utilize treatment of the contaminated soil to reduce the toxicity, mobility, and volume of the waste. If performed, treatment would reduce the toxicity and mobility of the contaminants at SWMU 7. Depending on the treatment technology, the volume of contaminants may be reduced or increased. The contaminated soil would be transported off site to a RCRA-permitted TSDF. After treatment, soil would be placed in a RCRA-permitted landfill at the facility. The treatment process converts hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert. The most likely treatment processes would be stabilization/solidification.

Short-term Effectiveness

Based on the relatively low concentration of contaminants, the short-term effectiveness for Alternative 3 would be moderate. Site workers would be required to have the appropriate health and safety training and would wear the required PPE during implementation. The only potential risk to the community would be during transport of the contaminated materials off site for treatment and disposal.

The soil removal is estimated to take 1 month to complete. Land use restrictions could be implemented within a range of 3 months to 1 year. Sampling would be conducted quarterly for the first year and annually thereafter until results adequately demonstrate to U.S. EPA and FDEP that protection of human receptors and the environment is achieved. Each sampling event would take 1 day to complete.

Implementability

Alternative 3 is considered to be implementable. Excavation contractors and equipment are readily available for soil removal. The remedial technologies are well proven and established in the remediation and construction industries. Additional removal of materials, if indicated by confirmation sampling, would require supplemental excavation during the site work. TSDFs are available for treatment of soil contaminated with metals. Sampling and analysis are also readily implementable.

Cost Analysis

The following costs are estimated for Alternative 3.

Capital Costs: $102,000
O&M Costs: $11,500 per year to $46,000 per year
Present-Worth: $239,000 estimated over 10 years.

These costs are based on the assumption that soil is found to be a non-hazardous waste. However, if TCLP standards are exceeded, the capital costs for soil disposal would increase significantly.

Detailed cost estimates are included in Appendix C. To date, the Navy has spent approximately 7.9 million dollars on IRAs at nine sites/SWMUs/areas of concern.

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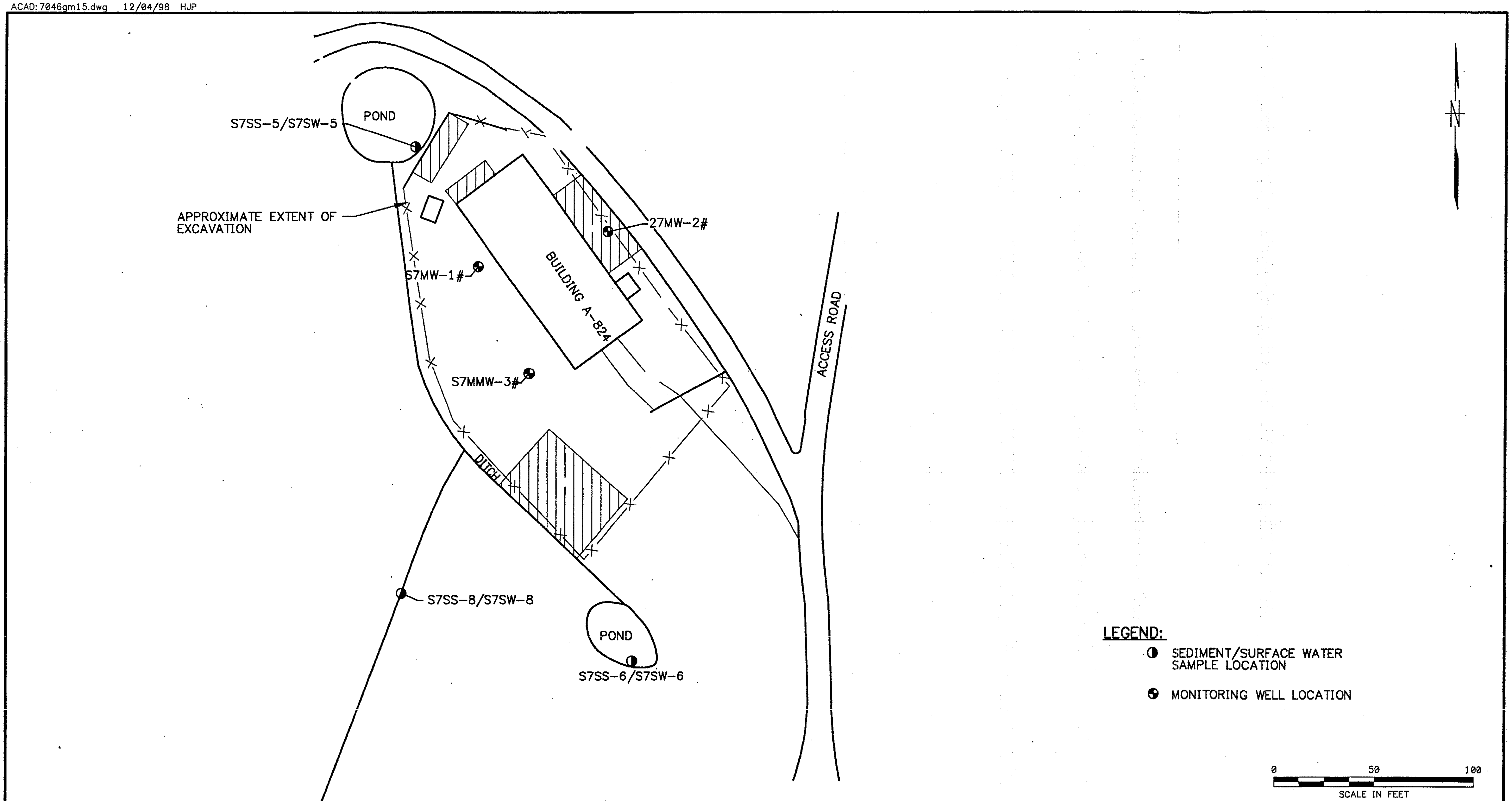


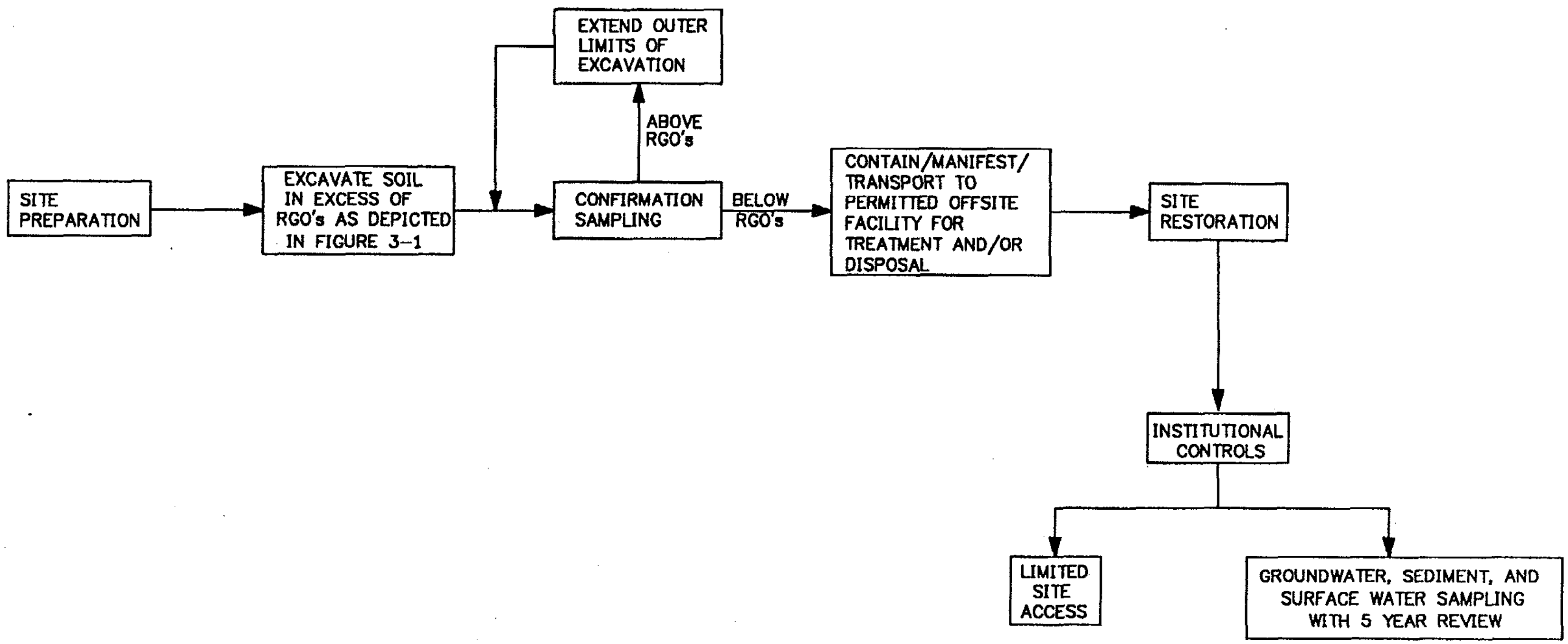
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 12/4/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

ALTERNATIVE 2-INSTITUTIONAL CONTROLS WITH MONITORING
SWMU 7
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

CONTRACT NO. 7046
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 5-1 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98



DRAWN BY MF DATE 4/20/98	BLOCK FLOW DIAGRAM SWMU 7, ALTERNATIVE 3 NAVAL AIR STATION KEY WEST BOCA CHICA KEY, FLORIDA	CONTRACT NO. 7046
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COST/SCHED-AREA		APPROVED BY DATE
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FORM CADD NO. SDIV_AH.DWG - REV 0 - 1/20/98

6.0 RECOMMENDATION OF THE FINAL CORRECTIVE MEASURE

6.1 INTRODUCTION

This section presents a comparison of the corrective measures alternatives in Section 5.0 for each evaluation standard. The standards for comparison are identical to those used for the detailed analysis of individual alternatives.

The following corrective measures alternatives are being compared in this section:

- Alternative 1 - No Action
- Alternative 2 - Institutional Controls with Monitoring
- Alternative 3 - Remove and Treat and/or Dispose of Soil That Contain Chemical Concentrations Greater than Industrial RGOs; Institutional Controls

6.2 COMPARATIVE ANALYSIS OF ALTERNATIVES

A corrective measures alternative is selected based on a comparison between the alternatives using the standards presented in the detailed analysis in Section 5.0. This section presents a comparative discussion of the corrective measures alternatives versus the evaluation standard.

6.2.1 Protection of Human Health and the Environment

The cumulative risks from all the corrective measures alternatives are less than 1.0E-4 for ICR and 1.0 for non-carcinogenic risk (see Appendix A). Based on the risk estimates, there would be a progressive reduction of risks as corrective measures become more aggressive. The ICR for a trespassing adult is 1.0E-05 for Alternative 1. As summarized in Appendix A, Table A-8, this ICR would be reduced to 4.5E-06 for Alternative 2 and 9.8E-07 for Alternative 3 (with institutional controls). For the adolescent trespasser, the ICRs for Alternatives 1, 2, and 3 would be 1.0E-05, 3.8E-06, and 8.7E-07, respectively. For the occupational workers, the ICRs for Alternatives 1, 2, and 3 would be 4.9E-05, 1.0E-05, and 1.2E-06, respectively.

Soil contaminants at the site do not appear to pose significant potential risks to terrestrial plant and animal receptors. Alternatives 2 and 3 would incorporate a monitoring program consisting of periodic tests of groundwater, surface water, and sediment.

- Alternative 1 would not reduce the current potential risks to human health or the environment and some increases in risk could occur in the long term if residential development occurs.

- Alternative 2 would reduce the risk to human health and would include site monitoring to determine if further action is required.

- Alternative 3 would reduce the risk to human health and the environment by removing contaminated soil with concentrations in excess of industrial RGOs to meet the media clean-up standards.

6.2.2 Media Clean-Up Standards

This standard considers whether the corrective measures alternative will achieve the media clean-up standards. In addition, this standard includes an assessment of relevant institutional needs for each corrective measures alternative. The effects of federal, state of Florida, and local environmental regulations are also considered.

- Alternatives 1 and 2 would not comply with the media clean-up standards. However, Alternative 2 would monitor the concentration of chemicals within groundwater, sediment, and surface water contaminant levels to assess the level of COCs over time.

- Alternative 3 would comply with the industrial RGOs for soil. Additionally, through surface water, groundwater, and sediment sampling, this alternative would assess the effectiveness of the soil removal and determine whether natural processes are diminishing the concentration of any remaining site contaminants over time.

6.2.3 Source Control

This standard evaluates the corrective measures alternatives for control of the source of contamination so as to reduce or eliminate further releases that may pose a threat to human health and the environment to the furthest extent possible. This standard addresses whether source control measures are necessary and what type of source control actions would be appropriate.

- Alternatives 1 and 2 would not include source control measures. However, Alternative 2 would monitor the groundwater, sediment, and surface water to assess the extent of contaminant migration, if any.

- Alternative 3 includes partial source control measures for the soil. Removal and treatment of the soil above industrial RGOs would provide for control of the most contaminated portion of the soil.

6.2.4 Waste Management Standards

The corrective measures alternative must comply with applicable standards for the management of wastes. This standard includes a description of how the specific waste management activities will be conducted in order to maintain compliance with all applicable state and federal regulations.

- Alternatives 1 and 2 would not include removal of any waste materials and, therefore, the standards for management of waste material do not apply.

- Alternative 3 would include the removal and disposal of the soil in excess of the industrial RGOs. Removal of the soil would be conducted in accordance with RCRA (40 CFR 262, 263, 264, and 268) and state of Florida (Chapter 62-730 F.A.C.) regulatory requirements, as well as equivalent requirements for the state in which the TSDF is located. Since contaminant concentrations may exceed the LDRs, an approved TSDF would be utilized for receipt of the contaminated soil. In addition, a licensed waste hauler would be used for transportation of the containerized waste materials to the permitted TSDF. All applicable RCRA and state of Florida waste management requirements would be adhered to in the containerization, labeling, and manifesting of site waste materials.

6.2.5 Long-Term Reliability and Effectiveness

Evaluation of long-term reliability and effectiveness of the corrective measures alternatives includes an assessment of useful life, O&M requirements, and demonstrated reliability.

- Alternative 1 would allow the human health risks to remain and possibly increase in the long term.

- Alternative 2 would allow the residual risk to remain; however, Alternative 2 would implement institutional controls, which would be relatively reliable and protective of human health in the long term when properly implemented. Monitoring would assess the residual risk over time.

- Alternative 3 would remove contaminated soil; therefore, it would be extremely reliable and effective over the long term. It should be relatively protective in the long term of human health but some risks may remain. This alternative would monitor the long-term effects of the soil removal on the environment.

6.2.6 Reduction in the Toxicity, Mobility, or Volume of Wastes Through Treatment

This standard includes the ability of the corrective measures to reduce the toxicity, mobility, or volume of the contaminated media through treatment.

- Alternatives 1 and 2 do not include treatment; therefore, no reduction in the toxicity, mobility, or volume would be achieved.

- Alternative 3 may include treatment of the soil, if required. Any treatment technologies used would provide for a reduction in the toxicity and mobility of contaminants in the soil.

6.2.7 Short-Term Effectiveness

This standard includes an evaluation of the potential effects to the workers and community during implementation of the corrective measures. This standard is not applicable to Alternative 1- No Action.

- No significant risks to the community are anticipated for the three alternatives, other than the minimal risk associated with transportation of the contaminated media through the community and during off-site treatment and disposal under Alternative 3.

- Alternative 2 has only minimal short-term risk to workers during sampling activities. Monitoring will continue until results adequately demonstrate to U.S. EPA and FDEP that protection of human health and the environment is achieved.

- Alternative 3 would have some short-term risk to workers because of the removal and treatment of the contaminated soil. However, the risk to workers would be incrementally higher than Alternative 2. The time needed to complete the soil removal and treatment action is estimated to be 1 month; however, the time needed to complete the monitoring portion of the institutional controls is dependent on approval of the U.S. EPA and FDEP.

6.2.8 Implementability

This standard includes consideration of the relative ease of implementation, availability of equipment and services, the technical complexity of the process, and the ability to obtain required permits. The time needed to complete each corrective measures alternative is also provided. This criterion is not applicable to Alternative 1, No Action.

- Alternative 2 would include institutional controls which are readily implementable. These controls would include administrative access restrictions and would require enforcement to maintain human health protection. Monitoring would continue until results adequately demonstrate to U.S. EPA and FDEP that protection of off-site residents and the environment has been achieved.

- Alternative 3 would include the removal of the soil containing concentrations of COCs above industrial RGOs. The removal of the contaminated soil would be readily implementable because of the use of proven and commercially available technologies. Likewise, the monitoring component for groundwater, sediment, and surface water would be implementable. It is assumed administrative access restrictions will require enforcement to maintain human health protection.

6.2.9 Cost

A cost estimate of each of the corrective measures includes both capital, operation, and maintenance costs. Capital costs include both direct and indirect costs. O&M costs are post-construction activities that are necessary to ensure the continued effectiveness of a corrective measure.

Alternative	Capital ($)	Operating ($/year.)	Present Worth ($)
1	0	0	0
2	13,400	11,500-46,000	151,000
3	102,000	11,500-46,000	239,000

6.3 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 6-1 provides a table summarizing the comparative analysis of the corrective measures alternatives for the three alternatives, based on the results of the evaluation presented in Section 6.2.

6.4 RECOMMENDED CORRECTIVE MEASURE ALTERNATIVE

The recommended alternative for this site is Alternative 2 – Institutional Controls with Monitoring. Under this alternative, groundwater, sediment, and surface water would be sampled and analyzed at a frequency yet-to-be determined by the NAS Key West Partnering Team. Further, exposure to soils in areas not removed by the IRA would be managed by implementing appropriate access restrictions. The institutional control alternative is further described below.

By separate MOA with the U.S. EPA and the FDEP, NAS Key West, on behalf of the Department of the Navy, agreed to implement periodic site inspection, condition certification, and agency notification procedures designed to ensure the maintenance by Station personnel of any site-specific land-use controls (LUC) deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of that agreement was that through the Navy's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to the U.S. EPA and FDEP as to the permanency of those remedies, which included the use of specific LUCs.

Although the terms and conditions of the MOA are not specifically incorporated herein by reference, it is understood and agreed by the Navy, U.S. EPA, and FDEP that the contemplated permanence of the remedy reflected herein shall be dependent on the Station's substantial good-faith compliance with the specific LUC maintenance commitments reflected therein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

The proposed alternative, Institutional Controls with Monitoring, is protective of human health and the environment under current industrial land use, complies with State and Federal ARARs, and is cost effective.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF CORRECTIVE MEASURES ALTERNATIVES
SWMU 7 CMS REPORT
NAS KEY WEST - BOCA CHICA KEY, FLORIDA

Alternative 1: No Action	**Alternative 2: Institutional Controls with Monitoring**	**Alternative 3: Remove and Treat and/or Dispose of Soil That Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls**
Protection of Human Health and the Environment		
Would not be protective of human health. Would not monitor the risks to the environment.	Would be protective of human health and would monitor the extent of contamination in the environment.	This alternative would be protective of human health and the environment by removing soil in excess of the industrial RGOs.
Media Clean-up Standards		
Would not comply with media clean-up standards.	Would not comply with media clean-up standards.	Would achieve industrial soil RGOs.
Source Control		
No new source control would be implemented.	No new source control would be implemented.	The contaminated soil in excess of the industrial RGOs would be removed, treated, and disposed off site.
Waste Management Standards		
No standards applicable because no waste will be generated.	No standards applicable because no waste will be generated.	Would comply with all applicable waste management standards during implementation.
Long-Term Reliability and Effectiveness		
No controls would be in place; residual contamination and existing risks would remain	Limited site access would provide control. The site contamination would be measured with long-term monitoring with 5-year reviews to determine need for further action.	Long-term effectiveness of this alternative, which removes some of the primary source, would be easily measured with long-term monitoring to assess the decrease of contamination concentrations in the environment.
Reduction in Toxicity, Mobility, or Volume through Treatment		
This alternative would involve no treatment to reduce toxicity, mobility, or volume of the contaminated media.	This alternative would involve no treatment to reduce toxicity, mobility, or volume of the contaminated media.	This alternative would involve possible treatment of soil to reduce toxicity, and mobility of the waste. Depending on the treatment technology used, waste volume would be decreased or increased.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF CORRECTIVE MEASURES ALTERNATIVES
SWMU 7 CMS REPORT
NAS KEY WEST - BOCA CHICA KEY, FLORIDA

Alternative 1: No Action	Alternative 2: Institutional Controls with Monitoring	Alternative 3: Remove and Treat and/or Dispose of Soil That Contains Chemical Concentrations Greater than Industrial RGOs; Institutional Controls
Short-Term Effectiveness		
Not applicable.	This alternative would reduce risk of exposure through institutional controls and would pose only minimal risk during long-term monitoring.	Short-term risks would be present during the removal, potential treatment, and disposal of contaminated soil. Community risk would only be during transport, treatment, and disposal of the contaminated media.
Implementability		
Readily implementable since no action would occur.	Easily implementable because site is located within an active military base where rules can be strictly enforced.	No difficulties are anticipated. Excavation contractors are readily available and the remediation technologies are well proven.
Cost (Total Present Worth)		
$0.00	$151,000	$239,000

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APPENDIX A

HUMAN HEALTH RISK ASSESSMENT CALCULATIONS

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A.1 HUMAN HEALTH RISKS ASSESSMENT CALCULATIONS

A.1.1 Remedial Goal Options (RGOs)

As stated in Section 3.3, the likely land use scenario for SWMU 7 is to remain a military base. Therefore, the receptors considered in this RGO determination are the Adult and Adolescent Trespassers and Occupational Worker (based on FDEP Selection Criteria). The Maintenance Worker was eliminated based on recommendations of the Partnering Team (11/18/98). If SWMU 7 were to change to a residential area in the future, then these RGOs should be re-estimated.

Details of the RGO determinations are presented in the Supplemental RFI/RI report (BRE, 1997). They were calculated for several potential receptors at NAS Key West. All exposure pathways (considering all receptors, media, and routes of exposure) with incremental cancer risks (ICRs) of greater than 1E-06 and/or Hazard Indices (HIs) of greater than 1.0 were identified. For each scenario, individual chemicals which contribute at least 1E-06 to the ICR or at least 0.1 to the HI were selected.

Site-Specific RGOs accounted for the same exposure pathways and intake scenarios that were applied in the baseline risk assessment. They were developed by modifying the representative concentrations that were used in the calculation of cancer risk or HQs. The calculated cancer or non-cancer risk values (ICR or HI) for each contributing route of exposure (ingestion, dermal contact, inhalation) were added for each chemical selected. The following equation was then used to determine the relevant RGOs:

RGO concentration = (Exposure Concentration)*(Desired Risk Level)/(Calculated Risk Level)

Risks for Corrective Measure Alternatives

Human health risk values were re-calculated for each of several proposed corrective measures alternatives by modification of the cancer and non-cancer risks originally determined. In this way, the original input parameters and exposure assumptions remained intact and the original representative concentrations could be used. All original COCs were included in the new risk calculations and whenever appropriate, all original exposure pathways were considered. Exposure to groundwater was not considered because this medium was not determined to be a potential concern to human receptors.

A.2 HUMAN HEALTH RISKS FOR CORRECTIVE MEASURES ALTERNATIVES

A.2.1 Alternative 1 (No Action)

This alternative assumes that there will be no institutional controls, media removal, or media treatment. The site will be left as is and therefore, all human health risks originally calculated would still apply. This option is considered primarily for comparative purposes as the various corrective measures are evaluated.

A.2.2 Alternative 2 (Institutional Controls)

This alternative involves limitation of site access and use. Warning signs should be posted and a number of other security measures would be employed. From a human health risk assessment perspective, the effect would be reduced exposure to the site media. No residents or excavation workers would be permitted on site, Trespassers would be actively discouraged from entering the site, and the assumed frequency of exposure would be no more than once a month. Workers and trespassing adults would be expected to make an effort to avoid ingestion or skin contact with the media because of the hazard posting. Occupational exposures were assumed to be reduced to approximately one-fifth (20.8%) of the original estimates. Workers would be required to be on site less frequently (one day per week as opposed to the original estimate of 5 days per week). The reduction factors are shown in table A-1. These factors were multiplied times the associated risks previously estimated to give new risk values. Under Alternative 2, revised risks are shown in Table A-2 and are compared to original risks (the no action alternative) in Table A-3.

Cancer risks for both adult and adolescent trespassers and occupational workers still exceed 1E-06 under the institutional controls alternative. Most of the risk arises from dermal contact with surface soil. The highest cancer risk for the potential receptors are as follows: trespasser adult (3.8E-06; dermal contact with surface soil), trespasser adolescent (2.7E-06; dermal contact with surface soil), and occupational worker (8.6E-06; dermal contact with surface soil). Hazard Indices (summed noncancer risk values) are all below 1.0 for each of the three potential receptors.

A.2.3 Alternative 3 (Soil Removal and Institutional Controls)

This alternative includes two separate revisions. The first option includes only soil removal, while the other option includes soil removal and institutional controls. Any soil sample that contains a contaminant that exceeds a RGO would be moved off-site. The RGO concentration is typically selected from a number of values reflecting human health risk, ecological risk, and/or State or Federal screening or cleanup levels, with the lowest value among these typically chosen. For soil under Alternative #3, the RGO selected for arsenic was the FDEP Industrial Clean-Up (3.7 mg/kg).

For Aroclor-1260 in soil, the RGO selected was the modified industrial RGO (2,100 ug/kg).

For the protection of human health, upper range risks from exposure to soil would be limited to the risks associated with the RGO concentrations, which implies that the RGO concentrations would be the maximum soil concentration permitted at the site. Therefore, risks of exposure were recalculated by modifying the representative concentrations that were used in the estimation of cancer risks or HQs to give the new risks at the RGO level. The following equation was used to account for risks after soil removal:

Alternative Risk = (Original Risk Value)/(Original Representative Concentration)*(New Representative Concentration)

The New Representative Concentration arises from recalculating sample statistics to yield the exposure point concentration, after first removing all samples from the data set that exceed FDEP Industrial Cleanup Goals. Removing the soil samples CONF-2 (Aroclor-1260 concentration 16,500 ug/kg) and CONF-5 (Aroclor-1260 concentration 10,000 ug/kg) and S7SB-14 (arsenic concentration 4.9 mg/kg) and S7SB-18 (arsenic concentration 4.5 mg/kg), lowered the representative concentrations from 16,500 ug/kg to 730 ug/kg for Aroclor-1260 and 4.9 mg/kg to 1.8 mg/kg for arsenic. The risks were re-estimated using the new representative concentration and are shown in Table A-4 and compared to the original risks (the no action alternative) in Table A-5.

Cancer risks for both adult and adolescent trespassers and the occupational workers still exceed 1E-06 under the first soil removal alternative. The cumulative cancer risk for the adult trespasser was 3.0E-06, with dermal contact exposure to sediment contributing to a significant portion of the cancer risk (1.8E-06). The cumulative cancer risk for the adolescent trespasser was 2.8E-06, with dermal contact exposure to sediment contributing to a significant portion of the cancer risk (1.6E-06). The cumulative cancer risk for the occupational worker was 5.6E-06, with dermal contact exposure contributing to a significant portion of the cancer risk (4.9E-06). For both the adult and adolescent trespassers, the cumulative cancer risks based on surface soil exposure dropped below 1E-06, however, cumulative cancer risks based on sediment exposure still exceeded 1E-06. Hazard Indices (summed noncancer risk values) are all below 1.0 for each of the three potential receptors.

A modified alternative #3 was estimated for risks at the site. This option assumes removal of the soil sample that exceeds FDEP Industrial Criteria AND factoring in the adjustments for institutional controls as was done under Alternative #2. The factors shown in Table A-1 were again used. When both approaches were considered, the modified alternative #3 cancer risks were all below 1E-06 for the adult and adolescent trespasser. The cumulative cancer risk for the occupational worker was 1.2E-06, with dermal contact exposure contributing to a significant portion of the cancer risk (1.0E-06). Hazard Indices are all below 1.0 for each of the three potential receptors. Under this modified alternative, revised risks are shown in Table A-6 and compared to the original risks (the no action alternative) in Table A-7.

A.2.4 Comparison of Risks for Corrective Measures Alternatives

The cumulative risks for all 3 corrective measures alternatives are summarized in Table A-8. The data in this table shows a progressive reduction in cancer risks as corrective measures become more aggressive.

The total cancer risk for a trespassing adult is 1.0E-05 with no controls (Alternative #1). The cancer risk progressively decreases to 4.5E-06 (Alternative #2), 3.2E-06 (Alternative #3), and finally to 9.8E-07 (Alternative #3 Modified).

The total cancer risk for a trespassing adolescent is 1.0E-05 with no controls (Alternative #1). The cancer risk progressively decreases to 3.8E-06 (Alternative #2), 2.7E-06 (Alternative #3), and finally to 8.7E-07 (Alternative #3 Modified).

The total cancer risk for an occupational worker is 4.9E-05 with no controls (Alternative #1). The cancer risk progressively decreases to 1.0E-05 (Alternative #2), 5.6E-05 (Alternative #3), and finally to 1.2E-06 (Alternative #3 Modified). The cancer risk for this receptor does not drop below 1E-06, however 1.2E-06 is very close to the target goal.

Hazard Indices (summed noncancer risk values) are all below 1.0 for each of the three potential receptors under Alternative #1, #2, #3, and #3 With Institutional Controls.

TABLE A-1
Factors for Re-Estimating Cumulative Risks
Corrective Measures Alternative #2 (Institutional Controls) (1)
SWMU 7
NAS Key West

Receptor	**Trespassers**				**Workers**	
Exposure Routes	Adult Revised/Original Assumptions	Adult Multiplication Factor	Adolescent Revised/Original Assumptions	Adolescent Multiplication Factor	Occupational Revised/Original Assumptions	Occupational Multiplication Factor
Surface Soil						
Dermal Contact	EF = 12/24	0.5	EF = 12/30	0.4	EF = 52/250	0.208
Incidental Ingestion	EF = 12/24; IR = 50/100	0.25	EF = 12/30	0.4	EF = 52/250	0.208
Inhalation of Dust	EF = 12/24	0.5	EF = 12/30	0.4	EF = 52/250	0.208
Sediment						
Dermal Contact	EF = 12/45	0.27	EF = 12/45	0.27	NA	NA
Incidental Ingestion	EF = 12/45; IR = 50/100	0.13	EF = 12/45	0.27	NA	NA

(1) Exposure assumptions were revised to reflect changes that would result if institutional controls such as warning signs, access restrictions, use restrictions, etc. are implemented. No residents or excavation workers are included because the most likely land use is industrial.

(2) With institutional controls, it is assumed that any trespassing would occur no more than one time per month (12 events/year). Ingestion rate for soil would be limited to one-half of the previous level for adults because it is assumed that hazard posting would increase efforts to limit intake.

(3) The risk ratios are used to develop multiplication factors which are then multiplied by the risks originally estimated to give new risks.

TABLE A-2
Cumulative Risks
Corrective Measures Alternative #2 (Institutional Controls)
SWMU 7
NAS Key West

Incremental Cancer Risk	Trespassers		Workers
Exposure Route	**Adult**	**Adolescent**	**Occupational**
Surface Soil			
Dermal Contact	3.8E-06	2.7E-06	8.6E-06
Incidental Ingestion	2.6E-07	5.4E-07	1.5E-06
Inhalation of Dust	2.3E-15	1.3E-15	2.7E-14
Sediment			
Dermal Contact	4.9E-07	4.3E-07	NA
Incidental Ingestion	2.5E-08	6.8E-08	NA
Total	**4.5E-06**	**3.8E-06**	**1.0E-05**

Hazard Index	Trespassers		Workers
Exposure Route	**Adult**	**Adolescent**	**Occupational**
Surface Soil			
Dermal Contact	7.0E-03	8.5E-03	1.2E-02
Incidental Ingestion	3.8E-04	1.3E-03	1.7E-03
Inhalation of Dust	NA	NA	NA
Sediment			
Dermal Contact	4.1E-03	6.2E-03	NA
Incidental Ingestion	2.1E-04	9.5E-04	NA
Total	**1.2E-02**	**1.7E-02**	**1.4E-02**

Notes:
1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.

TABLE A-3
Cumulative Risks
Corrective Measures Alternative #1 Versus Alternative #2* (Institutional Controls)
SWMU 7
NAS Key West

Incremental Cancer Risks	Trespassers				Workers	
Exposure Route	Adult Alternative 1**	Adult Alternative 2	Adolescent Alternative 1**	Adolescent Alternative 2	Occupational Alternative 1**	Occupational Alternative 2
Surface Soil						
Dermal Contact	7.5E-06	3.8E-06	6.8E-06	2.7E-06	4.1E-05	8.6E-06
Incidental Ingestion	1.0E-06	2.6E-07	1.3E-06	5.4E-07	7.1E-06	1.5E-06
Inhalation of Dust	4.6E-15	2.3E-15	3.4E-15	1.3E-15	1.3E-13	2.7E-14
Sediment						
Dermal Contact	1.8E-06	4.9E-07	1.6E-06	4.3E-07	NA	NA
Incidental Ingestion	1.9E-07	2.5E-08	2.5E-07	6.8E-08	NA	NA
Total	**1.0E-05**	**4.5E-06**	**1.0E-05**	**3.8E-06**	**4.9E-05**	**1.0E-05**

Hazard Index	Trespassers				Workers	
Exposure Route	Adult Alternative 1**	Adult Alternative 2	Adolescent Alternative 1**	Adolescent Alternative 2	Occupational Alternative 1**	Occupational Alternative 2
Surface Soil						
Dermal Contact	1.4E-02	7.0E-03	2.1E-02	8.5E-03	5.9E-02	1.2E-02
Incidental Ingestion	1.5E-03	3.8E-04	3.4E-03	1.3E-03	8.0E-03	1.7E-03
Inhalation of Dust	NA	NA	NA	NA	NA	NA
Sediment						
Dermal Contact	1.5E-02	4.1E-03	2.3E-02	6.2E-03	NA	NA
Incidental Ingestion	1.6E-03	2.1E-04	3.5E-03	9.5E-04	NA	NA
Total	**3.2E-02**	**1.2E-02**	**5.1E-02**	**1.7E-02**	**6.7E-02**	**1.4E-02**

(*) Exposure assumptions were revised to relect fewer days on site for most receptors, lower intake rates for adults.

Factors used are explained in Table A-1. No residents or excavation workers are included here because residential land use is not expected and excavation is not expected

(**) Alternative 1 assumes no action would be taken; therefore, the risks are the same as previously calculated for the COCs selected.

1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.

TABLE A-4
Cumulative Risks
Corrective Measures Alternative #3 (Soil Removal)
SWMU 7
NAS Key West

Incremental Cancer Risk	Trespassers		Workers
Exposure Route	**Adult**	**Adolescent**	**Occupational**
Surface Soil			
Dermal Contact	8.9E-07	7.9E-07	4.9E-06
Incidental Ingestion	1.1E-07	1.4E-07	7.3E-07
Inhalation of Dust	1.7E-15	1.2E-15	4.8E-14
Sediment			
Dermal Contact	1.8E-06	1.6E-06	NA
Incidental Ingestion	1.9E-07	2.5E-07	NA
Total	**3.0E-06**	**2.8E-06**	**5.6E-06**

Hazard Index	Trespassers		Workers
Exposure Route	**Adult**	**Adolescent**	**Occupational**
Surface Soil			
Dermal Contact	5.2E-03	8.0E-03	2.2E-02
Incidental Ingestion	5.6E-04	1.2E-03	3.0E-03
Inhalation of Dust	NA	NA	NA
Sediment			
Dermal Contact	1.5E-02	2.3E-02	NA
Incidental Ingestion	1.6E-03	3.5E-03	NA
Total	**2.2E-02**	**3.6E-02**	**2.4E-02**

Notes:

1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.
2. Risks are based on removing soil in excess of the FDEP Industrial Cleanup Goal for arsenic (3.7 mg/kg) and t modified industrial RGO for Aroclor-1260 (873 ug/kg).

TABLE A-5
Cumulative Risks
Corrective Measures Alternative #1 Versus Alternative #3* (Soil Removal)
SWMU 7
NAS Key West

Incremental Cancer Risks	Trespassers				Workers	
Exposure Route	Adult Alternative 1**	Adult Alternative 3	Adolescent Alternative 1**	Adolescent Alternative 3	Occupational Alternative 1**	Occupational Alternative 3
Surface Soil						
Dermal Contact	7.5E-06	8.9E-07	6.8E-06	7.9E-07	4.1E-05	4.9E-06
Incidental Ingestion	1.0E-06	1.1E-07	1.3E-06	1.4E-07	7.1E-06	7.3E-07
Inhalation of Dust	4.6E-15	1.7E-15	3.4E-15	1.2E-15	1.3E-13	4.8E-14
Sediment						
Dermal Contact	1.8E-06	1.8E-06	1.6E-06	1.6E-06	NA	NA
Incidental Ingestion	1.9E-07	1.9E-07	2.5E-07	2.5E-07	NA	NA
Total	**1.1E-05**	**3.0E-06**	**1.0E-05**	**2.8E-06**	**4.9E-05**	**5.6E-06**

Hazard Index	Trespassers				Workers	
Exposure Route	Adult Alternative 1**	Adult Alternative 3	Adolescent Alternative 1**	Adolescent Alternative 3	Occupational Alternative 1**	Occupational Alternative 3
Surface Soil						
Dermal Contact	1.4E-02	5.2E-03	2.1E-02	8.0E-03	5.9E-02	2.2E-02
Incidental Ingestion	1.5E-03	5.6E-04	3.4E-03	1.2E-03	8.0E-03	3.0E-03
Inhalation of Dust	NA	NA	NA	NA	NA	NA
Sediment						
Dermal Contact	1.5E-02	1.5E-02	2.3E-02	2.3E-02	NA	NA
Incidental Ingestion	1.6E-03	1.6E-03	3.5E-03	3.5E-03	NA	NA
Total	**3.2E-02**	**2.2E-02**	**5.1E-02**	**3.6E-02**	**6.7E-02**	**2.4E-02**

(*) Exposure was revised to include soil removal to FDEP Industrial Standards. No residents or excavation workers are included here because residential land use or excavation of subsurface soil is not expected

(**) Alternative 1 assumes no action would be taken; therefore, the risks are the same as previously calculated for the COCs selected.

Notes:

1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.
2. Risks are based on removing soil in excess of the FDEP Industrial Cleanup Goal for arsenic (3.7 mg/kg) and the modified industrial RGO for Aroclor-1260 (873 ug/kg).

TABLE A-6
Cumulative Risks
Corrective Measures Alternative #3
(Soil Removal & Institutional Controls for all Media)
SWMU 7
NAS Key West

Incremental Cancer Risk	Trespassers		Workers
Exposure Route	**Adult**	**Adolescent**	**Occupational**
Surface Soil			
Dermal Contact	4.5E-07	3.2E-07	1.0E-06
Incidental Ingestion	2.6E-08	5.4E-08	1.5E-07
Inhalation of Dust	8.4E-16	4.9E-16	9.9E-15
Sediment			
Dermal Contact	4.9E-07	4.3E-07	NA
Incidental Ingestion	2.5E-08	6.8E-08	NA
Total	**9.8E-07**	**8.7E-07**	**1.2E-06**

Hazard Index	Trespassers		Workers
Exposure Route	**Adult**	**Adolescent**	**Occupational**
Surface Soil			
Dermal Contact	2.6E-03	3.2E-03	4.5E-03
Incidental Ingestion	1.4E-04	4.9E-04	6.2E-04
Inhalation of Dust	NA	NA	NA
Sediment			
Dermal Contact	4.1E-03	6.2E-03	NA
Incidental Ingestion	2.1E-04	9.5E-04	NA
Total	**7.0E-03**	**1.1E-02**	**5.1E-03**

Notes:

1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.
2. Risks are based on removing soil in excess of the FDEP Industrial Cleanup Goal for arsenic (3.7 mg/kg) and the modified industrial RGO for Aroclor-1260 (873 ug/kg).

TABLE A-7
Cumulative Risks
Corrective Measures Alternative #1 Versus Alternative #3* (Soil Removal & Institutional Controls)
SWMU 7
NAS Key West

Incremental Cancer Risks	Trespassers				Workers	
Exposure Route	Adult Alternative 1**	Adult Alternative 3	Adolescent Alternative 1**	Adolescent Alternative 3	Occupational Alternative 1**	Occupational Alternative 3
Surface Soil						
Dermal Contact	7.5E-06	4.5E-07	6.8E-06	3.2E-07	4.1E-05	1.0E-06
Incidental Ingestion	1.0E-06	2.6E-08	1.3E-06	5.4E-08	7.1E-06	1.5E-07
Inhalation of Dust	4.6E-15	8.4E-16	3.4E-15	4.9E-16	1.3E-13	9.9E-15
Sediment						
Dermal Contact	1.8E-06	4.9E-07	1.6E-06	4.3E-07	NA	NA
Incidental Ingestion	1.9E-07	2.5E-08	2.5E-07	6.8E-08	NA	NA
Total	**1.1E-05**	**9.8E-07**	**1.0E-05**	**8.7E-07**	**4.9E-05**	**1.2E-06**

Hazard Index	Trespassers				Workers	
Exposure Route	Adult Alternative 1**	Adult Alternative 3	Adolescent Alternative 1**	Adolescent Alternative 3	Occupational Alternative 1**	Occupational Alternative 3
Surface Soil						
Dermal Contact	1.4E-02	2.6E-03	2.1E-02	3.2E-03	5.9E-02	4.5E-03
Incidental Ingestion	1.5E-03	1.4E-04	3.4E-03	4.9E-04	8.0E-03	6.2E-04
Inhalation of Dust	NA	NA	NA	NA	NA	NA
Sediment						
Dermal Contact	1.5E-02	4.1E-03	2.3E-02	6.2E-03	NA	NA
Incidental Ingestion	1.6E-03	2.1E-04	3.5E-03	9.5E-04	NA	NA
Total	**3.2E-02**	**7.0E-03**	**5.1E-02**	**1.1E-02**	**6.7E-02**	**5.1E-03**

Notes:

(*) Exposure assumptions were revised to relect fewer days on site for most receptors, lower intake rates for adults and smaller exposure area for maintenance workers.
Factors used are explained in Table A-1. Additionally, exposure assumptions were revised to include soil removal for FDEP Industrial Cleanup Standards.
No residents or excavation workers are included here because residential land use or excavation of subsurface soil is not expected

(**) Alternative 1 assumes no action would be taken; therefore, the risks are the same as previously calculated for the COCs selected.

1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.
2. Risks are based on removing soil in excess of the FDEP Industrial Cleanup Goal for arsenic (3.7 mg/kg) and the modified industrial RGO for Aroclor-1260 (873 ug/kg).

TABLE A-8
Cumulative Cancer and Noncancer Risks
Corrective Measures Alternative #1, #2, #3, and #3 With Institution Controls
SWMU 7
NAS Key West

Incremental Cancer Risk	Trespassers		Workers
Alternative and Medium	**Adult**	**Adolescent**	**Occupational**
Alternative #1			
Surface Soil	8.5E-06	8.2E-06	4.9E-05
Sediment	2.0E-06	1.9E-06	NA
Total	**1.0E-05**	**1.0E-05**	**4.9E-05**
Alternative #2			
Surface Soil	4.0E-06	3.3E-06	1.0E-05
Sediment	5.1E-07	5.0E-07	NA
Total	**4.5E-06**	**3.8E-06**	**1.0E-05**
Alternative #3			
Surface Soil	1.0E-06	9.3E-07	5.6E-06
Sediment	2.0E-06	1.9E-06	NA
Total	**3.2E-06**	**2.7E-06**	**5.6E-06**
Alternative #3 With Institutional Controls			
Surface Soil	4.7E-07	3.7E-07	1.2E-06
Sediment	5.1E-07	5.0E-07	NA
Total	**9.8E-07**	**8.7E-07**	**1.2E-06**

Hazard Index	Trespassers		Workers
Alternative and Medium	**Adult**	**Adolescent**	**Occupational**
Alternative #1			
Surface Soil	1.6E-02	2.5E-02	6.7E-02
Sediment	1.7E-02	2.7E-02	NA
Total	**3.2E-02**	**5.1E-02**	**6.7E-02**
Alternative #2			
Surface Soil	7.4E-03	9.8E-03	1.4E-02
Sediment	4.3E-03	7.2E-03	NA
Total	**1.2E-02**	**1.7E-02**	**1.4E-02**
Alternative #3			
Surface Soil	5.7E-03	9.2E-03	2.4E-02
Sediment	1.7E-02	2.7E-02	NA
Total	**2.2E-02**	**3.6E-02**	**2.4E-02**
Alternative #3 With Institutional Controls			
Surface Soil	2.7E-03	3.7E-03	5.1E-03
Sediment	4.3E-03	7.2E-03	NA
Total	**7.0E-03**	**1.1E-02**	**5.1E-03**

Notes:
1. Risks are driven by Aroclor-1260 and arsenic in surface soil and arsenic in sediment.

APPENDIX B

DEVELOPMENT OF CROSS-MEDIA REMEDIAL GOAL OPTIONS

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B.1.0 INTRODUCTION

The following sections present technical discussions and results of groundwater modeling at SWMU 7 (Boca Chica Building A-824) for the Naval Air Station (NAS), Key West, Florida. The modeling work performed consists of the following three tasks:

- The development of Soil Remedial Goal Options (RGOs) that are protective of surface water.
- For chemicals in groundwater that exceed maximum contaminant levels (MCLs), estimation of groundwater washout times by natural processes (e.g., advection, dispersion, and adsorption).
- For soil concentrations that exceed leaching criteria, estimation of soil washout times via leaching from contaminated soil to groundwater.

The modeling was conducted to support the development and evaluation of remedial alternatives for the CMS for SWMU 7.

B.1.1 OBJECTIVES

The objective of the first task is to develop a set of soil RGOs. The soil RGOs are cross-media RGOs which represent concentrations in one media (e.g., soil) and are protective of human heath and the environment to another media (e.g., surface water). More specifically, the soil RGO is the soil concentrations in the source area which will not cause surface water concentrations at the exposure point to exceed the acceptable concentrations in the exposure media (i.e., surface water criteria)

The soil concentrations were estimated at the source media based on the predetermined surface water concentrations at the exposure point and the contaminant transport pathway (groundwater). The assumed soil concentration was then iteratively changed until the model-predicted concentration at the exposure location was just below the acceptable concentration. The final assumed soil concentration is the cross-media soil RGO. The RGO's developed are intended to be used as conservative comparison values and are not final cleanup values. The soil RGOs were developed through the use of a groundwater flow contaminant fate and transport model.

The second task is to provide a computation of groundwater washout times for chemicals in groundwater exceeding their MCLs. The computations were also accomplished through the use of the same contaminant fate and transport model tool by considering the natural processes affecting contaminant fate and transport in groundwater.

The third task is to calculate soil washout times for chemicals in soil that exceed the state of Florida and Federal Soil to Screening Levels (SSL). The most conservative SSL from the following criteria were used for each detected chemical in soil: (1) FDEP soil leaching criteria (FDEP, 1995) and (2) the generic SSLs (dilution attenuation Factors 20) presented in the U.S. EPA Soil Screening Guidance: User's Guide, Appendix A (U.S. EPA, 1996). U.S. EPA SSLs are developed based on the MCL and therefore are also protective of groundwater media. The same groundwater model tool was used for the estimation of soil washout time via migration pathway of leachate generation from contaminated soil to groundwater.

The analysis presented in Appendix B differs from a full fate and transport modeling analysis in that a calibrated groundwater flow and transport model covering the entire site was not developed. In addition, this analysis relies heavily on conservative literature sources of chemical input parameters so that the chemical migration of contaminants is not specifically calibrated to site conditions. The results of this analysis, represent approximate, yet still conservative, results.

B.1.2 REPORT ORGANIZATION

This report has been divided into six discrete sections. In addition to the introduction (Section B.1.0), Section B.2.0 presents the technical approach used for the development of soil RGOs. Section B.3.0 provides the input data used for the development of soil RGOs protective of surface water. Section B.4.0 provides a technical discussion for the estimation of groundwater washout times by natural processes (e.g., advection and dispersion). Section B.5.0 provides a similar discussion of estimation of soil washout times via leaching from contaminated soil to groundwater. Section B.6.0 presents modeling results for each of the three tasks performed for SWMU 7.

B.2.0 SOIL RGOS DEVELOPMENT

The technical approach used to develop the soil RGOs is described in the following subsections. The first subsection briefly describes the geology, hydrogeology, and the pattern of contaminant releases. The second subsection describes the analytical groundwater contaminant fate and transport model used for the task and the associated simplifying assumptions, and the supplemental equations. The final subsection describes the groundwater to surface water assumptions used for soil RGO (protective of surface water) development.

B.2.1 SITE CONCEPTUAL MODEL

Building A-824, located north of US 1 on Boca Chica Key is a former temporary hazardous waste storage area. Approximately 30 feet northwest of the building is a small pond. Another pond is located southeast of Building A-824. An interim removal action was conducted in late 1995 to remove PCB-contaminated soil at the north end of the building for the purpose of preventing further migration of PCBs into other media. Bechtel Environmental Inc. (BEI) subsequently excavated and transported 26 cubic yards of PCB-contaminated soil. The excavated area was then backfilled with crushed stone to match the existing grade.

Rainwater which falls on the site can transport contaminants through runoff and/or by infiltrating into the soil. Runoff can transport contaminants from the surface soils in both the dissolved form and also in solid form sorbed to soil particles being eroded by the runoff. However, overland transport will not be considered as a pathway in this investigation based on the following factors: (1) the small volume of surface water at SWMU 7, (2) the flat topography, and (3) relatively low levels of contaminant remaining in surface soil which indicates little or no overland transport is expected.

A portion of the rainwater which falls on the site reaches the groundwater by directly infiltrating into the soils. As the water infiltrates through the contaminated soil, contaminants leach out of the soil and are transported in dissolved form with the water through the unsaturated zone to the groundwater below. The contaminants can then be transported laterally in the groundwater and eventually migrate to a surface water exposure point.

Conceptually, the groundwater contaminant pathway consists of an unsaturated zone and a shallow unconfined aquifer. The unsaturated zone and shallow aquifer consist of compacted fill materials superimposed on oolitic limestone. The uppermost soil layer consists of fill material to a depth of approximately 2 to 3 feet below ground surface (bls). At SWMU 7, the groundwater table is present at

1.09 feet to 3.24 feet bls. Dense limestone was encountered below the fill material at 1 to 3 feet bls. The fill material runs along the perimeter of the building beyond the road to the east and south of the site. Because SWMU 7 is located near the shoreline, a mixing depth of 5 feet is assumed. This is the average thickness of the freshwater lens below the center of the western half of Key West. The saturated zone was assumed to be 20 feet thick, representing the regional average thickness of the ooliti limestone. Groundwater can travel horizontally and vertically in the saturated zone

The supplemental RFI/RI indicated that groundwater flow direction is toward the southeast. Water level measurement indicate that the groundwater flow underlying the site may be significantly influenced by tidal fluctuations. Because of the uncertainty of the tidal fluctuations, a similar groundwater gradient used for SWMU 1 was assumed for the modeling task.

The conceptual model for soil RGO development is shown in Figure 1. Also, the source area for the soil RGO development is shown in Figure 2.

B.2.2 GROUNDWATER TRANSPORT MODEL

A portion of the rainfall which falls on the site will infiltrate through the unsaturated soil into the groundwater. In this study, upgradient groundwater flow is assumed to be clean (i.e., zero concentration). Upgradient flow will combine infiltrated water and carry dissolved contaminants in the groundwater to the groundwater exposure point. Dissolved contaminants migrate through the groundwater at a slower velocity than the velocity of the groundwater. The velocity of the contaminants is said to be retarded. The amount of the retardation is chemical specific. Also, the contaminants may decay in the environment because of biological and/or chemical processes. Therefore, as contaminants migrate through the groundwater, they may decay and their concentrations will correspondingly decrease.

B.2.2.1 Groundwater Model Tool

The groundwater modeling was performed using an analytical contaminant fate and transport model. This groundwater model is implemented on the spreadsheet software Excel 5.0 and Crystal Ball 3.0 and is called ECTran (which stands for Excel-Crystal Ball Transport). The ECTran model (Chiou 1993) is based on straight forward mass-balances and advection/dispersion analytical equations, but can be used to simulate a variety of complex conditions. To date, ECTran and its predecessors have been employed at hazardous waste sites in U.S. EPA Regions III, V, VI, and X to evaluate soil cleanup goals, cleanup time estimations, and to support baseline risk assessments. It has been used at DOD, DOE, and industrial sites for both RCRA and CERCLA applications.

The ECTran model simulates vertical contaminant transport with uniform (thickness, concentration, porosity, etc.) layers. The model predicts the concentration down gradient of the source at a single point at a specified distance from the exposure point. This predicted concentration is at the centerline of the contaminant plume.

B.2.2.2 Groundwater Modeling Assumptions And Procedures

Source Area

The source area was selected based on the locations at which contaminants were detected. The source area is designated as a rectangular area with length parallel to groundwater flow direction, and width perpendicular to the flow direction.

Layer simulated in the model

The uppermost layer simulated in the ECTran model is the unsaturated zone. This layer is assumed to have a uniform thickness of 3 feet. The bottom most layer simulated in the ECTran model is the shallow unconfined aquifer (saturated zone). Since the site is close to the shoreline, a mixing depth of 5 feet denoting the average thickness of the freshwater lens below the center of the western half of Key West was assumed. The saturated zone was assumed to be 20 feet thick, representing the regional average thickness of the oolitic limestone.

Initial Soil and Groundwater Concentrations

An initial soil concentration was assumed in the 3-foot thick unsaturated layer for soil RGO development of all COCs. The assumed unsaturated soil concentration was then iteratively changed until the model-predicted concentration in the groundwater at the exposure point was just below the acceptable concentration. The final assumed concentration is the soil RGO protective of surface water.

During development of the soil RGOs, the initial groundwater concentration under the source area was assumed to be the maximum detected concentrations of the groundwater samples. The soil via groundwater to surface water RGO is a soil concentration which will not contaminate the surface water body at an unacceptable level at the exposure point.

Modeling Time Frame

The contaminant simulations were continued until the concentration at the exposure point peaked or until the simulation reached 1000 years. Typically, concentrations of organic chemicals will reach their peak concentrations at the exposure point earlier than inorganic chemicals. The further into the future the model is used to predict contaminant concentrations, the uncertainty of the results become greater due to the possibility of land use changes, changes in the properties of the contaminants, or even changes in climate. Due to this uncertainty, model simulations were limited to a 1000-year time frame. The 1000-year modeling time frame has been used previously at other government facilities. Some chemicals which move very slowly in the groundwater may not reach the exposure point in 1000 years and will result in an exposure point concentration of zero and a corresponding RGO concentration of 100% (pure product).

Chemical Fate and Transport

Several mechanisms/processes affecting chemical fate and transport in groundwater were accounted for during the development of the RGOs. They include sorption, dilution, advection, dispersion, and chemical/biological decay. Sorption is the reaction that occurs between solute and the surfaces of solids causing the solute to bond to varying degrees to the surface. Dilution occurs because of the mixing of contaminated groundwater with unaffected groundwater. Advection is the primary mechanism responsible for the movement of contaminants as a consequence of groundwater flow. Dispersion occurs because of fluid mixing due to effects of unresolved heterogeneities in the permeability distribution. Decay involves the degradation of a chemical by natural chemical and biological processes.

B.2.3 Groundwater to Surface Water Assumptions Used for Soil RGO Development

To determine the soil via groundwater to surface water RGO, an acceptable groundwater concentration protective of surface water at the surface water/groundwater interface at the shoreline was first calculated. This acceptable groundwater concentration was calculated based on the assumptions and equations presented in this section. The soil RGOs were then developed with the groundwater model and assumptions as described in the previous section, based on the acceptable groundwater concentration protective of the surface water concentrations in the exposure media (i.e., surface water criteria). The assumed soil concentration under the source was iteratively changed until the model-predicted concentration at the surface water/groundwater interface at the shoreline of the ocean was just below the acceptable groundwater concentration. The final assumed source soil concentration is the cross-media soil RGO protective of surface water.

The seepage concentration was based on the flux of contaminants out of the ground divided by the total flow of water out of the ground. The flux of contaminants into the ocean at the shoreline was based on the chemical specific velocity of each of the contaminants in the groundwater. The contaminant velocity is the velocity of the groundwater divided by the retardation factor (Domenico, 1982). A retardation factor of one would correspond to a chemical which migrates through the groundwater at the same velocity as the groundwater. The higher the retardation factor, the slower the contaminant migrates in the groundwater. The following equation is used to calculate the chemical mass flux in the groundwater at the groundwater/surface water interface.

$$Q_C = \frac{V_{GW}\, A\, C}{R_C} \tag{1}$$

where:

Q_C = Chemical flux (mass/time)

V_{GW} = Groundwater velocity (length/time)

C = Chemical concentration in the groundwater (mass/length^3) (Predicted with the ECTran model)

A = Cross sectional area of the mass flow (length^2)

and R_C is chemical specific retardation factor given by:

$$R_C = 1 + \frac{\rho_b}{n} K_d \tag{2}$$

where:

R_C = Chemical specific retardation factor (dimensionless)

ρ_b = Dry bulk density of soil (mass/length^3)

n = Porosity (dimensionless)

K_d = Soil / water partitioning coefficient (length^3/mass)

The total flow of groundwater is given by the groundwater velocity multiplied by the cross-sectional area of the groundwater flow. The seep concentration (C_s) is then

$$C_s = \frac{Q_C}{V_{GW} A} \tag{3}$$

After replacing Q_c in Equation 3 by Equation 1, the groundwater velocity and the area cancel out so that the seep concentration is the groundwater concentration divided by the retardation factor.

$$C_s = \frac{C}{R_d} \tag{4}$$

Equation 4 was used to calculate the acceptable groundwater concentration at the groundwater/surface water interface assuming C_s is the surface water exposure criteria. The soil concentration was then iteratively changed until the predicted maximum groundwater concentration at the groundwater/surface water interface was just below the acceptable groundwater concentration based on the surface water exposure criteria.

B.3.0 INPUT DATA FOR MODELING

B.3.1. CHEMICAL INPUT PARAMETERS

The primary chemical input parameters include the soil/water partitioning coefficient, K_d, the exposure criteria, and chemical and biological decay half-lives. The chemical input parameters used in the modeling are discussed below.

<u>Chemicals of Concern (COC):</u>

A chemical is considered as a COC if its soil concentration in unsaturated soil exceeds a SSL value. The following chemical was considered a COC based because its one detection (28 µg/kg at S7SB-5) exceeded the FDEP Leaching SSL of 10 µg/kg.

Organics: Methylene Chloride

Table 1 presents a list of COC used for soil RGO development along with the current maximum detected concentrations. The initial groundwater concentration under the source was assumed to be the maximum detected concentrations during the development of this soil RGO.

<u>Soil/Water Partitioning Coefficient:</u>

Chemical-specific soil/water partitioning coefficients (K_ds) were used to estimate each chemical's mobility. A chemical's K_d value is the ratio of its concentration in soil (or sediment) to its concentration in water when the two concentrations are in equilibrium. A high K_d value would be representative of a chemical which has a tendency to bind to the soil and is therefore less mobile in water. Depending on the chemical form of a certain contaminant (specifically for inorganics), the K_d value can vary substantially. No site-specific K_d values were available for NAS Key West. The K_d values used in this evaluation were taken from literature sources.

In order to closely follow the U.S. EPA procedures in the selection of K_d values, K_d values were taken directly from the EPA's Soil Screening Level (SSL) Guidance if available, or were calculated based on the procedures proposed in the SSL Guidance (U.S. EPA, 1996).

The K_d values for organic constituents are typically calculated by multiplying the K_{oc} value (soil organic carbon/water partition coefficient) by the foc (fraction of organic carbon) (U.S. EPA, 1988). One composite soil sample from SWMU 1 (Well MW5-2) (B&R Environmental, March 1998) was analyzed for foc and the resulting value (i.e., 1.04 mg/kg) was very low compared to typical foc measurements. In addition, it was determined that the soil sample that was analyzed was a surface soil sample and not a sample from the unconfined surficial aquifer. Therefore, it is not appropriate to use this value for determining K_d values. Because of a lack of site-specific data and the potential for foc values to be low in the oolitic limestone of Key West, a conservative foc of 0.001 or 0.1% was selected for calculating organic constituent K_d values. This foc value is the lowest acceptable value that can be used in the $K_d = K_{oc}$* foc model (U.S. EPA, 1988). The K_d values and their corresponding sources are presented in Table 2.

Half-life Decay Constants:

The inorganic chemicals are assumed not to decay during migration in the groundwater. Decay of organic contaminants can occur by biological and non-biological mechanisms. This decay is quantified by chemical specific half-life. Half-lives were taken from literature values. Table 2 presents the half-life decay constants used in the modeling.

Exposure Criteria:

Surface water criteria were used for the soil RGO development. The surface water action level used is taken from criteria agreed upon by the NAS Key West Partnering Team. Table 3 presents this surface water criterion and the corresponding calculated groundwater concentration protective of surface water at the surface water/groundwater interface at the shoreline. Refer to the details outlined in Section B.2.3 for a description of how the acceptable groundwater concentration protective of surface water was calculated.

B.3.2 PHYSICAL INPUT PARAMETERS

The groundwater physical input parameters are described in the next two subsections.

B3.2.1 Surface Water Infiltration and Water Budget:

A HELP model (Schroeder et al., 1994) was used to estimate the annual water budget. The results are as follows:

Annual mean precipitation: 37.95 inches per year

Runoff:	0.06 inches per year
Evapotranspiration:	17.943 inches per year
Infiltration:	19.948 inches per year
Change in Storage:	0.005 inches per year

A weighted average infiltration rate of 7 inches per year was used for modeling. This is based on a ratio of paved area to unpaved area (Figure 2).

B.3.2.2 Groundwater Physical Input Parameters

Layer Thickness: As described in the Conceptual Model section, a typical thickness of the unsaturated zone was assumed to be 3 feet. The saturated zone was assumed to be 20 feet thick, representing the regional average thickness of the oolitic limestone below the center of the western half of Key West. In addition, a mixing depth of 5 feet representing the average thickness of the freshwater lens was assumed. Table 4 presents a summary of physical and geologic parameters used for the modeling task.

Source Area Size: In RGO development, it is assumed that the source area corresponds to the rectangular area at the south end of Building A-824. The size of the rectangle was estimated to be 100 feet long (parallel to groundwater flow direction) by 90 feet wide (perpendicular to flow direction) (see Figure 2 and Table 4).

Exposure Point: The exposure point for the soil RGO development was the surface water (i.e., ocean) at the groundwater/surface water interface to the southeast of Building A-824. The distance to this exposure point is approximately 700 feet (along groundwater flow path direction) (see Table 4).

Hydraulic Conductivity K: The porous limestone has a reported K of 72 to 1024 gallons per day per square ft (IT, 1994), or 3.4×10^{-3} cm/sec to 4.83×10^{-2} cm/sec, or 10 to 137 ft/day. Average K of 73 ft/day was selected for modeling.

Gradient: The gradient was selected to be 0.0017, which is similar to SWMU 1 (IT, 1994).

Effective Porosity: The effective porosity is assumed to be 0.3.

Seepage Velocity: The seepage velocity can be calculated with the following equation.

$$V_{seep} = \frac{KI}{effective\ porosity}$$

Where: K = hydraulic conductivity (73 ft/day)

I = gradient (0.0017)

Effective porosity = 0.3

The seepage velocity is then approximately 150 ft/year.

B.4.0 GROUNDWATER WASHOUT TIMES BY NATURAL PROCESSES

The time required for contaminants in groundwater under the source area to reduce from the maximum detected concentrations to the MCL levels by natural processes was estimated. Chemicals that have exceeded the corresponding MCL are selected for the analysis. The analysis has also accounted for most natural processes affecting contaminant fate and transport including dilution due to infiltration and upgradient groundwater, dispersion, and sorption. The technical approach and groundwater modeling tool selected are similar to soil RGO development. Refer to the details outlined in Section B.2.0 for a description of the modeling process.

B.4.1 MODELING ASSUMPTIONS FOR GROUNDWATER WASHOUT TIME

The following general assumptions were made for the analysis:

- Washout time was estimated in the saturated layer under the source area.
- Maximum soil concentrations selected from surface soil and subsurface soil samples were used as the initial soil concentrations.
- Assume the source is depleting from the source area, which means non-constant source loading rates.
- Infiltration rates used represent source area-specific weighted average rates. This is based on a ratio of paved area to unpaved area.

The calculation was performed through the use of a groundwater flow contaminant fate and transport model (ECTran model). The time corresponding to when the groundwater concentration under the source reduced to below the MCL level was selected as the washout times.

B.4.2 SITE CONCEPTUAL MODEL

The following subsections provide a summary of model input parameters and simple conceptual model for SWMU 7. The conceptual model for groundwater washout time by natural occurring processes is similar in nature to the soil RGO development. The major difference lies in that a forward computation without an iterative procedure was performed. The general assumptions made for groundwater washout times (Section B.4.1) are also applicable for the analysis. Figure 1 can also be referred to for the site conceptual model. As depicted in Figure 1, the exposure point is now selected as the groundwater directly beneath the soil source area.

B.4.3 CHEMICAL INPUT PARAMETERS

The primary chemical input parameters include the soil/water partitioning coefficient, K_d, the exposure criteria, and chemical and biological decay half-lives. The chemical input parameters used in the modeling are discussed below.

Chemicals of Concern (COC)

A chemical is considered as a COC if its groundwater concentration exceeds a MCL value in their corresponding media. The following chemical was considered as COC because it exceeds its MCL.

Inorganics: Antimony.

Table 5 presents the maximum detected concentrations of antimony in surface and subsurface soil since 1993. The initial soil and groundwater concentrations under the source area were assumed to be the maximum detected concentrations sampled since 1993.

Soil/Water Partitioning Coefficient

No site-specific K_d values were available for NAS Key West. The K_d values used in this evaluation were taken from literature sources.

In order to closely follow the U.S. EPA procedures in the selection of K_d values, K_d values were taken directly from the EPA's Soil Screening Level (SSL) Guidance if available, or were calculated based on the procedures proposed in the SSL Guidance (EPA 1996). The K_d values and their corresponding sources are presented in Table 6.

Half-life Decay Constants

No decay are assumed for inorganic compounds.

Exposure Criteria

The groundwater exposure criteria are the MCLs, and were obtained from "Drinking Water Regulations and Health Advisories," U.S. EPA Washington, D.C., October 1996. Table 7 presents a summary of the groundwater exposure criteria.

B.4.4 PHYSICAL INPUT PARAMETERS

The groundwater physical input parameters are described in the next two subsections.

Surface Water Infiltration and Water Budget

The HELP model results used in the soil RGO development was used to estimate the annual water budget. The weighted average infiltration rates were used for modeling. This is based on a ratio of paved area to unpaved area (Figure 3).

Groundwater Physical Input Parameters

Layer Thickness: As described in the Conceptual Model section, a typical thickness of the unsaturated zone was assumed to be 3 feet. The saturated zone was assumed to be 20 feet thick, representing the regional average thickness of the oolitic limestone below the center of the western half of Key West. Also, a mixing depth of 5 feet representing the average thickness of the freshwater lens was assumed. Table 8 presents a summary of physical and geologic parameters used for the modeling task.

Source Area Size: The source area for antimony was determined based on the locations of detected concentrations sampled since 1993. The length is measured parallel to groundwater flow direction while the width is measured perpendicular to flow direction (see Figure 3 and Table 8).

Exposure Point: The exposure point for the washout time estimation was the groundwater under the source area.

Hydraulic Conductivity K: A reported average K of 73 ft/day for the porous limestone was selected for modeling (IT, 1994).

Gradient: The gradient was selected to be 0.0017, which is similar to SWMU 1 (IT, 1994).

Effective Porosity: The effective porosity is assumed to be 0.3.

Seepage Velocity: The seepage velocity can be calculated with the same equation as presented in Section B.3.2.2. The seepage velocity is calculated to be approximately 150 ft/year.

B.5.0 SOIL WASHOUT TIMES VIA LEACHING FROM SOIL TO GROUNDWATER

Soil washout time is defined as the time required for the contaminant in the unsaturated soil of the source area to reduce from the maximum detected soil concentration to a low level soil concentration by natural processes. Any further migration of the leachate from this low level soil concentration to the underlying groundwater will not cause the groundwater concentrations in the saturated layer under the source to be greater than MCL levels. The washout time calculations were performed for one chemical. Chemicals that exceed the soil to groundwater criteria were described in Section B.1.1 selected for the analysis. The computation has also accounted for most natural processes affecting contaminant fate and transport. The technical approach and groundwater modeling tool selected are similar to soil RGO development. Refer to the details outlined in Section B.2.0 for a description of the modeling process.

B.5.1 SITE CONCEPTUAL MODEL

The following subsections provide a summary of model input parameters and simple conceptual model for SWMU 7. The general assumptions made for groundwater washout times (Section B.4.1) are also applicable for the analysis. In addition, the site conceptual model used in the washout times calculation is similar in nature to the groundwater washout time at SWMU 7. Figure 1 can also be referred to for the conceptual model. Again, the exposure point is selected as the groundwater directly beneath the source area. Maximum detection of soil and groundwater concentrations were assumed as the initial concentrations, followed by groundwater fate and transport modeling, and the time corresponding to when the groundwater concentration under the source reduced to below the MCL level by natural processes was selected as the soil washout times.

B.5.2 CHEMICAL INPUT PARAMETERS

The primary chemical input parameters include the soil/water partitioning coefficient, K_d, the exposure criteria, and chemical and biological decay half-lives. The chemical input parameters used in the modeling are discussed below.

Chemicals of Concern (COC)

A chemical is considered as a COC if the soil concentrations exceed soil to groundwater criteria in their corresponding media. The following chemical was considered as COC because its one detection (28 µg/kg at S7SB-5) exceeded the FDEP leaching SSL of 10 µg/kg.

Organics: Methylene Chloride

Table 9 presents a list of COC used for soil washout time along with the maximum detected concentrations in surface and subsurface soil since 1993. The initial soil and groundwater concentrations were assumed to be the maximum detected concentrations sampled since 1993.

Soil/Water Partitioning Coefficient

No site-specific K_d values were available for NAS Key West. The K_d values used in this evaluation were taken from literature sources.

In order to closely follow the U.S. EPA procedures in the selection of K_d values, K_d values were taken directly from the EPA's Soil Screening Level (SSL) Guidance if available, or were calculated based on the procedures proposed in the SSL Guidance (EPA 1996). The K_d values and their corresponding sources are presented in Table 10.

Half-life Decay Constants

Decay of organic contaminants can occur by biological and non-biological mechanisms. This decay is quantified by chemical specific half-life. Half-lives were taken from literature values. Table 10 presents the half-life decay constants used in the modeling.

Exposure Criteria

The groundwater exposure criteria are the MCLs, and were obtained from "Drinking Water Regulations and Health Advisories," U.S. EPA Washington, D.C., October 1996. Table 11 presents a summary of the groundwater exposure criteria.

B.5.3 PHYSICAL INPUT PARAMETERS

The groundwater physical input parameters are described in the next two subsections.

Surface Water Infiltration and Water Budget

The HELP model results used in the soil RGO development was used to estimate the annual water budget. The weighted average infiltration rates were used for modeling. This is based on a ratio of paved area to unpaved area (Figure 4).

Groundwater Physical Input Parameters

Layer Thickness: As described in the Conceptual Model section, a typical thickness of the unsaturated zone was assumed to be 3 feet. The saturated zone was assumed to be 20 feet thick, representing the regional average thickness of the ooliti limestone below the center of the western half of Key West. In addition, a mixing depth of 5 feet representing the average thickness of the freshwater lens was assumed. Table 12 presents a summary of physical and geologic parameters used for the modeling task.

Source Area Size: Source area for methylene chloride was determined based on the locations of detected concentrations sampled since 1993. The length is 100 feet (measured parallel to groundwater flow direction) while the width is 90 feet (measured perpendicular to flow direction) (see Figure 4 and Table 12).

Exposure Point: The exposure point for the washout time estimation was the groundwater under the source area.

Hydraulic Conductivity K: A reported average K of 73 ft/day for the porous limestone was selected for modeling (IT, 1994).

Gradient: The gradient was selected to be 0.0017, which is similar to SWMU 1 (IT, 1994).

Effective Porosity: The effective porosity is assumed to be 0.3.

Seepage Velocity: The seepage velocity can be calculated with the same equation as presented in Section B.3.2.2. The seepage velocity is calculated to be approximately 150 ft/year.

B.6.0 RESULTS

The results of the groundwater modeling for soil RGOs as well as washout times computation are discussed in the following three sections.

B.6.1 SOIL RGO (PROTECTIVE OF SURFACE WATER) DEVELOPMENT

Soil RGOs protective of surface water were developed for the soil within the source area and are presented in Table 13. Acceptable groundwater concentrations that are protective of the surface water at the shoreline of the ocean were first developed (Table 3), in order to calculate the soil RGOs presented in Table 13. If a chemical concentration is detected in the soil in the source area, the soil RGO presented in Tables 13 is appropriate for comparison.

The soil RGO developed by modeling with ECTran indicate that the current soil concentrations at SWMU 7 are substantially below the soil RGO. The current maximum detected soil concentrations from 1993 for methylene chloride are reported as 28 µg/kg, which is much lower than the soil RGO of 1.0×10^{6} mg/kg. Therefore, the current soil concentrations in the source area will not cause the surface water at the shoreline of the ocean exceeding the surface water criteria.

B.6.2 ESTIMATION OF GROUNDWATER WASHOUT TIMES BY NATURAL PROCESSES

Table 14 presents the results of groundwater washout time by natural processes for chemicals in groundwater exceeding MCL. The predicted time was also evaluated for the groundwater under the source area. The modeling results indicate that the washout time for antimony to diminish from the maximum detected concentration (46 ug/L) to its MCL (6.0 ug/L) is approximately 362 years. Typically, concentrations of inorganic chemicals will reach their peak concentrations at the exposure point slower than organic chemicals.

B.6.3 ESTIMATION OF SOIL WASHOUT TIMES BY NATURAL PROCESSES

Table 15 presents the results of soil washout times via leaching from contaminated soil to the groundwater under the source area. The modeling results indicate that the washout times for methylene chloride in soil via leaching and natural processes is approximately 2.0 years. This is the time required to reduce from the maximum detected soil concentration to a certain low level soil concentration.

Consequently, at this low level soil concentration, any further migration of the leachate to the underlying aquifer will not cause the groundwater concentrations under the source to be greater than the MCL level (5 ug/L).

B.7.0 REFERENCES

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TABLE 1
MAXIMUM DETECTED SOIL AND GROUNDWATER CONCENTRATIONS FOR CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SOIL RGOs DEVELOPMENT
SWMU 7, NAS KEY WEST

Chemical	Maximum Detected Concentrations in Surface Soil (1) (ug/kg)	Location	Maximum Detected Concentrations in Subsurface Soil (1) (ug/kg)	Location	Maximum Detected Groundwater Concentrations (2) (ug/L)	Location
Methylene Chloride	28	S7SB-5	27	S7SB-10	1	S7MW-1

Notes:

1. The maximum detected concentrations in surface and subsurface soils were based on Tables 4-2 and 4-1, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998 respectively.
2. The maximum detected concentrations in groundwater were based on Table 4-5, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.

TABLE 2

SOIL PARTITIONING COEFFICIENTS AND HALF-LIVES FOR CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA

SOIL RGOs DEVELOPMENT

SWMU 7, NAS KEY WEST

Chemicals of Concern	Koc L/kg	Kd L/kg	Ref	Half-Life (2) (years)
Methylene Chloride	11.7	0.0117	1	0.15

Organic Kd = foc*Koc, foc is minimum allowable value of 0.001 based on EPA Soil Screening User's Guide, April 1996, and Superfund Exposure Assessment Manual, April 1988.

(1) EPA Soil Screening Guidance User's Guide, April, 1996.
(2) Howard et. al., Handbook of Environmental Degradation Rates, 1991.

TABLE 3
SURFACE WATER CRITERIA PROTECTIVE OF GROUNDWATER FOR CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SOIL RGOs DEVELOPMENT
SWMU 7, NAS KEY WEST

Chemicals of Concern	Partitioning Coefficient Kd L/kg	Retardation Factor Rd	SurfaceWater Criteria (1) ug/L	Groundwater Criteria Protective of Surface Water (2) ug/L
Methylene Chloride	1.17E-02	1.059	1580	1.67E+03

Notes:
(1) Surface Water Criteria are from Table B-5, Supplemental RFI/RI Report, 1997.
(2) Groundwater Criteria Protective of Surface Water are calculated by multiplying the surface water criteria by their corresponding Rd (retardation factor).

TABLE 4
SUMMARY OF PHYSICAL AND GEOLOGIC PARAMETERS
SOIL RGOs DEVELOPMENT
SWMU 7, NAS KEY WEST

Chemical	Source Area (1)		Shallow Aquifer Thickness (2) (ft)	Unsaturated Zone Thickness (3) (ft)	Mixing Depth (4) (ft)	Distance to Exposure Point (5) (ft)
	Length (ft)	Width (ft)				
Methylene Chloride	100	90	20	3	5	700

(1) See Figures 1 and 2.

(2) Shallow aquifer thickness is the average thickness of the oolitic limestone below the center of the western half of the Key West.

(3) The unsaturated zone thickness is based on lithologic description of the Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.

(4) Mixing depth is the average thickness of the fresh water lens below the center of the western half of the Key West.

(5) Measured from Figure 2.

TABLE 5
GROUNDWATER WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
MAXIMUM DETECTED SOIL AND GROUNDWATER CONCENTRATIONS FOR
CHEMICALS IN GROUNDWATER EXCEEDING MAXIMUM CONTAMINANT LEVELS
SWMU 7, NAS KEY WEST

Chemical	Maximum Detected Concentrations in Surface Soil (1) (mg/kg)	Location	Maximum Detected Concentrations in Subsurface Soil (1) (mg/kg)	Location	Maximum Detected Groundwater Concentrations (2) (ug/L)	Location	Maximum Contaminant Level (MCL) (3) (ug/L)
Antimony	4.9	S7SB-9	3.8	S7SB-10	46	S7MW-3	6

Notes:

1. The maximum detected concentrations in surface and subsurface soils were based on Tables 4-2 and 4-1, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998 respectively.
2. The maximum detected concentrations in groundwater were based on Table 4-5, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.
3. MCLs were obtained from "Drinking Water Regulations and Health Advisories," USEPA Washington, D.C., October 1996.

TABLE 6
GROUNDWATER WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
SOIL PARTITIONING COEFFICIENTS AND HALF-LIVES FOR
CHEMICALS IN GROUNDWATER EXCEEDING MAXIMUM CONTAMINANT LEVELS
SWMU 7, NAS KEY WEST

Chemicals of Concern	Koc L/kg	Kd L/kg	Ref
Antimony	NA	45	1

Organic Kd = foc*Koc, foc is minimum allowable value of 0.001 based on EPA Soil Screening User's Guide, April 1996, and Superfund Exposure Assessment Manual, April 1988.

(1) EPA Soil Screening Guidance User's Guide, April, 1996.
No deacy is assumed for Inorganic chemical.

TABLE 7
GROUNDWATER WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
GROUNDWATER CRITERIA PROTECTIVE OF GROUNDWATER FOR
CHEMICALS IN GROUNDWATER EXCEEDING MAXIMUM CONTAMINANT LEVELS
SWMU 7, NAS KEY WEST

Chemicals of Concern	Groundwater Criteria (Maximum Contaminant Level) (1) ug/L
Antimony	6

Notes:
(1)Groundwater Water Criteria are the MCLs, and were obtained from "Drinking Water Regulations and Health Advisories," USEPA Washington, D.C., October 1996.

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TABLE 8
GROUNDWATER WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
SUMMARY OF PHYSICAL AND GEOLOGIC PARAMETERS
GROUNDWATER WASHOUT TIME ESTIMATION BY NATURAL ATTENUATION
SWMU 7, NAS KEY WEST

Chemical	Source Area (1)		Shallow Aquifer Thickness (2) (ft)	Unsaturated Zone Thickness (3) (ft)	Mixing Depth (4) (ft)
	Length (ft)	Width (ft)			
Antimony	90	90	20	3	5

(1) See Figure 3.

(2) Shallow aquifer thickness is the average thickness of the oolitic limestone below the center of the western half of the Key West.

(3) The unsaturated zone thickness is based on lithologic description of the Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.

(4) Mixing depth is the average thickness of the fresh water lens below the center of the western half of the Key West.

TABLE 9
SOIL WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
MAXIMUM DETECTED SOIL AND GROUNDWATER CONCENTRATIONS FOR
CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SWMU 7, NAS KEY WEST

Chemical	Maximum Detected Concentrations in Surface Soil (1) (ug/kg)	Location	Maximum Detected Concentrations in Subsurface Soil (1) (ug/kg)	Location	Maximum Detected Groundwater Concentrations (2) (ug/L)	Location	Maximum Contaminant Level (MCL) (3) (ug/L)
Methylene Chloride	28	S7SB-5	27	S7SB-10	1	S7MW-1	5

Notes:
1. The maximum detected concentrations in surface and subsurface soils were based on Tables 4-2 and 4-1, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998 respectively.
2. The maximum detected concentrations in groundwater were based on Table 4-5, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.
3. MCLs were obtained from "Drinking Water Regulations and Health Advisories," USEPA Washington, D.C., October 1996.

TABLE 10
SOIL WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
SOIL PARTITIONING COEFFICIENTS AND HALF-LIVES FOR
CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SWMU 7, NAS KEY WEST

Chemicals of Concern	Koc L/kg	Kd L/kg	Ref	Half-Life (2) (years)
Methylene Chloride	11.7	0.0117	1	0.15

Organic Kd = foc*Koc, foc is minimum allowable value of 0.001 based on EPA Soil Screening User's Guide, April 1996, and Superfund Exposure Assessment Manual, April 1988.

(1) EPA Soil Screening Guidance User's Guide, April, 1996.
(2) Howard et. al., Handbook of Environmental Degradation Rates, 1991.

TABLE 11
SOIL WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
GROUNDWATER CRITERIA PROTECTIVE OF GROUNDWATER FOR
CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SWMU 7, NAS KEY WEST

Chemicals of Concern	Groundwater Criteria (Maximum Contaminant Level) (1) ug/L
Methylene Chloride	5

Notes:
(1)Groundwater Water Criteria are the MCLs, and were obtained from "Drinking Water Regulations and Health Advisories," USEPA Washington, D.C., October 1996.

TABLE 12
SOIL WASHOUT TIME ESTIMATION BY NATURAL PROCESSES
SUMMARY OF PHYSICAL AND GEOLOGIC PARAMETERS
SOIL RGOs DEVELOPMENT
SWMU 7, NAS KEY WEST

Chemical	Source Area (1)		Shallow Aquifer Thickness (2) (ft)	Unsaturated Zone Thickness (3) (ft)	Mixing Depth (4) (ft)
	Length (ft)	Width (ft)			
Methylene Chloride	100	90	20	3	5

(1) See Figure 4.
(2) Shallow aquifer thickness is the average thickness of the oolitic limestone below the center of the western half of the Key West.
(3) The unsaturated zone thickness is based on lithologic description of the Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.
(4) Mixing depth is the average thickness of the fresh water lens below the center of the western half of the Key West.

TABLE 13
SOIL RGO PROTECTIVE OF SURFACE WATER
CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SOIL RGOs DEVELOPMENT
SWMU 7, NAS KEY WEST

Chemicals of Concern	Soil RGO Protective of Surface Water mg/kg	Maximum Soil Concentrations ug/kg	In Exceedence of Soil RGO?
VOCs			
Methylene Chloride	>1.0 E + 06 (1)	28.0	no

(1) Indicates that a pure concentration of the contaminant will not result in exposure in exceedance of criteria.

TABLE 14
PREDICTED GROUNDWATER WASHOUT TIME USING FATE AND TRANSPORT MODELING
CHEMICALS IN GROUNDWATER EXCEEDING MAXIMUM CONTAMINANT LEVELS
SWMU 7, NAS KEY WEST

Chemical	Initial Soil Concentration in Unsaturated Zone (Max detected conc.) (1) (mg/kg)	Initial Groundwater Concentrations (2) (ug/L)	Maximum Contaminant Level (MCL) (ug/L)	Predicted Groundwater Washout Times (3) (years)
Antimony	4.90	46	6	362

Notes:
1. The maximum detected concentrations in soils were based on Tables 4-1 and 4-2, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.
2. The maximum detected concentrations in groundwater were based on Table 4-5, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.
3. The washout times were calculated at the saturated layer beneath the source area.

TABLE 15
PREDICTED SOIL WASHOUT TIME USING FATE AND TRANSPORT MODELING
CHEMICALS IN SOIL EXCEEDING SOIL TO GROUNDWATER CRITERIA
SWMU 7, NAS KEY WEST

Chemical	Initial Soil Concentration in Unsaturated Zone (Max detected conc.) (1) (ug/kg)	Initial Groundwater Concentrations (2) (ug/L)	Maximum Contaminant Level (MCL) (3) (ug/L)	Predicted Soil Washout Times (4) (years)
Methylene Chloride	28	1	5	2.0

Notes:

1. The maximum detected concentrations in surface and subsurface soils were based on Tables 4-2 and 4-1, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998 respectively.
2. The maximum detected concentrations in groundwater were based on Table 4-5, Supplemental RCRA Facility Investigation and Remedial Investigation Report, January 1998.
3. MCLs were obtained from "Drinking Water Regulations and Health Advisories," USEPA Washington, D.C., October 1996.
4. The washout times were calculated at the saturated layer under the source area.

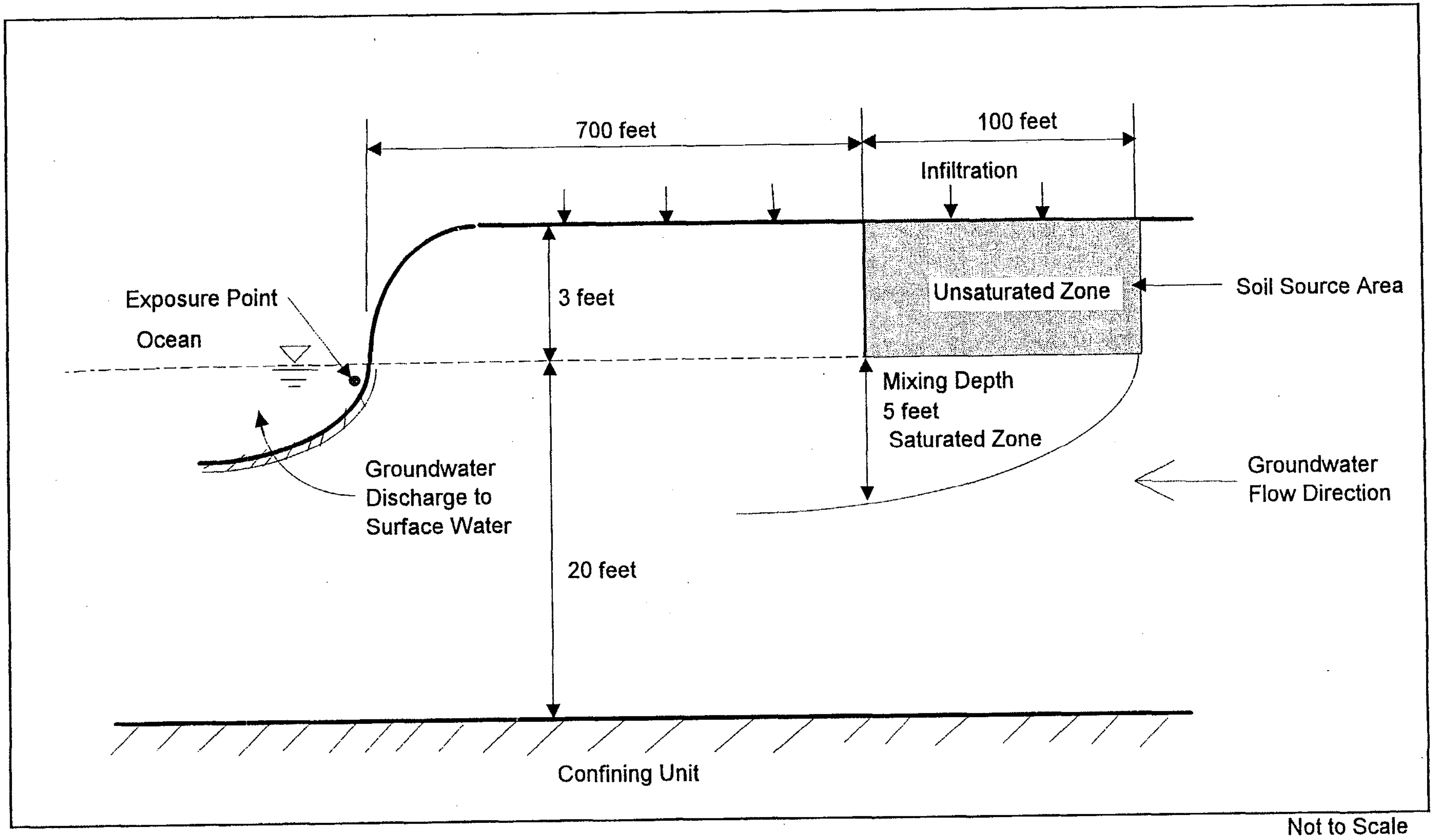


Figure 1 Conceptual Model for Soil RGOs Development (SWMU 7)

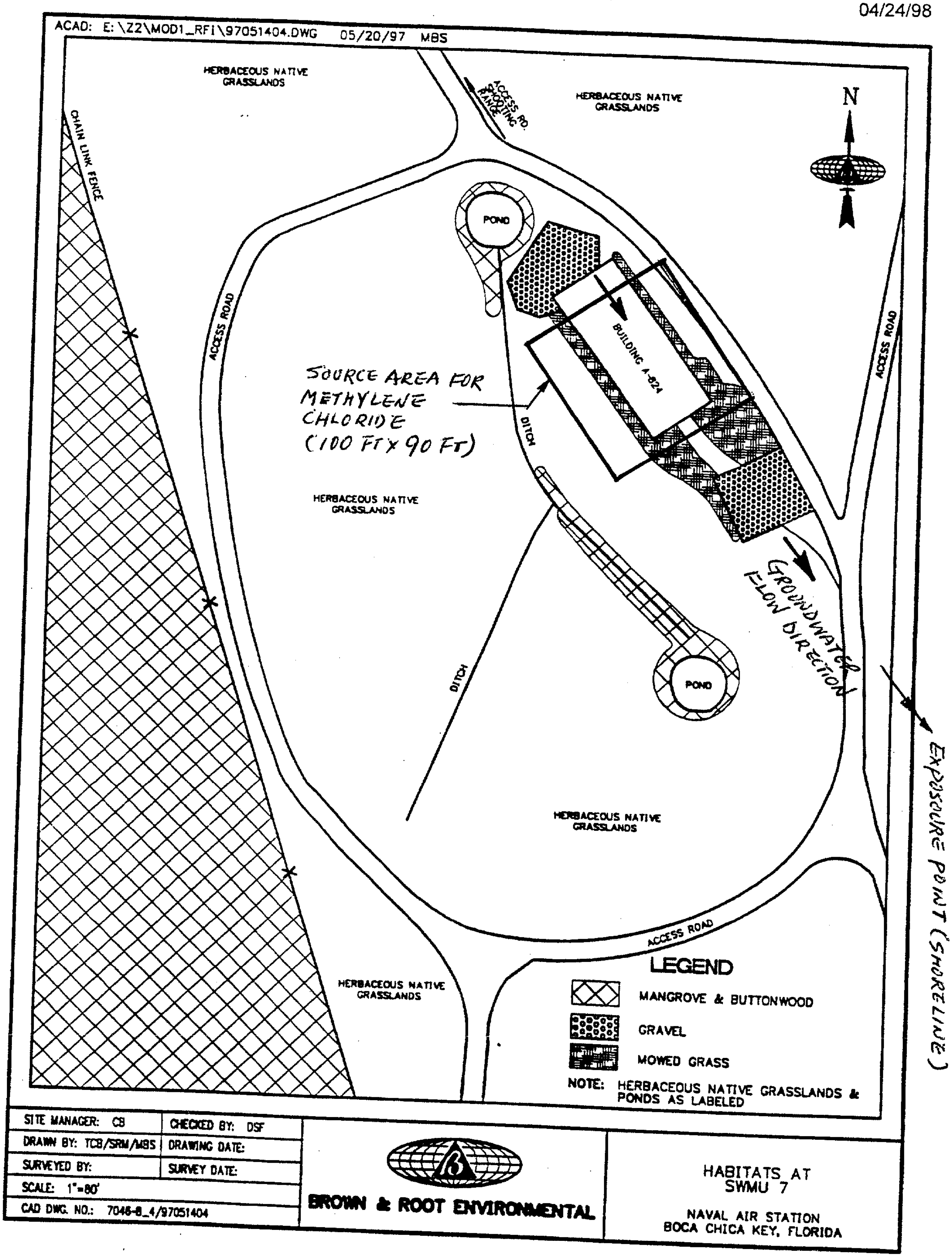


Figure 2 Source Area and Exposure Point for Soil RGO Development (SWMU 7)

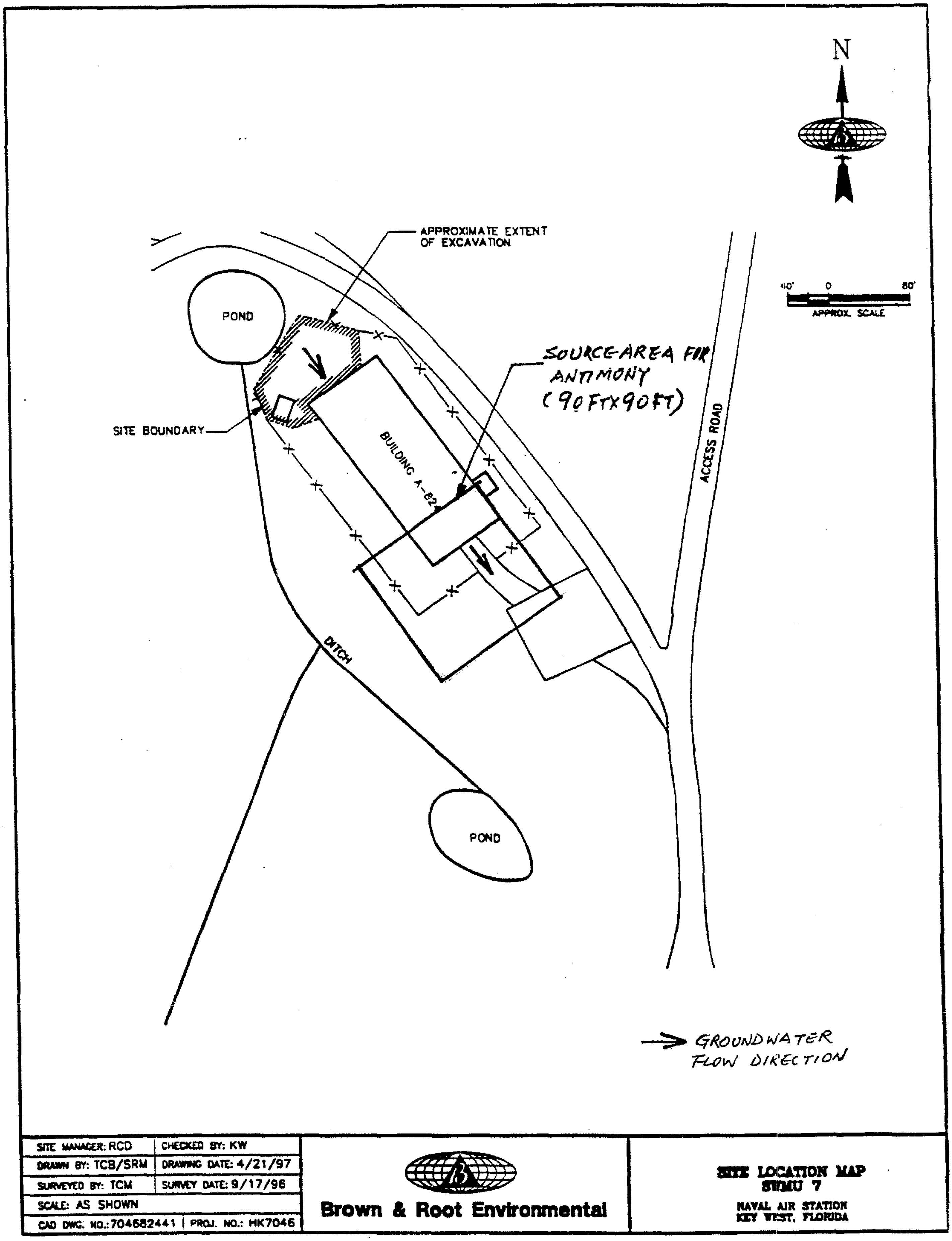
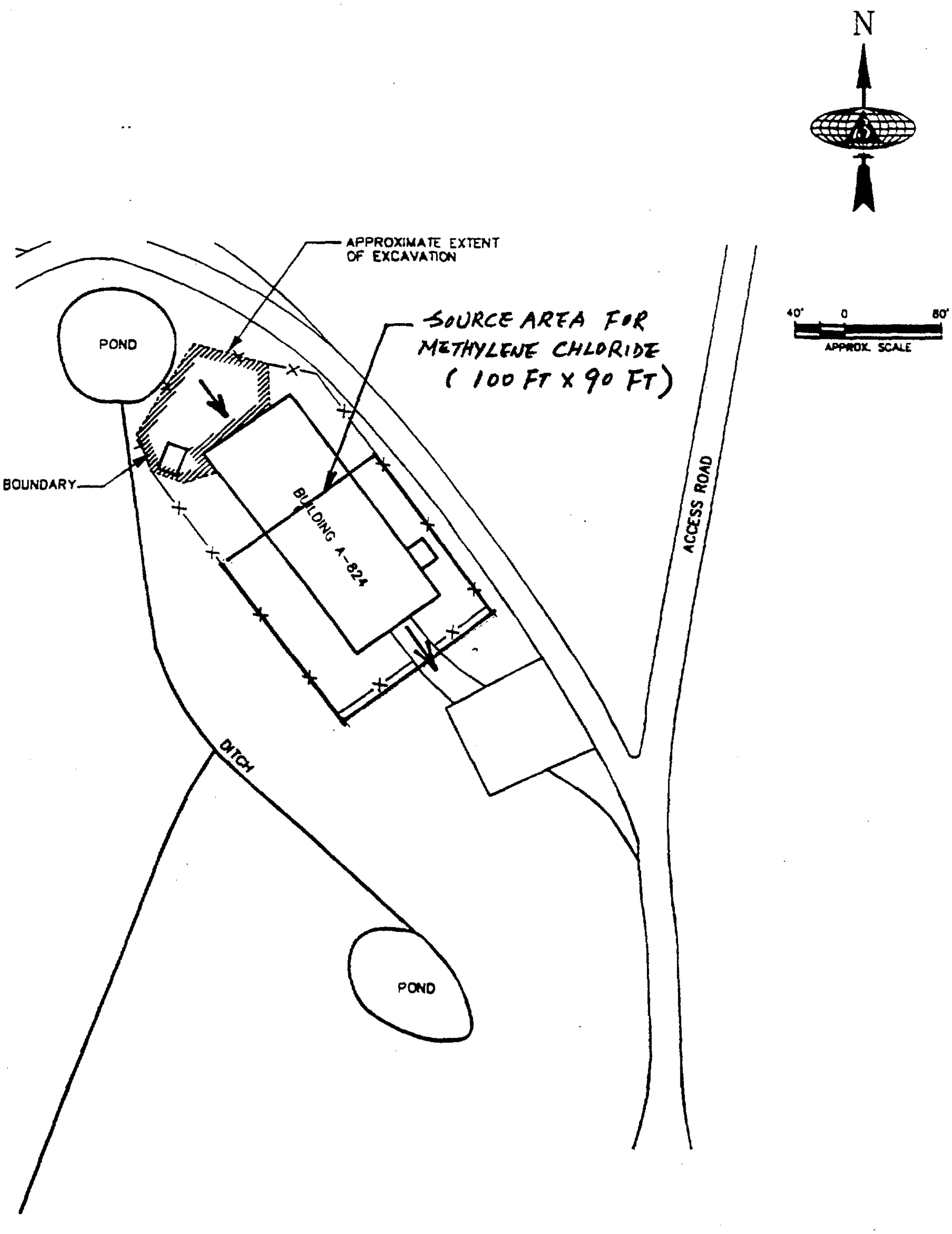


Figure 3 Source Area for Groundwater Washout Time Estimation (SWMU 7)



SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCM	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682441	PROJ. NO.: HK7046

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SITE LOCATION MAP
SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA

Figure 4 Source Area for Soil Washout Time Estimation (SWMU 7)

APPENDIX C

COST ESTIMATE FOR ALTERNATIVES

NAVAL AIR STATION
Boca Chica Key, Florida
SWMU 7
Alternative No. 2 - Institutional Controls with Monitoring

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost
1.1 Warning Signs	6	ea		$70.00	$15.00	$10.00	$0	$420	$90	$60	$570
1.2 Move Existing Fencing	225	LF			$7.70	$3.05	$0	$0	$1,733	$686	$2,419
1.3 Add New Fencing	145	LF		$12.60	$2.80	$1.80	$0	$1,827	$406	$261	$2,494
Subtotal							$0	$2,247	$2,229	$1,007	$5,483
Overhead on Labor Cost @ 30%									$669		$669
G & A on Labor Cost @ 10%									$223		$223
G & A on Material Cost @ 10%								$225			$225
G & A on Subcontract Cost @ 10%							$0				$0
Total Direct Cost							$0	$2,472	$3,120	$1,007	$6,599
Indirects on Total Direct Labor Cost @ 75%									$2,340		$2,340
Profit on Total Direct Cost @ 10%											$660
Subtotal											$9,599
Total Field Cost											$9,599
Contingency on Total Field Cost @ 20%											$1,920
Engineering on Total Field Cost @ 20%											$1,920
TOTAL COST											**$13,438**

NAVAL AIR STATION
Boca Chica Key, Florida
SWMU 7
Alternative No. 2 - Institutional Controls with Monitoring
Annual Cost

Item	Item Cost Year 1	Item Cost Years 2 - 10	Item Cost every 5 years	Notes*
Sampling	$16,000	$4,000		Collect 6 groundwater, surface water and sediment samples, per sample period, plus travel, living and shipping cost
Analysis	$14,000	$3,500		6 groundwater, surface water and sediment samples analyzed for inorganics and PCBs.
Report	$16,000	$4,000		Forty hours per sampling report plus other direct cost
Site Review			$20,000	Analysis Review performed for years 5 & 10
TOTALS	$46,000	$11,500	$20,000	

* Sample numbers include 3 QA/QC samples per medium.

NAVAL AIR STATION
Boca Chica Key, Florida
NAVAL AIR STATION
Boca Chica Key, Florida - SWMU 7
Alternative No. 2 - Limited Action
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$13,438		$13,438	1.000	$13,438
1		$46,000	$46,000	0.935	$43,010
2		$11,500	$11,500	0.873	$10,040
3		$11,500	$11,500	0.816	$9,384
4		$11,500	$11,500	0.763	$8,775
5		$31,500	$31,500	0.713	$22,460
6		$11,500	$11,500	0.666	$7,659
7		$11,500	$11,500	0.623	$7,165
8		$11,500	$11,500	0.582	$6,693
9		$11,500	$11,500	0.544	$6,256
10		$31,500	$31,500	0.508	$16,002

TOTAL PRESENT WORTH **$150,880**

NAVAL AIR STATION
Boca Chica Key, Florida
SWMU 7
Alternative No. 3 - Excavate Soil and Treat and/or Dispose Offsite; Institutional Controls

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost
1 MOBILIZATION/DEMOBILIZATION											
1.1 Storage Trailer (1)	1	mo	$500.00				$500	$0	$0	$0	$500
1.2 Construction Survey	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
1.3 Equipment Mobilization/Demobilization	1	ls	$5,000.00				$5,000	$0	$0	$0	$5,000
1.4 Decontamination Trailer	1	mo	$1,500.00				$1,500	$0	$0	$0	$1,500
2 DECONTAMINATION											
2.1 Laundry Service	4	wks	$250.00				$1,000	$0	$0	$0	$1,000
2.2 Truck Decon Pad											
a) Concrete Pad - 8"	40	cy		$70.00	$125.00	$5.00	$0	$2,800	$5,000	$200	$8,000
b) Gravel Base - 6"	30	cy		$7.50	$3.33	$8.00	$0	$225	$100	$240	$565
c) Curb	120	lf		$3.07	$1.99	$0.05	$0	$368	$239	$6	$613
d) Collection Sump	1			$1,450.00	$500.00	$220.00	$0	$1,450	$500	$220	$2,170
e) Splash Guard	280	sf		$1.25	$1.00		$0	$350	$280	$0	$630
2.2 Decontamination Services (man-weeks)	1	mo	$1,200.00	$840.00			$1,200	$840	$0	$0	$2,040
2.3 Decon Water	10000	gal	$0.20				$2,000	$0	$0	$0	$2,000
2.4 Decon Water Storage Tank, 6,000 gallon	1	mo		$5,000.00	$400.00		$0	$5,000	$400	$0	$5,400
2.5 Clean Water Storage Tank, 4,000 gallon	1	mo		$3,000.00	$300.00		$0	$3,000	$300	$0	$3,300
2.6 Warning Signs	6	ea		$70.00	$15.00	$10.00	$0	$420	$90	$60	$570
CONTAMINATED SOIL DISPOSAL											
3.1 Excavate Contaminated Soil	70	cy			$1.00	$3.04	$0	$0	$70	$213	$283
3.2 Load Soil	70	cy			$0.51	$0.65	$0	$0	$36	$46	$81
3.3 Haul and Dispose of Contaminated Soil: Nonhazardou	95	ton	$60.00				$5,700	$0	$0	$0	$5,700
3.4 TCLP Analysis - Arsenic	1	ea	$130.00				$130	$0	$0	$0	$130
RESTORATION											
4.1 a) Confirmatory Sampling Analysis - Metals	6	ea	$100.00				$600	$0	$0	$0	$600
b) Confirmatory Sampling Analysis - PCBs	6	ea	$95.00				$570	$0	$0	$0	$570
4.2 Backfill Topsoil - 6"	70	cy		$12.50	$2.70	$7.43	$0	$875	$189	$520	$1,584
a) Place & Spread	70	cy			$0.65	$0.86	$0	$0	$46	$60	$106
4.3 Revegetation	4	msf		$24.60	$8.40	$6.68	$0	$98	$34	$27	$159
Subtotal							$22,200	$15,427	$7,283	$1,591	$46,501
Overhead on Labor Cost @ 30%									$2,185		$2,185
G & A on Labor Cost @ 10%									$728		$728
G & A on Material Cost @ 10%								$1,543			$1,543
G & A on Subcontract Cost @ 10%							$2,220				$2,220
Total Direct Cost							$24,420	$16,969	$10,196	$1,591	$53,176
Indirects on Total Direct Labor Cost @ 75%									$7,647		$7,647

NAVAL AIR STATION
Boca Chica Key, Florida
SWMU 7
Alternative No. 3 - Excavate Soil and Treat and/or Dispose Offsite; Institutional Controls

			Unit Cost				Total Cost				Total Direct
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Cost
Profit on Total Direct Cost @ 10%											$5,318
Subtotal											$66,141
Health & Safety Monitoring @ 10%											$6,614
Total Field Cost											$72,755
Contingency on Total Field Cost @ 20%											$14,551
Engineering on Total Field Cost @ 20%											$14,551
TOTAL COST											**$101,856**

NAVAL AIR STATION
Boca Chica Key, Florida
SWMU 7
Alternative No. 3 - Excavate Soils, Offsite Treatment and/or Disposal, Institutional Controls
Annual Cost

Item	Item Cost Year 1	Item Cost Years 2 - 10	Item Cost every 5 years	Notes*
Sampling	$16,000	$4,000		Collect6 groundwater, surface water and sediment samples, per sample period, plus travel, living and shipping cost
Analysis	$14,000	$3,500		6 groundwater, surface water and sediment samples analyzed for inorganics, and PCBs.
Report	$16,000	$4,000		Forty hours per sampling report plus other direct cost
Site Review			$20,000	Analysis Review performed for years 5 & 10
TOTALS	$46,000	$11,500	$20,000	

* Sample numbers include 3 QA/QC samples per medium.

NAVAL AIR STATION
Boca Chica Key, Florida
NAVAL AIR STATION
Boca Chica Key, Florida - SWMU 7
Alternative No. 3 - Excavate Soils, Offsite Treatment and/or Disposal, Institutional Controls
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$101,856		$101,856	1.000	$101,856
1		$46,000	$46,000	0.935	$43,010
2		$11,500	$11,500	0.873	$10,040
3		$11,500	$11,500	0.816	$9,384
4		$11,500	$11,500	0.763	$8,775
5		$31,500	$31,500	0.713	$22,460
6		$11,500	$11,500	0.666	$7,659
7		$11,500	$11,500	0.623	$7,165
8		$11,500	$11,500	0.582	$6,693
9		$11,500	$11,500	0.544	$6,256
10		$31,500	$31,500	0.508	$16,002
				TOTAL PRESENT WORTH	**$239,298**

APPENDIX D

CNBJAXINST 5090.2N4

5-AUG-97

DEPARTMENT OF THE NAVY
COMMANDER NAVAL BASE JACKSONVILLE
BOX 102, NAVAL AIR STATION
JACKSONVILLE, FLORIDA 32212-0102

CNBJAXINST 5090.2
N4

COMMANDER, NAVAL BASE JACKSONVILLE INSTRUCTION 5090.2

Subj: LAND USE RESTRICTIONS (LURS) AT ENVIRONMENTAL REMEDIATION SITES ON BOARD U.S. NAVY INSTALLATIONS

Ref: (a) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § § 9601 *et seq.*
(b) Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 *et seq.*
(c) OPNAVINST 5090.1B

1. Purpose. To establish a systematic program, protective of human health and the environment, governing land use at environmental remediation sites on board selected U.S. Navy installations in the Commander, Naval Base, Jacksonville (COMNAVBASE JAX) Area of Responsibility (AOR).

2. Applicability. This instruction applies to sites undergoing environmental remediation at Naval Air Station, Jacksonville, FL, Naval Air Station Key West, FL, and Naval Station, Mayport, FL.

3. Discussion. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (references (a) and (b)) are the two primary federal laws governing the remediation of sites contaminated with hazardous substances and hazardous wastes. The U.S. Navy created the environmental remediation program to oversee the clean-up of these sites on board Naval facilities. Per reference (c), the Naval Facilities Engineering Command (NAVFAC) has been assigned the responsibility for centralized management of the installation restoration program. Southern Division (SOUTHDIV) is the NAVFAC component responsible for administration of the environmental remediation program for the U.S. Navy installations in the COMNAVBASE JAX AOR. The Florida Department of Environmental Protection (FDEP) and the U.S. Environmental Protection Agency (EPA) Region IV (hereafter referred to as "the agencies") have oversight and coordinating responsibilities over NAVFAC remediation actions. Remediation standards for clean-up of contaminated sites are established to ensure protection for human health and the environment.

a. Environmental restoration is a very costly process. There are an estimated 3300 sites nation-wide on board U.S. Navy and U.S. Marine Corps installations. Currently, the U.S. Navy's nationwide funding level is projected at just under $300 million per year.

b. Tens to hundreds of millions of dollars can be saved through the selection of clean-up remedies which appropriately reflect the current and future land use. However, to be effective, these future LURs must be strictly monitored and enforced. The agencies have expressed concern that the U.S. Navy lacks an effective mechanism to adequately ensure retention of identified LURs. This could allow the U.S. Navy to benefit from less stringent and thereby less costly remediation.

c. Consequently, the agencies are reluctant to accept final agreements (Records of Decision (ROD)) which do not include LURs (AKA institutional controls). This has impacted the "close out" of action at remediation sites on several installations. This instruction establishes a mechanism through which each Naval installation can enter into a Memorandum of Agreement (MOA) with the agencies, promulgate local instructions, develop a process to change land use where required, select optimum land use categories, optimize the use of scarce remediation funds, and ensure the maintenance of the identified land use category.

4. Action

a. Commanding Officers (COs): COs of installations conducting environmental remediation projects shall adopt local instructions which include, at a minimum, the following:

(1) A mechanism to enter into a MOA between the installation (including installation planners, Resident Officer-in-Charge of Construction (ROICC), installation environmental personnel and SOUTHDIV) and the agencies overseeing the present and anticipated land use category on a site-by-site basis. This will allow selection of clean-up standards that are protective of human health and the environment without unnecessary expenditure of limited fiscal resources. The local MOA can be supported and reinforced through RODs, closure permit restrictions (in the case of RCRA corrective actions) and environmental documentations performed under the National Environmental Policy Act (NEPA).

(2) Retention of the identified land use category throughout the specified remediation period. Restrictions on changes in land shall be accomplished through strict adherence to such vehicles as the base master planning process.

(3) A requirement for the installation environmental program manager to conduct routine LUR review of identified remediation sites, with incorporation of this responsibility into the environmental program manager's position description.

(4) A requirement for the installation Environmental Compliance Board (ECB) (developed under paragraph 1-2.14 of reference (c)) to review on a quarterly basis the status of adherence to the LURs.

(5) A requirement to forward an annual report to the agencies (with a copy to SOUTHDIV) certifying retention of the specified LUR category for each affected site on the installation.

(6) The installation CO must follow identification of the proper procedures in order to obtain concurrence from the agencies to change a previously identified LUR for a site. Concurrence of the agencies must be obtained in writing prior to commencing any construction or other activity inconsistent with the previous LUR. Requests for review of a LUR change proposal will consider the degree of change proposed, the effectiveness of the remediation effort to date, any natural remediation which may have occurred since the original remedial actions, etc.

(7) A requirement to notify the agencies if, despite proper precautions, an unauthorized change in land use is discovered by the installation. The change in land use will be reported immediately to the agencies for collaborative determination of an appropriate remedy.

(8) A notation that any funding associated with additional remediation caused by a LUR change (whether approved or unauthorized) will be the responsibility of the installation CO.

b. SOUTHDIV: As the agency responsible for the management of environmental remediation projects, SOUTHDIV shall accomplish the following:

(1) Take the lead in coordinating the drafting of a MOA to establish the specific agreement between each covered installation, the agencies and SOUTHDIV. At a minimum, the MOA will address real estate issues, LURs and remediation requirements.

(2) Support the installation CO, as required, during negotiations with the agencies.

(3) Review the installation's LUR instruction when conducting the tier two Environmental Compliance Evaluation (ECE) in support of the major claimant.

5. Special Note. The FDEP-EPA-U.S. Navy partnering team will view strong participation in this process to govern land use at environmental remediation sites positively, i.e., funding priority will be given to the most efficient site remediations.

KEVIN F. DELANEY

Distribution:
CNBJINST 5605.1
List IV: FA6a, FA6b, FA7a
List II: 26JJ1a, FA47a, FT48a

APPENDIX E

RESPONSE TO REGULATORY COMMENTS MADE TO THE DRAFT CMS FOR SWMU 7 (Rev. 0) DATED APRIL 1998

RESPONSE TO U.S. EPA COMMENTS
DRAFT SWMU 7 CMS, NAS KEY WEST

1. **Comment: Page 1-6, Figure 1-2.** The scale in this figure is not accurate and should be modified accordingly. Also, Sigsbee Key is still labeled Dredgers Key on this map.

   Response: Concur. The scale of the figure will be modified. Additionally, Sigsbee Key will be correctly labeled.

2. **Comment: Page 2-12, Section 2.5.2.2, General.** It is unclear how mercury was included in Section 2.5.2.1 under Surface Water (Future Resident Scenario) utilizing EPA Region IV criteria, but omitted in Section 2.5.2.2 Surface Water (Future Resident Scenario) utilizing FDEP criteria. Generally, state criteria are equal to or more stringent than Federal criteria. Clarification should be provided.

   Response: Mercury will be included in Section 2.5.2.2 Surface Water (Future Resident Scenario).

3. **Comment: Page 3-5, Section 3.2.1.4, General.** Executive Order 11988 Statement of Proceedings on Floodplain Management should be considered as a potential location-specific ARAR or To-Be-Considered (TBC).

   Response: Concur. Executive Order 11988 will be considered as a potential location-specific ARAR or TBC.

4. **Comment: Page 3-10, Section 3.3, Last Paragraph.** The HI for surface water under the future resident scenario is 2, yet surface water is eliminated as media of concern. Further justification for the elimination of the surface water pathway should be provided.

   Response: The intended land use at SWMU 7 for the foreseeable future is for industrial purposes. Additionally, the surface water bodies are not large in volume. As such, treatment technologies for surface water in itself were not evaluated; however, surface water monitoring is proposed as a component of institutional control actions enacted at the site. No changes to the text of Section 3.3 are proposed.

5. **Comment: Page 3-13, Section 3.5, First Paragraph.** The referenced section should be Section 3.4.2, not Section 3.2

Response: Concur. The correction will be made.

6. **Comment: Section 5.1.2, General.** The description of Alternative 2 would benefit from the addition of a figure showing where the institutional controls would apply.

   Response: Concur. A figure will be included in Chapter 5 depicting elements of the institutional controls alternative (e.g., sample locations).

7. **Comment: Page 5-2, Sections 5.1.2, First Paragraph.** This section indicates that groundwater is to be monitored only for inorganics. However, the cost analysis also includes analyses for PCBs. This discrepancy should be resolved.

   Response: The text of Section 5.1.2 will be changed to reflect that sampling and analysis of both inorganics and PCBs that will be conducted. The cost estimate correctly reflects this approach and no changes will be made to the cost estimate.

8. **Comment: Appendix A. Page A-2, Section A.2.2, Alternative 2.** This section states the assumptions associated with enacting institutional controls. This section assumes that trespassers would make a concerted effort to avoid ingestion or contact with the media because of the hazard postings and that occupational workers would be required to spend less time at the site. Both assumptions rely on half of the original "no action" exposure duration. According to the assumption in this section, occupational workers would be required to spend half as much time at the site as normal. Procedures for tracking this would be required. If institutional controls are adopted as a part of the remedy, then procedures for tracking this should be developed as a part of remedy implementations.

   Response: In conjunction with the Land-Use Controls Implementation Plan (LUCIP), as will be agreed to by the NAS Key West Partnering Team, such concerns will be addressed.

9. **Comment: Appendix C, Page 1 of 1, Alternative 2.** This costing worksheet summarizes the costs associated with Alternative 2. A total of $90.00 was estimated for labor with respect to Warning Sign placement. However, as seen in the spreadsheet, this amount was not multiplied by the associated labor overhead, and other indirect cost. This discrepancy should be corrected.

   Response: Concur. The labor figure will be multiplied by the associated labor overhead and other indirect costs.

RESPONSE TO FDEP COMMENTS
DRAFT SWMU 7 CMS, NAS KEY WEST

1. **General Comment:** The text in the CMS reports should include language that clearly states FDEP must manage risk to a 1E-06 estimated level of risk.

   Response: Per the agreement with the NAS Key West Partnering Team, carcinogenic risks in excess of 1E-06 will be managed via the LUCIP for SWMU 7.

2. **General Comment:** FDEP requests that risk management tools be implemented at SWMUs 5 and 7.

   Response: Risk management tools shall be discussed and agreed upon by the Partnering Team and included in the Land Use Control Implementation Plan for SWMUs 5 and 7.

3. **Comment: SWMU 7, Page 6-6.** Modify this page as follows:

   The recommended alternative for this site is Alternative 2 – Institutional Controls with Monitoring. Under this alternative, groundwater, sediment, and surface would be sampled and analyzed at a frequency yet-to-be determined by the NAS Key West Partnering Team. Further, exposure to soils in areas not removed by the IRA would be managed by implementing appropriate access restrictions. The institutional control alternative is further described below.

   By separate MOA with the U.S. EPA and the FDEP, NAS Key West, on behalf of the Department of the Navy, agreed to implement periodic site inspection, condition certification, and agency notification procedures designed to ensure the maintenance by Station personnel of any site-specific land-use controls (LUC) deemed necessary for future protection of human health an the environment. A fundamental premise underlying execution of that agreement was that through the Navy's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to the U.S. EPA and FDEP as to the permanency of those remedies, which included the use of specific LUCs.

   Although the terms and conditions of the MOA are not specifically incorporated herein by reference, it is understood and agreed by the Navy, U.S. EPA, and FDEP that the contemplated permanence of the remedy reflected herein shall be dependent on the Station's substantial good-faith compliance with the specific LUC maintenance commitments reflected therein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

The proposed alternative, Institutional Controls with Monitoring, is protective of human health and the environment under current industrial land use, complies with State and Federal ARARs, and is cost effective.

Response: Concur. The text will be replaced.

RESPONSE TO BECHTEL COMMENTS
DRAFT SWMU 7 CMS, NAS KEY WEST

1. **Comment: Page 2-3.** "Base personnel also indicated that transformer oil was dumped on the ground immediately north of the building." There were rumors that also transformers were cleansed out in area adjacent to the fence and the cleaning solutions disposed of on the ground. Also depending on the source and levels of contamination TSCA may apply to disposal of PCB contaminated soils.

   Response: Concerning the rumors, TtNUS is hesitant to include the item without a referenced source. If a reference can be provided, the statement will be added to the report.

   It is agreed that depending on the source and levels of contamination, TSCA may apply to disposal of PCB contaminated soils. However, the detected levels of PCB in the confirmation samples taken in 1995 were observed to be 16.5 and 10.0 mg/kg which is less than the 50 mg/kg criteria for managing the soil as a TSCA waste. Additionally, rules regarding the disposal of PCB wastes have recently been promulgated and are generally less restrictive regarding the disposal of such soils. As such, the soil will be likely managed as a non-hazardous waste.

2. **Comment: Page 3-18.** S7CONF-5(C) and –2(C) The IRA removed soil up to the fence and building. The areas shown on Figure 3-1 have already been excavated.

   Response: Confirmation samples indicated detections of PCBs of 16.5 mg/kg adjacent to the building and 10 mg/kg adjacent to the fence. These detections indicate that soil remains above regulatory criteria and that additional soil excavation is required.

3. **Comment: Page 3-18 Last Paragraph.** The soils in this area are extremely shallow. The IRA excavation extended to caprock, which was 3 to 6 inches deep. This would change the amount of soils excavated and the cost of the remediation.

   Response: Concur. The report will be revised to reflect an excavation depth of 6 inches.

4. **Comment: Page 4-5**. The TCLP value for arsenic to be a RCRA waste is 5 mg/kg. This is a leachate value. Using the 20 times rule, the waste need to contain at least 100 mg/kg before it could even possibly fail TCLP. The text needs to consider this waste to be non-hazardous.

Response: As stated on page 5-4, last paragraph of Alternative 3, Component 2, the cost estimate assumes that the soil will be managed as a non-hazardous waste. However, characterization of the waste will be a necessary part of the disposal process and would be conducted in accordance with the text of Alternative 3. No change to the text is proposed.

5. **Comment: Page 5-3 1st paragraph.** The soil was removed up to the edge of the building. Further removal would be under the slab of the building.

   Response: Please refer to the response to Comment 3.

6. **Comment: Page 5-3 last paragraph.** We used a similar idea with haybales and filter fabric. The site is so flat that I would now only cover the site with erosion control blankets, like CURLEX. The sandbags are labor intensive and expensive.

   Response: Concur. The suggestion will be incorporated in the text of the report.

7. **Comment**: In general, we have been writing off these sites with long term monitoring. With the reductions in cost listed above, I think that maybe this site could be a candidate for further field action.

   Response: Such discussion is suggested as an item of discussion at a future Partnering Team meeting.

DRAFT RESPONSE TO COMMENTS
DUDLEY PATRICK, SOUTHDIV
DRAFT SWMU 7 CMS REPORT
SEPTEMBER 1998

1. **Comment: Page 3-25, Fig. 3-1.** The title should be "Extent of Contaminated Soil".

   Response: Concur. The title will be changed.

2. **Comment: Page 5-12, 1st para., 2nd sentence.** The sentence states that "a reevaluation of the site would be performed every 5 years . . ."; however, the MOA to be signed on August 31, 1998 states that the facility will perform quarterly inspections and make an annual report to EPA and FDEP verifying the integrity of institutional controls placed at the site. Suggest add words to reflect this schedule to this section and other applicable sections.

   Response: Concur. Text throughout the report will be changed to reflect the MOA.

3. ***Comment: Page 6-2, sect. 6.2.2, 1st bullet, 2nd sentence.*** The words "over time" are repeated at the beginning and at the end of the sentence.

   Response: The sentence will be corrected.