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SUPPLEMENTAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION AND REMEDIAL INVESTIGATION REPORT FOR EIGHT SITES NAS KEY WEST FL

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BROWN AND ROOT ENVIRONMENTAL

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Supplemental RCRA Facility Investigation and Remedial Investigation Report

for

Eight Sites Naval Air Station Key West, Florida

Southern Division Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

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KEY WEST, FLORIDA

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ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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2155 Eagle Drive
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Submitted by:
Brown & Root Environmental
661 Anderson Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

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PREPARED BY:

R Scott Fulkinson for

CHUCK BRYAN
TASK ORDER MANAGER
BROWN & ROOT ENVIRONMENTAL
AIKEN, SOUTH CAROLINA

APPROVED BY:

Debbie Wroblewski

DEBBIE WROBLEWSKI
PROGRAM MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA

EXECUTIVE SUMMARY

This report presents the results of a Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation and Remedial Investigation (RFI/RI) at Naval Air Station (NAS) Key West on behalf of the U.S. Navy, Naval Facilities Engineering Command, Southern Division (NAVFACENGCOM-Southern Division). The report covers the investigation of eight sites [Solid Waste Management Units (SWMUs) 4, 5, 7; Installation Restoration (IR) Sites 1, 3, 7, 8; and Area of Concern B (AOC B)] and eight NAS Key West background locations. Brown & Root Environmental (B&R Environmental) performed this Supplemental RFI/RI in accordance with a workplan for the supplemental investigation of 13 sites (ABB, 1995), which was reviewed by the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP).

IT Corporation performed the initial RFI/RI investigation of sites at NAS Key West from 1992 to 1994 and reported the results to EPA and FDEP in 1994. In commenting on the initial RFI/RI, the regulatory agencies noted three overlying data gaps that led to preparation of the Supplemental RFI/RI:

- The nature and extent of contaminants should be completely characterized
- Characterization of the ecological risk caused by sites should be based on quantitative ecological sampling and analyses rather than biological inventories and qualitative assessments
- Sitewide background data on contaminants of concern should be provided to supplement existing site-specific background data

This Supplemental RFI/RI Report contains a complete assessment of the nature and extent of contamination, a human health risk assessment, and an ecological risk assessment at eight sites. This report also contains results from a comprehensive background study to support the analysis and evaluation of the eight sites.

Site data collected during previous investigations at NAS Key West, as well as additional data gathered during the Supplemental field investigation, were used in this Supplemental RFI/RI Report for characterizing the nature and extent of contamination and performing the ecological and human health risk assessments at the sites. Because B&R Environmental sorted historical data to remove samples from

areas excavated as part of the 1995 and 1996 interim removal actions, the conclusions of this report apply to the site conditions as they presently exist after removal of contaminated soil.

The primary purposes of RFI/RI activities at NAS Key West are to provide the Navy with data that:

- Characterize the nature and extent of releases from the sites
- Characterize potential pathways of contaminant migration in the soil, surface water, and groundwater
- Identify potential receptors
- Assess potential risks to human health and the environment
- Determine if contaminants released from the sites require further corrective measures to mitigate the risk to human health or the environment

The RFI/RI report consists of nine chapters and eleven appendixes. Chapter 1 provides an introduction, the purpose and scope of the report, an overview of the base environmental setting, a summary of the investigation procedures used during this RFI/RI and a review of the investigation history of the facility. Chapters 2 through 9 describe observed conditions at the eight sites investigated and summarize the analytical results of the RFI/RI. Each of these chapters discusses the transport and exposure pathways that play a role in contaminant migration and uptake of hazardous substances via each exposure pathway. The results of the human health risk assessment and the ecological risk assessment are also presented for each site. Conclusions and recommendations are then presented at the end of each chapter.

The nature and extent subsections of Chapters 2 through 9 present the contaminants detected at the site, the spatial and (if applicable) temporal extent to which contaminants have impacted environmental media, and the relationship between the findings and the activities that occurred during base operations. The detected contaminants in each medium (soil, sediment, surface-water, and groundwater) were compared to applicable or relevant and appropriate requirements (ARARs), screening action levels (SALs), and, where appropriate, background levels. This approach provides the reader with a quick overview of the distribution and extent of site contaminants that were detected and identifies areas of greatest potential impact. Figures (i.e., maps of each site) accompany the text to provide the reviewer with a frame of reference regarding site contamination in soil, sediment, surface water, and groundwater, as applicable. The approach presented in the "Nature and Extent" sections of the report is a conservative method in which the reader is presented information showing which chemicals most greatly exceed certain standards of protection (i.e., ARARs, SALs or background). The comparison of measured concentrations to standards that are specifically protective of human or environmental receptors is performed in the human health and ecological risk assessments, which follow the discussions of the nature and extent and fate and transport of contamination.

As mentioned above, eleven appendixes are included in the report. While titles of all appendixes can be found in the report's table of contents, a brief description of four appendixes is in order. Investigation procedures (i.e., methods) are presented in Appendix C (Field Procedures). Within Appendix C, Section 2.0 presents procedures for data quality assessment while Sections 3.2 and 3.3 describe methods used for the performance of human health and ecological risk assessments. The development and use of the background data set can be found in Appendix F (Comprehensive Background Report for NAS Key West). Appendix I includes Laboratory analytical reports, while memorandums that summarize the data validation results are in Appendix J.

For the NAS Key West background sites, this Supplemental RFI/RI produced the following results:

- In general, only relatively low levels of compounds were detected in NAS Key West background groundwater, sediment, soil, and surface water. Metals were the most frequently detected compounds in all four media, followed by pesticides in soil and sediment. A few volatile and semivolatile organic compounds were detected in each medium, although occurrences were generally isolated.

- Overall concentrations of contaminants in tissue at the background locations were generally within the range of values considered to be normal, and indicate negligible tissue contamination at background sites. However, concentrations of arsenic in some tissue samples and lead in sheepshead minnow samples exceeded values identified in some literature sources.

Table ES-1 summarizes conclusions for the eight sites. The table shows whether significant contamination remains in surface water, sediment, soil, and groundwater; whether ecological or human health risks exist; and whether a corrective measures study (CMS) or feasibility study (FS) is warranted.

SWMU 4 appears to have inorganic contamination (i.e., antimony and beryllium) present at concentrations indicating potential adverse health effects only to the hypothetical future resident. However, the metals detected at SWMU 4 are not believed to be associated with past site-related activity. Based on the lack of current human health and ecological risk posed by the site and its current nonresidential land use, it is recommended that SWMU 4 be approved for no further action (NFA).

SWMU 5 currently has metal contamination present at levels that pose potential noncarcinogenic and carcinogenic risk to hypothetical future residents, as well as potential carcinogenic risk to current trespassers and site workers. Present contaminant release pathways are primarily limited to soil and sediment contaminants that could potentially infiltrate the water table and be carried with the flow of groundwater to downgradient locations. Therefore, a CMS has been recommended to evaluate soil excavation and removal in the vicinity of the sand blasting area.

TABLE ES-1

SUMMARY OF CONCLUSIONS
NAS KEY WEST

Site	Significant Residual Contamination				Ecological Risk	Human Health Risk	Recommendation
	Surface Water	Sediment	Soil	Ground-water			
SWMU 4	No	No	No	No	No	Yes for future resident scenario	No Further Action
SWMU 5	No	Yes	Yes	No	No	Yes for future resident scenario	Corrective Measures Study
SWMU 7	No	Yes	Yes	No	Low potential risk to terrestrial receptors	Yes for future resident scenario Possible for current trespasser and maintenance and occupational worker scenarios	Corrective Measures Study
IR 1	No	Yes	Yes	Yes	Potential risk to benthic receptors	Yes for future resident scenario Possible for current trespasser and occupational worker scenarios	Feasibility Study with toxicity testing
IR 3	NA	NA	Yes	No	No	Yes for future resident scenario Possible for current trespasser and occupational worker scenarios	Presumptive Remedy (capping)
IR 7	No	No	No	No	No	Yes for future resident scenario Possible for current trespassers scenarios	No Further Action with institutional controls and monitoring
IR 8	No	Yes	No	Yes	Potential risk to benthic receptors	Yes for future resident scenario and current adolescent trespasser scenario Possible for current adult trespasser scenario	Feasibility Study with toxicity testing
AOC B	No	Yes	No	No	No	Yes for future resident scenario Possible for current trespasser scenarios	No Further Action with institutional controls

NA Not applicable because surface water and sediment are not present at IR 3.

SWMU 7 appears to have inorganic and polychlorinated biphenyl (PCB) (i.e., arsenic and Aroclor-1260, respectively) contamination present at levels sufficient to pose potential carcinogenic and noncarcinogenic risks for the hypothetical future resident scenario in the human health risk assessment. The human health risk assessment also indicates potential carcinogenic risk to current trespassers and workers. However, the ecological risk assessment concludes that potential risk to terrestrial receptors is low. A CMS has been recommended to determine the need for any additional remedial actions. Additional sampling was performed at a site near SWMU 7. Results from these analyses indicate chemicals that are consistent with fuel contamination were detected in surface soil. Thus, this site should be transferred to the NAS Key West Underground Storage Tank Program.

Despite an interim remedial action in 1996 to remove contaminated soil, IR 1 still has metal contamination remaining in soil, groundwater, and sediment. Several organochlorine pesticides and PCBs are also present in sediment and groundwater at the site. Contaminants are present at concentrations indicating possible adverse health effects to the hypothetical future resident and to current trespassers and occupational workers. A feasibility study (FS) is recommended to determine whether elevated concentrations of sediment contaminants are toxic to benthic receptors at IR 1, conduct additional soil sampling as necessary, and evaluate the need for groundwater corrective measures and further soil excavation. Any additional sampling and remedial activities should not be conducted until sediment toxicity test results are evaluated.

IR 3 currently has inorganic and pesticide contaminants in surface soil at sufficient concentrations to cause potential health effects to the hypothetical future resident. However, the ecological risk assessment indicates the absence of a complete exposure pathway for ecological receptors; thus, the potential for ecological impacts does not exist. Present contaminant release pathways are limited to dermal exposure and possible infiltration into the water table. A presumptive remedy of an asphalt cap is recommended as the final remedial action at IR 3.

IR 7 currently has elevated concentrations of antimony in surface water that pose potential adverse noncarcinogenic health effects to the hypothetical future resident. Additionally, arsenic in sediment poses potential carcinogenic risks to the hypothetical future resident and current trespassers. There appears to be no ecological risk posed by the contaminants at IR 7. The concentrations of arsenic in sediment and antimony in surface water, however, are only slightly above background levels. Thus, the detected levels of arsenic and antimony are believed to be the result of statistical variability in the data and not caused by past disposal at IR 7. Based on the minimal human health and ecological risk posed by the site, it is recommended that IR 7 be approved for no further action (NFA) with provisions for institutional controls and monitoring.

IR 8 currently has elevated concentrations of several metals in sediment and groundwater. The human health risk assessment indicates that potential adverse carcinogenic and noncarcinogenic health effects exist for the hypothetical future resident and for current trespassers. The ecological risk assessment concludes that potential risks to benthic receptors may exist and recommends sediment toxicity testing to evaluate whether metals are actually impacting benthic organisms near the site. A feasibility study is recommended to determine whether elevated concentration of sediment contaminants are toxic to benthic receptors at IR 8, conduct additional sampling as necessary, and evaluate the need for corrective measures. Any additional sampling and remedial activities should not be conducted until sediment toxicity test results are evaluated.

AOC B has slightly elevated inorganic contamination in surface water and sediment (i.e., antimony and arsenic, respectively); however, the metals are not believed to be associated with past site-related activity. Sediment contamination may pose potential risks to benthic organisms, but no bioaccumulation has occurred, suggesting that the contaminants are not bioavailable. Based on the minimal human health and ecological risks posed by the site, it is recommended that AOC B be approved for NFA with provisions for institutional controls.

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8-6 Soil Chemical Concentrations IR 8 8-17
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9-12 Habitats at AOC B 9-105
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LIST OF ACRONYMS AND ABBREVIATIONS
NAS KEY WEST SUPPLEMENTAL RFI/RI

ABB	ABB Environmental Services, Inc.
ABSEFF	Absorption efficiency
AL	action level
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
B&R Environmental	Brown & Root Environmental
BB&L	Blasland, Bouck, and Lee
BEI	Bechtel Environmental, Inc.
BHC	benzene hexachloride
BLS	below land surface
BTAG	BioTechnical Assistance Group
CAMP	Corrective Action Management Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-Term Environmental Action, Navy
cm	centimeter
cm/sec	centimeters per second
CMS	Corrective Measures Study
CNS	central nervous system
COC	chemical of concern
COPC	chemical of potential concern
CTE	central tendency exposure
cy	cubic yards
DA	dose absorbed
DAD	dermally absorbed dose
DBH	diameters at breast height
DDD	dichlorodiphenyl dichloroethane
DDE	dichlorodiphenyl dichloroethylene
DDT	dichlorodiphenyl trichloroethane
DO	dissolved oxygen
DOD	United States Department of Defense
ECC	ecological contaminants of concern
ECG	electrocardiograph
EMAP	Environmental Monitoring and Assessment Program
EPA	United States Environmental Protection Agency
ER-L	Effect Range-Low
ER-M	Effect Range-Medium
ERA	Ecological Risk Assessment
FDEP	Florida Department of Environmental Protection
FGFWFC	Florida Game and Fresh Water Fish Commission
FKAA	Florida Keys Aqueduct Authority
FNAI	Florida Natural Areas Inventory
FS	Feasibility Study
FSWQS	Florida Surface Water Quality Standards

ft/ft	foot per foot
FWS	Fish and Wildlife Service (U.S. Department of the Interior)
GC	Guidance Concentration
GC/MS	gas chromatography/mass spectrometry
GI	gastrointestinal
gpd/ft^2	gallons per day per square foot
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	Hazard Index
HQ	hazard quotient
HRS	hazard ranking system scoring
HSWA	Hazardous and Solid Waste Amendments
IARC	International Agency for Research on Cancer
IAS	Initial Assessment Study
IEUBK	Integrated Exposure and Uptake BioKinetic
IR	Installation Restoration
IRA	Interim Remedial Action
IRIS	Integrated Risk Information System
IT Corporation	International Technology Corporation
LD	lethal dose
LDLO	lowest lethal dose
LOAEL	lowest observed adverse effect level
µg/dL	micrograms per deciliter
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
m	meter
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MGD	million gallons per day
MS	matrix spike
mS/cm	millisiemens per centimeter
MSD	matrix spike duplicates
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standard
NACIP	Naval Assessment and Control of Installation Pollutants Program
NAS	Naval Air Station
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFA	no further action
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No-Observed-Adverse-Effect-Level
NOEL	No-Observed-Effect-Level
NOV	Notice of Violation

NPL	National Priority List
NTP	National Toxicology Program
ORNL	Oak Ridge National Lab
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene (perchloroethylene)
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PQL	practical quantitation limit
PRE	Preliminary Risk Evaluation
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAC	Remedial Action Contractor
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfC	reference concentration
RfD	reference dose
RFI	RCRA Facility Investigation
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RGO	remedial goal option
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
RME	reasonable maximum exposure
RPF	relative potency factor
SA	surface area
SAL	screening action level
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SF	slope factor
SOP	standard operating procedure
SOW	statement of work
SQAG	sediment Quality Assurance Guideline
SQC	sediment quality criteria
SSC	Species of Special Concern
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
SWQS	surface water quality standard
TAL	Target Analyte List
TBC	to be considered
TCA	trichloroethane
TCDD	tetrachlorodibenzodioxin

TCE	trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TF	trichlorotrifluoromethane
TLV	threshold limit value
TRV	toxicity reference values
TSD	treatment, storage, and disposal
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	volatile organic compound
WQS	Water Quality Standard

1.0 INTRODUCTION

Brown & Root Environmental (B&R Environmental) has performed a Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation and Remedial Investigation (RFI/RI) at the Naval Air Station (NAS) Key West on behalf of the U.S. Navy, Naval Facilities Engineering Command, Southern Division (NAVFACENGCOM-Southern Division). B&R Environmental completed this Supplemental RFI Report under Comprehensive Long-Term Environmental Action - Navy (CLEAN) Contract Number N62467-94-D-0888, Contract Task Order 0007.

1.1 PURPOSE AND SCOPE OF REPORT

This Supplemental RFI/RI report for NAS Key West presents information that (1) characterizes the nature and extent of releases of hazardous wastes or contaminants at three solid waste management units (SWMUs), four installation restoration (IR) areas, and one area of concern (AOC); (2) characterizes background conditions for NAS Key West; (3) characterizes potential pathways of contaminant migration in the soil, surface water, sediment, and groundwater; (4) identifies potential receptors; (5) assesses potential risks to human health and the environment; and (6) determines if contaminants released from a site require further corrective measures to mitigate the risk to human health or the environment. This Supplemental RFI/RI addresses the following eight sites:

- SWMU 4 - AIMD Building A-980
- SWMU 5 - AIMD Building A-990
- SWMU 7 - Building A-824
- IR 1 - Truman Annex Refuse Disposal Area
- IR 3 - Truman Annex DDT Mixing Area
- IR 7 - Fleming Key North Landfill
- IR 8 - Fleming Key South Landfill
- AOC B - Big Coppitt Key Abandoned Civilian Disposal Area

IT Corporation conducted RFI/RI field activities intermittently from January 1992 through December 1994. Field activities at NAS Key West included monitoring well installation, multi-media sample collection and analyses, topographic surveys, tidal influence studies, and biological inventories of habitats. IT Corporation submitted an RFI/RI Report to regulatory agencies for review. In commenting on the RFI/RI report, the U.S. Environmental Protection Agency Region IV (EPA) and Florida Department of

Environmental Protection (FDEP) noted three overlying information deficiencies that necessitated the Supplemental RFI/RI:

- The characterization of the nature and extent of contaminants is incomplete
- Characterization of the ecological risk caused by sites should be based on quantitative ecological sampling and analyses rather than biological inventories and qualitative assessments
- Sitewide background data on chemicals of concern (COCs) should be provided to supplement existing site-specific background data

The Supplemental RFI/RI Field Investigation, which was conducted from August to October 1996, focused on these areas. All of the data generated by past studies have been used in the risk assessments and other conclusions of this report. Past data were sorted to remove samples collected from areas subsequently excavated as part of the interim removal actions conducted during 1995 and 1996; thus, the conclusions of this report apply to site conditions as they presently exist.

1.2 REPORT ORGANIZATION

This RFI/RI report consists of nine major chapters and eleven appendixes. Chapter 1 provides an introduction, the purpose and scope of the report, an overview of the environmental setting at the base, an overview of the investigation procedures used during this RFI/RI, and a review of the investigative history of the facility. Chapters 2 through 9 characterize the eight sites investigated and present the results of the RFI/RI. Each of these chapters discusses the transport and exposure pathways that play a role in contaminant migration and uptake of hazardous substances via each exposure pathway. The chapters also present the results of the human health risk assessment and the ecological risk assessment for each site, as well as final conclusions and recommendations.

Chapters 2 through 9, in the subsections that characterize the nature and extent of contamination, present the contaminants detected at the site, the spatial and (if applicable) temporal extent to which contaminants have impacted environmental media, and the relationship between the findings and the activities that occurred during base operations. The report compares contaminants detected above background levels to applicable or relevant and appropriate requirements (ARARs) and screening action levels (SALs) for each medium (soil, sediment, surface water, and groundwater). This approach provides the reader with a quick overview of the distribution and extent of site contaminants and identifies areas of greatest impact. Figures (i.e., maps of each site) accompany the text to provide the reviewer with a frame of reference

regarding site contamination. A discussion of site-specific contaminant fate and transport, a human health risk assessment, and an ecological risk assessment follow the presentation of the nature and extent of contamination for each of the eight sites.

As mentioned above, the report includes several appendixes. While titles of all appendixes can be found in the report's table of contents, they are also described below. Appendix C (Investigation Procedures) presents investigation procedures (i.e., methods). Section 2.0 of Appendix C presents procedures for data quality assessment, and Sections 3.2 and 3.3, respectively, present methods for the human health and ecological risk assessments. Appendix F (Background Report) presents the methods used to develop the background data set, and Appendix H presents the laboratory analytical reports.

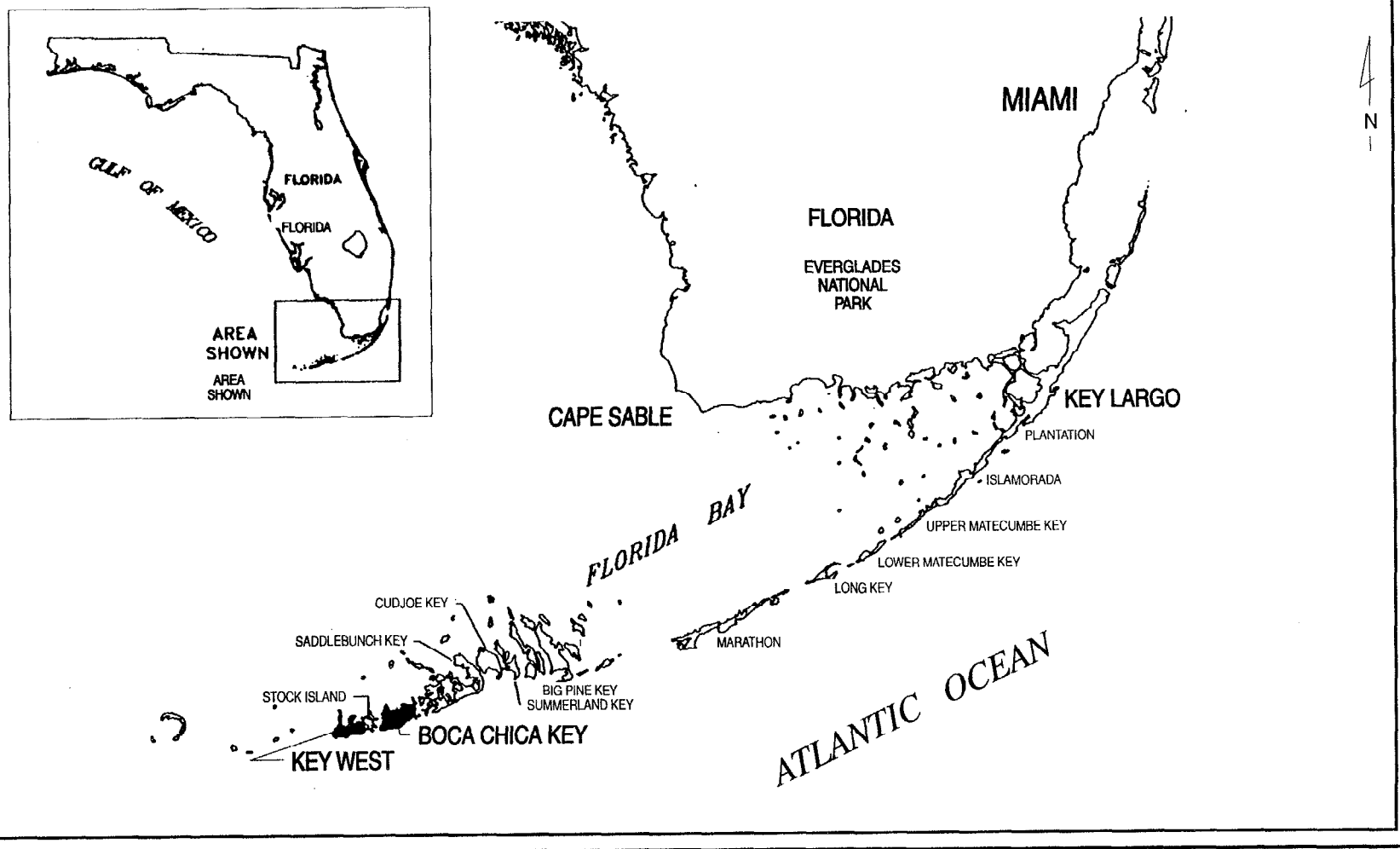
1.3 INSTALLATION DESCRIPTION

NAS Key West is in southern Monroe County, Florida. The U.S. Navy manages 6,323 acres of land divided into twenty separate tracts in the lower Florida Keys, concentrated around Key West and Boca Chica Key (Figure 1-1). The Naval Station at Key West was dis-established in 1974, resulting in the relocation of several units. At present, NAS Key West is proceeding with realignment of aviation operations, a research laboratory, communications intelligence, counternarcotics air surveillance operations, a weather service, and several other activities on Key West. In addition to the Naval activities and units, other DOD and Federal agencies at NAS Key West include the U.S. Air Force, U.S. Army, and U.S. Coast Guard.

Key West, one of the two westernmost major islands of the Florida Keys, is approximately 150 miles southwest of Miami and 90 miles north of Havana, Cuba. Key West connects to the mainland by the Overseas Highway (U.S. Highway No. 1). The topography at the NAS Key West, which is generally flat, consists of average land surface elevations less than 5 feet above mean sea level (msl) with the exception of filled areas that underlie the Overseas Highway (IT Corporation, 1994).

1.4 BASE ENVIRONMENTAL SETTING

Key West is approximately 4 miles long and 1.5 miles wide. Boca Chica Key is approximately 3 miles wide and 3 miles long. The City of Key West is the county seat for Monroe County. The principal industry of tourism in Key West brings annually about 1,225,000 tourists. Tourism, fishing, wholesale and retail trade, services, construction, finance, insurance, real estate, Federal government, state and local government, and transportation industries make up the major sources of employment in Key West.



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0 20 40
SCALE IN MILES

FIGURE 1-1. FACILITY LOCATION MAP
NAS KEY WEST

NAS KEY WEST — KEY WEST, FLORIDA

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The following subsections summarize existing conditions common to all sites located at NAS Key West.

1.4.1 Climate And Meteorology

Of the Florida Keys, the lower Keys have the lowest rainfall with an average annual rainfall of 39.4 inches. Temperature is fairly uniform across the Florida Keys with a July average temperature of 84 degrees Fahrenheit (°F), a January average temperature of 64 to 70°F, and an average annual temperature of 76.3°F. Freezing temperatures are rare in the Florida Keys due to the proximity to the Gulf Stream and the Gulf of Mexico, both of which modify advancing cold fronts. Freezes, when they occur, have the long-lasting effect of killing cold-sensitive species that might otherwise become established. Easterly tradewinds and sea breezes suppress summer heat from June to September (IT Corporation, 1994).

Hurricanes normally form in the warm, moist air over the tropical seas around the Lesser Antilles and occasionally in the Caribbean. They tend to move in a westerly to northwesterly direction, gradually turning northward and eastward. Most hurricanes that approach Key West do so from the south and east. Severe hurricanes have struck Key West from each direction. Tidal flooding causes an estimated 75 percent of all damage that occurs during a hurricane (IT Corporation, 1994).

Dry and wet seasons characterize Key West. From December through May, the Keys receive approximately 25 percent of their annual precipitation total. Approximately 75 to 80 percent of the annual rainfall falls from June through November. Rainfall usually occurs in advance of a cold front in the form of a few heavy showers, occasionally five to eight light showers per month. Overland flow or storm drains that drain approximately 50 percent of the island's surface area carry rainfall runoff from Key West to the tidal waters; however, much of the rainfall percolates directly into the subsurface (IT Corporation, 1994).

1.4.2 Topography

The NAS Key West Complex lies in the southeastern Coastal Plain physiographic province. A series of ancient marine reefs that formed during the Pleistocene period when the sea level was higher than it is at present control the topography of the Coastal Plain in southern Florida (ABB, 1995).

Ground elevations in the Key West area average between 4 and 5 feet above msl, and the highest point on Key West is approximately 18 feet above msl. The Key West area is characterized by a sparse veneer of residual soil and surface vegetation overlying eroded limestone. The topography of the lower Keys, generally smooth and flat in the center of the key, slopes gently toward the shoreline. With the exception of central Key West, most areas are within the 100-year floodplain (ABB, 1995).

1.4.3 Surface Water Hydrology

The surrounding saltwater bodies, the Atlantic Ocean and the Gulf of Mexico dominate the surface-water regime in the Florida Keys. FDEP classifies surface water in the Florida Keys as Class G-III Waters - Recreational, Propagation and Management of Fish and Wildlife. In the immediate area of NAS Key West are the Great White Heron National Wildlife Refuge and the Key West National Wildlife Refuge, which FDEP classifies as Outstanding Florida Waters to receive the highest degree of protection by the State. The residents of Florida consider these waters to be of exceptional recreational and ecological significance (ABB, 1995).

Freshwater recharge in the lower Keys occurs directly through rainfall. The nearly flat topography and porous nature of exposed limestone allows much of the rainfall to infiltrate to shallow groundwater tables, forming freshwater lenses. Overland flow or storm drains in most of the more developed areas carry remaining rainfall to tidal waters. Accelerated runoff and increased saltwater intrusion from canals, housing, dewatering (as a mosquito control measure), and marinas decrease the freshwater lens on the Florida Keys, shorten the period that residents can draw on freshwater supplies, and affect water quality. During the dry season, freshwater tends to disappear quickly by seepage to the sea and evaporation. Evaporation exerts an important effect on the Florida Keys' hydrologic budget, with transpiration affecting a more localized and confined area on individual islands (ABB, 1995).

1.4.4 Geology And Soil

The lower Keys, which are within the southern or distal geomorphic division of Florida, were formed during the Pleistocene era. Commonly referred to as the "Oolite Keys," they are underlain by the Oolitic Member (Miami Oolite) of the Miami Limestone. The Oolitic Member consists of variably sandy, fossiliferous limestone composed primarily of ooids (spherical calcareous grains 0.25 to 2.0 mm in diameter) that were created through eustatic elevation of the limestone. In the lower Keys, the Oolitic Member consists of the Ooid Calcarenite and the Oomoldic-recrystalline lithofacies. The Ooid Calcarenite lithofacies consists of very fine to coarse sand-size, spherical carbonate grains concentrically laminated around a silt-size to fine-sand-size nucleus. The Oomoldic-recrystalline lithofacies consists of slightly sandy to very sandy well- to moderately well-consolidated micritic calcite. The Miami Oolite overlies the Key Largo Limestone, a geologic unit consisting of light gray to light yellow coralline limestone comprised of coral heads encased in a matrix of calcarenite.

In the supplemental workplan, ABB reported that the Miami Oolite is 27 feet thick and that the Key Largo limestone is greater than 270 feet thick in the western portion of Key West. The Key Largo Limestone is

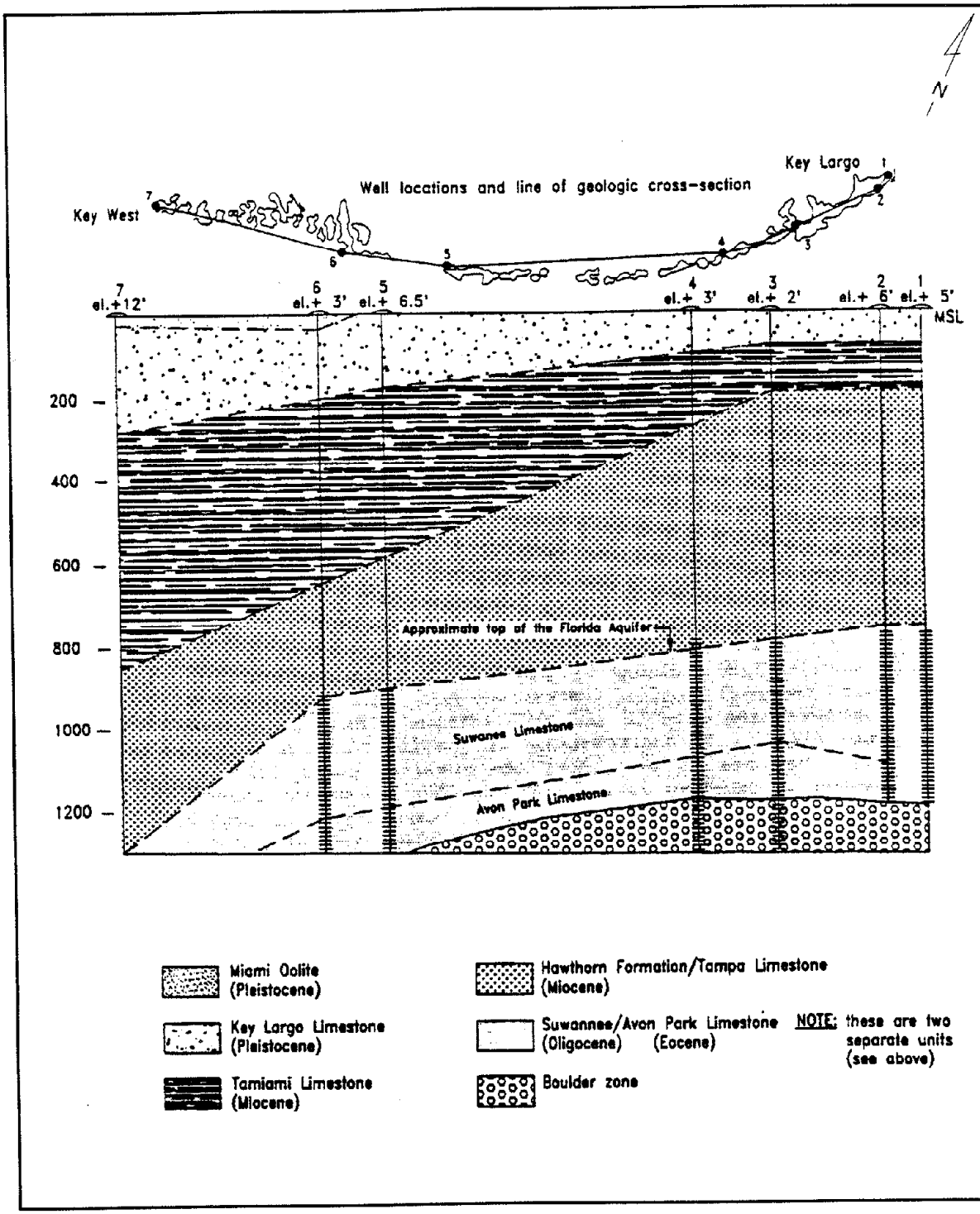
generally more porous than the Miami Oolite, but it contains only saltwater. Figure 1-2 shows a geologic cross-section of the Florida Keys (ABB, 1995).

Undisturbed soil in the Keys consists of shallow marl over limestone with the substrate rock outcropping at the surface. Many areas of the Florida Keys, such as Fleming Key, have been filled and graded. The soils on Boca Chica Key are primarily rockland with some filled areas and mangrove swamps. Other major soil groups on Boca Chica Key consist of gravelly sand and marl, and marl and weathered bedrock (ABB, 1995).

1.4.5 Hydrogeology

The surficial aquifer system that occurs in the lower Keys consists of the Oolitic Member, which is very porous and highly permeable due to the dissolution of carbonate by groundwater as it recharges the aquifer system. The aquifer is tidally controlled and fluctuates constantly. It is extremely porous, and solution holes and caverns are ubiquitous. The Tamiami Formation lies below the Key Largo Limestone unit, between 300 and 900 feet below land surface (bls). The formation contains mineralized water that does not meet Florida drinking water standards. Underlying the Tamiami Formation are the Hawthorn and Tampa Formations, which together act as an aquiclude confining the underlying limestone units. Below the confining units of the Hawthorn and Tampa Formations is the Suwannee Limestone, a fossiliferous limestone representing the top of the water-producing zone in the Florida Keys. The water is of adequate quality for drinking after treatment. The Avon Park Limestone is 1,300 feet bls and, although it has a higher transmissivity than the Suwannee Limestone and supplies large quantities of drinking water in central Florida, is of poor quality in the Florida Keys (ABB, 1995).

The unconfined surficial aquifer consists of the highly permeable, porous, solution-riddled Miami Oolite, which allows recharge from rainfall to seep quickly to the ocean and saltwater to intrude easily to the aquifer. The surficial aquifer is the principal aquifer of concern in Key West because of its reported use as a potable water resource to a limited extent (although not at NAS Key West) and because of its groundwater-to-surface-water contaminant migration route (ABB, 1995). The water table ranges in depths from 0.8 to 2.4 feet below msl at the center of Key West and from 0.4 to 2.2 feet below msl near the coast. The water table fluctuates diurnally because of tidal effects. Head differentials associated with tidal variations near the shore can further accelerate groundwater movement in the area. A reconnaissance water-quality sampling study completed in 1990 by the U.S. Geological Survey in cooperation with the South Florida Water Management District indicates that the freshwater lens contains non-potable water (ABB, 1995). The State of Florida classifies groundwater in unconfined aquifers that have a total



Brown & Root Environmental

0 16 32
SCALE IN MILES (APPROXIMATE)

FIGURE 1-2. GEOLOGIC CROSS-SECTION OF THE FLORIDA KEYS

NAS KEY WEST — KEY WEST, FLORIDA

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dissolved solids content of 10,000 milligrams per liter (mg/L) or greater as Class G-III (non-potable water). No freshwater public or registered domestic wells are in use on NAS Key West (ABB, 1995); however, domestic residences on Boca Chica and Key West are reported to use surfical aquifer wells for non-potable uses such as flushing water. The City Engineer of Key West also reports that water from some of these types of wells might be used for drinking after treatment such as reverse osmosis. The freshwater lens averages 5 feet in thickness below the center of the western half of Key West. The lens contains between 20 and 30 million gallons of fresh water, depending on the season. Underlying the freshwater lens is a 40-foot transition zone of brackish water (ABB, 1995).

1.4.6 Potable Water Supply

Potable water is supplied to all the Florida Keys. The Florida Keys Aqueduct Authority (FKAA) operates and maintains the Florida Keys Aqueduct that supplies potable water to all the Florida Keys. The water is drawn from wells near Florida City in southeastern Dade County and pumped 130 miles through a water main that parallels U.S. Highway No. 1 and terminates in Key West. Water is distributed along the length of the main. In 1984, the FKAA supplied the City of Key West with an average flow of 11.7 million gallons per day (mgd). The Navy received 14.35 percent of the average flow (ABB, 1995). In some instances, potable water is also obtained by rainwater catchment (the only source prior to the construction of the pipeline in the 1940s).

Alternative sources of potable and non-potable water used in the Florida Keys include private cisterns, private wells, home desalination systems, and bottled water. The Monroe County Health Department recognizes the public water supply as the only potable water source available on Key West. In addition to managing the centralized public water supply system, the FKAA has the authority to regulate all potable water supplies in the Keys, including alternative sources of water such as those mentioned above. Those residences using a dual system of private and public water are required to use a reduced-pressure valve to prevent water from back-flowing into the water supply system. The FKAA does, however, report that private wells in the freshwater lens in the Surficial Aquifer may be used for both potable and non-potable purposes (ABB, 1995). The number of people who use water from private wells in Key West for drinking or non-potable domestic purposes is unknown. The best estimate of the number of people using local groundwater for non-potable domestic purposes is less than 500 people (IT Corporation, 1994).

1.4.7 Population and Land Use

The City of Key West has a residential population of 24,832 (USCBS, 1990). The principal industry is tourism with about 1,225,000 tourists visiting annually. The Monroe County population is 78,024, and the

average age is approximately 39 years (USCBS, 1990). The average household size is 2.30 persons. The median cost of housing is $164,000. Key West has five elementary schools, two parochial elementary schools, one public high school, the Florida Keys Community College, and May Sands Exceptional Center. Monroe County has 33 churches, one synagogue, and two Florida Health System Hospitals (east and west). Land use in the City of Key West consists primarily of commercial and residential areas. Boca Chica is almost totally a military-use area.

1.4.8 General Area Ecology

The NAS Key West complex includes areas that have been developed by the Navy and retain little natural resource value; however, undeveloped areas still support high-quality natural communities and provide important habitats for rare species. Five non-marine natural community types have been identified within the NAS Key West study area (FNAI, 1994); each of these is described below. Exotic species such as Brazilian pepper (*Schinus terebinthifolius*) and Australian pine (*Casuarina equisetifolia*) dominate other areas within the complex.

1.4.8.1 Natural Communities

In areas of minimal topographic relief, natural communities often form a continuum that lacks distinct boundaries. As a rule, the boundaries change gradually along some environmental gradient, where dominant species become co-dominant and yield to species better adapted to the new conditions along the gradient. Depending on the species amplitude and ecological tolerances, some plants will range over several distinct community types. Natural communities cover approximately 20 percent of NAS Key West (FNAI, 1994).

1.4.8.1.1 Mangrove Swamp

Approximately 75 percent of the natural communities at NAS Key West can be classified as mangrove swamp, also known as tidal swamp (FNAI, 1994). Four plant species dominate these areas: red mangrove (*Rhizophora mangle*), black mangrove (*Avidennia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood (*Conocarpus erecta*). The relative abundance of each species varies greatly from area to area as do the density, average height, degree of canopy closure, and diversity of associated herbaceous species. Extremes in variation include hyposaline, shallow marl sites supporting 0.5 to 1.5-meter (m)-tall "spider" red mangroves; hypersaline dwarf black mangrove associations; and euryhaline tidal areas on deep peat soils supporting well-developed mixed assemblages of red/black/white

mangroves with closed canopies 10 to 12 m tall and trees with 20-centimeter (cm)-diameters at breast height (DBH)(FNAI, 1994).

Most of the mangrove vegetation at NAS Key West falls well between these extremes. The classic zone pattern of red mangrove to black mangrove to white mangrove to buttonwood along a seaward to landward elevational and salinity gradient is evident in some areas, but absent at others. Mixed mosaics of mangrove species make up the majority of mangrove swamps at NAS Key West, which vary continuously over a given area with regard to dominance.

Many terrestrial and aquatic vertebrate species are associated with mangrove swamp habitats. At least 220 species of fishes, 24 reptile and amphibian species, 18 mammal species, and 181 bird species (guilds include 18 wading birds, 25 probing shore birds, 29 floating and diving water birds, 14 aerially searching birds, 20 birds of prey, and 71 arboreal birds) inhabit mangrove swamp habitats in Florida (Myers and Ewel, 1990).

1.4.8.1.2 Coastal Rock Barren

An estimated 8 to 10 percent of the natural vegetation at NAS Key West can be classified as coastal rock barren (FNAI, 1994). Coastal rock barrens are generally characterized as flat rocklands with much exposed and eroded limestone, sparsely vegetated with stunted, xeric, and halophytic shrubs, cacti, algae, and herbs. Buttonwood in some form often dominates this community. It can vary from bonsai-like sprawling shrubs less than 30 cm in height growing with two or three other stunted halophytes on essentially bare rock pavement to erect, multi-trunked 10-m-tall trees growing on deeper marls and associated with a rich variety of xerophytic shrubs, trees, cacti, graminoids, and forbs. Typical species include saffron plum (*Bumelia celastrina*), Christmas berry (*Lycium carolinana*), cat's claw (*Pithecellobium keyense*), erithalis (*Erithalis fruticosa*), bay cedar (*Suriana maritima*), indigo berry (*Randia aculeata*), wild dilly (*Manilkara bahamensis*), poisonwood (*Metopium toxiferum*), seagrape (*Coccoloba uvifera*), joewood (*Jacquinia keyensis*), rhacoma (*Crossopetalum rhacoma*), Spanish stopper (*Eugenia myrtoides*), saltgrass (*Distichlis spicata*), fimbristylis (*Fimbristylis castanea*), and Porter's broom spurge (*Chamaesyce porteriana var. scoparia*). In these sites, the coastal rock barren becomes a relatively dense thorn scrub thicket of sclerophyllous vegetation that typically includes epiphytic bromeliads and orchids.

At NAS Key West, coastal rock barren occurs in both the open pavement rockland form and in the deeper marl thicket form. A wide range of forms of this community type at NAS Key West supports populations of various vascular plants and vertebrates.

1.4.8.1.3 Rockland Hammock

Rockland hammocks, small patches of closed, broad-leaved forests, contain a large number of evergreen and semievergreen tropical tree species. These hammocks occupy elevated, rarely inundated areas and make up an estimated 10 percent of the natural vegetation on NAS Key West (FNAI, 1994). Rockland hammock exhibits considerable variation in floristics, structural attributes, and relative dominance in canopy and understory composition. The rockland hammocks of the lower Keys are generally two layered forests with a discontinuous emergent canopy of deciduous species and a continuous evergreen canopy. They exhibit no well-defined subcanopy shrub layer or ground flora. Rockland hammock at NAS Key West generally displays a discontinuous emergent layer consisting of dry-season deciduous species such as Jamaica dogwood (*Piscidia piscipula*), poisonwood, or gumbo-lumbo (*Bursera simaruba*). The evergreen continuous canopy layer typically consists of blolly (*Pisonia discolor*), pigeon plum (*Coccoloba diversifolia*), Spanish stopper, white stopper (*Eugenia exillaris*), black ironwood (*Krugiodendron ferrum*), willow bustic (*Dipholis salicifolia*), darling plum (*Reynosia septentrionalis*), wild dilly, brittle thatch palm (*Thrinax morrisii*), torchwood (*Amyris elemifera*), and inkbark (*Exothea paniculata*) (FNAI, 1994).

Rockland hammock offers prime foraging areas for white-crowned pigeon and many wintering and migratory passerines. During the spring and summer, hammocks provide foraging and nesting habitat for black-whiskered vireos and mangrove cuckoos. Hammocks and hammock edges are generally good habitat throughout the year for most of the terrestrial herpetofauna of the lower Keys (FNAI, 1994).

1.4.8.1.4 Coastal Berm

NAS Key West contains several plant communities that can be classified as coastal berm. Approximately 4 percent of the natural plant communities can be classified as coastal berm (FNAI, 1994). Most typically, it occurs along the edges of shallow lagoons and consists of a low shell and marl ridge supporting plant species such as joewood, bay cedar, erithalis, seven-year apple (*Casasia clausiifolia*), sea ox-eye daisy (*Borrichia sp.*), sea grape, and saltgrass, among others (FNAI, 1994).

Another form of the coastal berm community at NAS Key West consists of deep storm-deposited marl and shell ridges integrated into the coastal rock barren community. Typically, these small patches of coastal berm appear as low ridges or hummocks covering the rocky pavement. They support a wide variety of xeric thorn scrub species, particularly saffron plum, cat's claw, poisonwood, buttonwood, sea grape, joewood, prickly pear cactus (*Opuntia stricta*), fimbristylis, and cordgrass (*Spartina spartinae*). These marl/shell deposits support a wide variety of other species, depending on the degree of arboreal development and the actual size of the patch (FNAI, 1994).

As habitat for vertebrates, coastal berm provides suitable foraging habitat for wintering and migratory birds. During periods of spring high tides, coastal berm situated along lagoons provides foraging or short-term roosting habitat for a variety of wading birds. Raccoons (*Procyon lotor*) use this lagoon edge community extensively for foraging.

1.4.8.1.5 Beach Dune

Less than 1 percent of NAS Key West consists of a sandy beach association that can be classified as beach dune (FNAI, 1994). None of these areas have well-developed dunes or dune vegetation. These communities provide potential habitat, albeit of poor quality, for nesting sea turtles and as seasonal foraging areas for several wading bird species. Due to the limited size of the beach areas at NAS Key West, very few vertebrate species would be expected to occur on these areas.

1.4.8.2 Wildlife

As expected, wildlife species at NAS Key West vary considerably depending on habitat. Developed areas of the base limit wildlife species primarily to birds associated with urbanized areas. A variety of species, however, use the relatively undisturbed habitats (particularly mangrove swamps and lagoons).

An 11-month field study observed 126 species of birds at NAS Key West (FNAI, 1994). As many as 300 species of birds might use habitats on the base either as migrants or as residents (Schuetz, 1996). Biologists observed four snake and three lizard species during the Florida Natural Areas Inventory (FNAI) study; the black racer (*Coluber constrictor*), red rat snake (*Elaphe guttata guttata*), Eastern diamondback rattlesnake (*Crotalus adamanteus*), rough green snake (*Opheodrys aestivus*), Florida Keys mole skink (*Eumeces egregius egregius*), Carolina anole (*Anolis carolinensis*), and brown Cuban anole (*A. sagrei*) (FNAI, 1994). Biologists previously observed the endangered Eastern indigo snake (*Drymarchon corais couperi*) (FNAI, 1994); this and other reptiles and amphibians undoubtedly occur on the base.

Very few mammal species occur on NAS Key West and in the lower Florida Keys. Only three native mammal species were observed during the FNAI study: the Lower Keys marsh rabbit, the raccoon, and the opossum (*Didelphis virginianus*) (FNAI, 1994). Raccoons are abundant and widespread on the base, and opossums are uncommon.

Relatively harsh natural ecological conditions in the Keys (i.e., poor soils, scarcity of fresh water) likely ensure a low species diversity of mammals. In addition, humans have extensively altered or destroyed natural habitats, so remaining natural habitats occur in small isolated patches. Exotic species such as

Australian pine have invaded and thus significantly altered many natural areas. Carnivorous mammals at NAS Key West are limited to raccoons and feral cats. No moles and shrews live on the base, and few rodent species occur there. Neither the eastern harvest mouse (*Reithrodontomys humulis*) nor the cotton mouse (*Peromyscus gossypinus*), both common in most of Florida, occur on the base. Native terrestrial mammals on the base appear to be limited to raccoons, marsh rabbits, opossums, and cotton rats (*Sigmodon hispidus*). Silver rice rats (*Oryzomys argentatus*) have been recorded on Saddlebunch Key but not on Boca Chica Key or Key West, in spite of extensive trapping efforts (FNAI, 1994). Three exotic rodents also occur on the base: the Norway rat (*Rattus norvegicus),* black rat (*Rattus rattus*), and house mouse (*Mus musculus*) (Frank, 1996; Schuetz, 1996).

1.4.8.3 Threatened and Endangered Species

Tables 1-1 and 1-2 present Federal and State-listed threatened and endangered species recorded at NAS Key West (FNAI, 1994). A few listed threatened and endangered species not recorded on Tables 1-1 and 1-2 undoubtedly occur on the base but have not been reported to the Florida Natural Areas Inventory (FNAI). For example, several listed sea turtle species occasionally use beaches in the Key West area (IT Corporation, 1994). The Florida tree snail (*Liguus fasciatus*), listed as a Species of Special Concern (SSC) by the Florida Game and Fresh Water Fish Commission (FGFWFC); the Stock Island tree snail (*Orthalicus reses*), listed as endangered by the FGFWFC and threatened by the United States Fish and Wildlife Service (FWS); and the mangrove rivulus (*Rivulus marmoratus*), listed as SSC by FGFWFC, might occur in the area (Deyrup and Franz, 1994; Gilbert, 1992).

B&R Environmental biologists observed several threatened and endangered species during field activities associated with the Supplemental RFI/RI. For example, biologists observed an active bald eagle nest approximately 0.5 mile west of SWMU 5. Wading birds, including little blue herons, snowy egrets, tricolored herons, reddish egrets, and white ibis, were observed foraging in lagoons and ditches. During field activities, biologists observed white crowned pigeons in flight at various locations. Biologists have observed ospreys and recorded three nesting pairs on the base (FNAI, 1994).

1.5 ENVIRONMENTAL RESTORATION BACKGROUND

The EPA and FDEP provide regulatory agency oversight to the Navy environmental restoration program at NAS Key West. All aspects of the program comply with State and Federal regulations as enforced by these regulatory agencies.

TABLE 1-1

THREATENED AND ENDANGERED ANIMAL SPECIES KNOWN TO OCCUR AT NAS KEY WEST (FNAI, 1994) NAS KEY WEST

Common Name	Scientific Name	Designated Status	
		FGFWFC	FWS
Fish			
Key silverside	*Menidia conchorum*	T	-
Reptiles			
Eastern indigo snake	*Drymarchon corais couperi*	T	T
Red rat snake	*Elaphe guttata guttata*	SSC	-
Florida Keys mole skink	*Eumeces egregius egregius*	SSC	-
Birds			
White crowned pigeon	*Columba leucocephala*	T	-
Little blue heron	*Egretta caerulea*	SSC	-
Reddish egret	*Egretta rufescens*	SSC	-
Snowy egret	*Egretta thula*	SSC	-
Tricolored heron	*Egretta tricolor*	SSC	-
White ibis	*Eudocimus albus*	SSC	-
Bald eagle	*Haliaeetus leucocephalus*	T	T
Osprey	*Pandion haliaetus*	SSC	-
Brown pelican	*Pelecanus occidentalis*	SSC	-
Least tern	*Sterna antillarum*	T	-
Mammals			
Silver rice rat	*Oryzomys palustris*	E	E
Lower Keys marsh rabbit	*Sylvilagus palustris hefneri*	E	E
Florida manatee	*Trichechus manatus*	E	E

Notes: E = Endangered.
T = Threatened.
SSC = Species of special concern.
- = Not Listed.
FGFWFC = Florida Game and Fresh Water Fish Commission.
FWS = U.S. Fish and Wildlife Service.

TABLE 1-2

THREATENED AND ENDANGERED PLANT SPECIES KNOWN TO OCCUR AT NAS KEY WEST (FNAI, 1994) NAS KEY WEST

Common Name	Scientific Name	Designated Status	
		FDA	FWS
Blodgett's wild mercury	*Argythamnia blodgettii*	E	-
Locustberry	*Byrsonima Lucida*	E	-
Porter's spurge	*Chamaesyce porteriana*	E	-
Geiger tree	*Cordia sebestena*	E	-
Rhacoma	*Crossopetalum rhacoma*	E	-
Wild cotton	*Gossypium hirsutum*	E	-
Manchineel	*Hippomane mancinella*	E	-
Joewood	*Jacquinia keyensis*	T	-
Bahama brake	*Pteris bahamensis*	E	-
West Indies mahogany	*Swietenia mahogani*	E	-
Brittle thatch palm	*Thrinax morrissi*	E	-
Florida thatch palm	*Thrinax radiata*	E	-
Banded wild pine	*Tillandsia flexuosa*	E	-
Worm-vine orchid	*Vanilla barbellata*	E	-

Notes: E = Endangered.
T = Threatened.
- = Not Listed.
FDA = Florida Department of Agriculture and Consumer Services.
FWS = U.S. Fish and Wildlife Service.

1.5.1 Installation Restoration Program

The Department of Defense (DOD) initiated the IR programs to protect public health and the environment through the investigation and remediation of conditions related to contamination resulting from past waste management and disposal activities. In 1975, the U.S. Army developed a pilot program to investigate past disposal sites at military installations. In 1980, DOD developed the IR program from the Army program and instructed the services to comply with IR program guidelines. The IR program complies with RCRA, Hazardous and Solid Waste Amendments (HSWA), and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) to address AOCs. NAS Key West has operated an active IR program since 1985.

1.5.2 RCRA/HSWA Corrective Action Program

RCRA, which ensures the management of solid and hazardous wastes in an environmentally sound manner, applies to hazardous waste treatment, storage, and disposal (TSD) facilities. RCRA Corrective Action, as mandated by HSWA, is the process by which hazardous waste TSDs are investigated and remediated, where necessary, to address releases of hazardous substances from these RCRA-permitted facilities. The RCRA/HSWA program has four components: the RCRA Facility Assessment (RFA), RFI, Corrective Measures Study (CMS), and Corrective Action.

B&R Environmental prepared a Corrective Action Management Plan (CAMP) to outline the strategy for finalizing completion of the RFI/RI assessment to confirm and characterize the nature and extent of releases of hazardous substances to the environment at NAS Key West (B&R Environmental, 1997). The RCRA/HSWA corrective action program addresses all SWMUs at NAS Key West (designated as "SWMU" sites) except the currently operating units which are regulated by current permit conditions. The Supplemental RFI/RI was conducted pursuant to HSWA Permit No. FL6-170-022-952 and the approved CAMP (B&R Environmental, 1997).

1.5.3 CERCLA Remedial Investigation

In October 1992, ABB Environmental Services, Inc. (ABB) submitted final Documentation Support and Hazard Ranking System Scoring (HRS) II for 12 sites at NAS Key West (ABB, 1992). ABB scored sites on a worst-first basis and continued until a threshold score of 50 or greater was obtained. They calculated a complete HRS II score for the entire NAS Key West and scored one of the individual twelve sites. A

copy of the report was also submitted directly to EPA Region IV. Currently, NAS Key West is not included on the National Priority List.

The Navy implements cleanup activities for the IR Program not addressed by a RCRA/HSWA program in accordance with the National Contingency Plan (NCP) and CERCLA as amended by SARA. CERCLA establishes the approach to address and clean up hazardous waste sites at both private and Federal facilities. These investigations are commonly known as RIs. The CERCLA program applies to sites (designated as "IR" and "AOC" sites) not addressed by the RCRA/HSWA program.

1.6 INVESTIGATIVE HISTORY

Several investigations have been performed at NAS Key West since the mid-1980s to identify, confirm, or delineate contamination at 15 sites identified at NAS Key West. This section summarizes each study and describes interim remedial actions occurring at several sites in 1995 and 1996.

1.6.1 Investigative Activities and Documentation

Based on historical data, aerial photographs, field inspections, and personnel interviews, eight potentially contaminated sites were initially identified at NAS Key West. As part of the Naval Assessment and Control of Installation Pollutants Program (NACIP) (i.e., the Navy's predecessor to the IR program), Envirodyne Engineers, Inc., performed an Initial Assessment Study (IAS) at NAS Key West in 1985 (Envirodyne Engineers, 1985). Envirodyne evaluated each of the eight potentially contaminated sites with regard to contamination characteristics, migration pathways, and pollutant receptors. As a result, they recommended a study to confirm or deny suspected contamination by sampling and monitoring for six of these sites (Note: where applicable, current site designations are shown in parentheses following the site name):

- Site No. 1: Truman Annex Refuse Disposal Area (IR 1)
- Site No. 2: Transformer Oil Disposal Area
- Site No. 3: Truman Annex DDT Mixing Area (IR 3)
- Site No. 4: Boca Chica Open Disposal Area (SWMU 1)
- Site No. 5: Boca Chica DDT Mixing Area (SWMU 2)
- Site No. 8: Fleming Key South Landfill (IR 8)

After the completion of the IAS report, Envirodyne recommended three more sites for investigation based on additional information collected:

- Site No. 7: Fleming Key North Landfill (IR 7)
- Site No. 9: Trumbo Point Bulk Fuel Storage Area
- Site No. 10: Boca Chica Fire-Fighting Training Area (SWMU 3)

Geraghty and Miller performed the verification phase of the IR confirmation study in 1986 (Geraghty & Miller, 1987). This study verified the presence or absence of shallow groundwater and soil contamination at the various sites and recommended additional investigation be undertaken at eight of the sites (i.e., no additional work was recommended for Site No. 2, Transformer Oil Disposal Area) during the characterization phase of the confirmation study.

In April 1988, a visual site inspection conducted by EPA at NAS Key West as part of the RFA process (EPA, 1988) identified the following seven SWMUs at NAS Key West (Note: SWMUs 1 through 3 were previously identified as part of the IAS and verification phase):

- SWMU 1: Boca Chica Open Disposal Area
- SWMU 2: Boca Chica DDT Mixing Area
- SWMU 3: Boca Chica Fire-Fighting Training Area
- SWMU 4: Aircraft Intermediate Maintenance Department (AIMD) Building A-980
- SWMU 5: Boca Chica AIMD Sand Blasting Building A-990
- SWMU 6: Wastewater Treatment Plant
- SWMU 7: Former Hazardous Waste Storage Building A-824

EPA prepared a draft RFA report in 1988 (EPA, 1988) that recommended SWMUs 1 through 6 for an RFI under the HSWA permit. That report recommended that contamination adjacent to the Former Hazardous Waste Storage Building A-824 be addressed as a release from a SWMU rather than as part of the closure of the unit (SWMU 7). The consulting firm of Blasland, Bouck, and Lee (BB&L) performed a cleanup of possible hazardous materials at Building A-824 and the surrounding area in 1991 that involved the removal and off-site treatment and disposal of 26 cubic yards of polychlorinated biphenyl (PCB)-contaminated soil. The building is currently used for storage of empty 55-gallon drums and old transformers and houses a solvent recycling operation.

IT Corporation performed an RI in 1990 to evaluate potential contaminant sources at eight of the NAS Key West sites listed above. The RI assessed risk to the environment and human health and determined the

necessity for remedial actions. IT Corporation prepared a preliminary RI report (IT Corporation, 1991) addressing the following sites:

- SWMU 1: Boca Chica Open Disposal Area
- SWMU 2: Boca Chica DDT Mixing Area
- SWMU 3: Boca Chica Fire-Fighting Training Area
- IR 1: Truman Annex Refuse Disposal Area
- IR 3: Truman Annex DDT Mixing Area
- IR 7: Fleming Key North Landfill
- IR 8: Fleming Key South Landfill
- Site No. 9: Trumbo Point Annex Bulk Fuel Storage Area

After the Preliminary RI was conducted, NAS Key West was issued the current RCRA/HSWA permit (August 30, 1990). The permit identified six SWMUs requiring an RFI. The Wastewater Treatment Plant (SWMU 6) is currently in operation and permitted separately; therefore, it is not included in the RFI/RI program. Three of these SWMUs were previously investigated as IR sites under the IR confirmation study. The Trumbo Point Annex Fuel Farm, one of the IR sites included in the Preliminary RI, was not included in the next investigation since it was being evaluated for remedial action. Therefore, the Navy added two new IR sites and two AOCs to the IR Program investigation along with the three SWMUs not previously investigated. Using the current site designations, Table 1-3 summarizes known or suspected contaminants and site status for the sites identified as requiring investigation at NAS Key West. Figure 1-3 shows the locations of these installation restoration sites.

At the time when the current RCRA/SWA permit was issued, each site was at various stages of the RFI/RI process; therefore, sites were grouped into the following four categories:

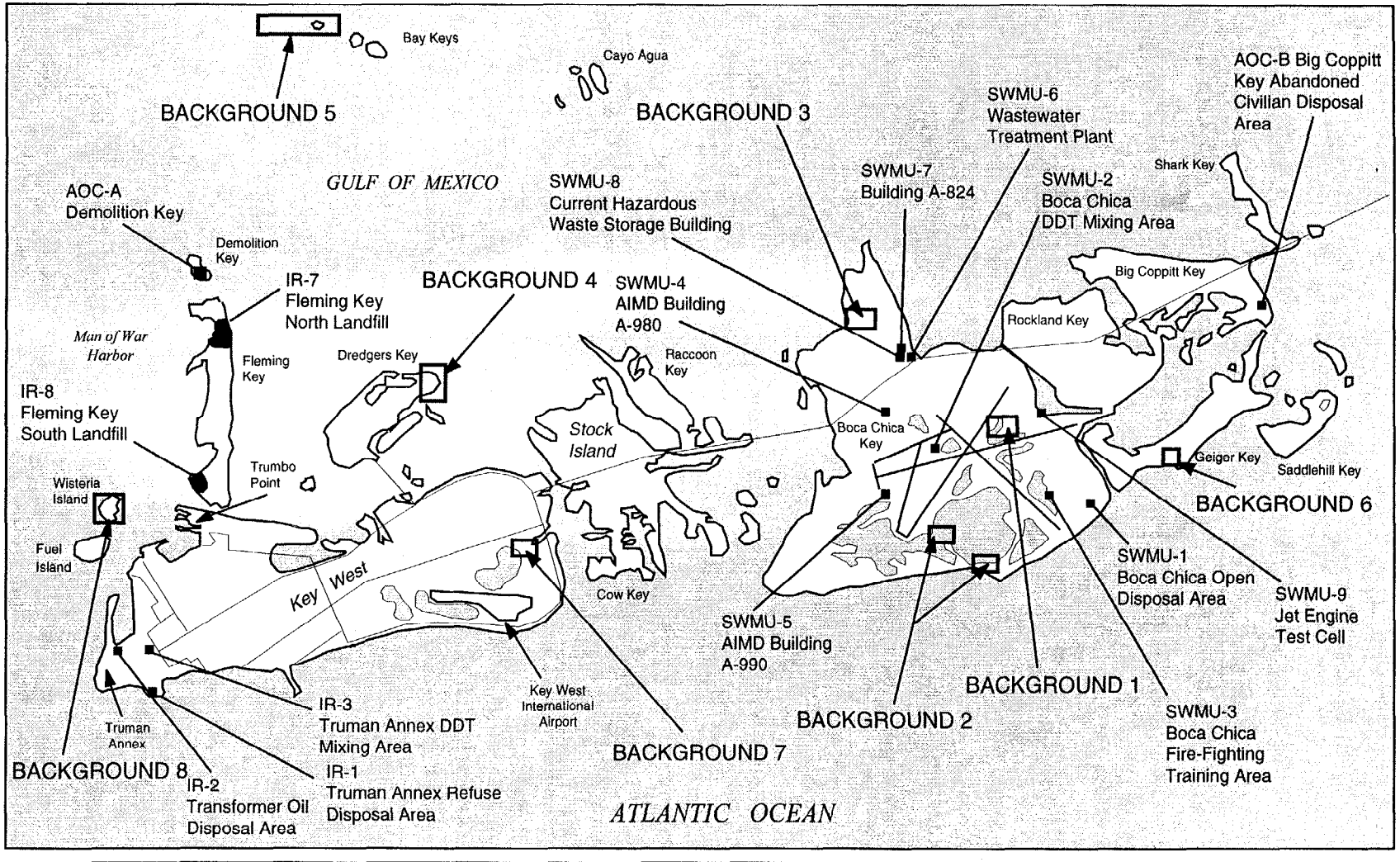
- Sites requiring additional RFI work
  - SWMU 1 - Boca Chica Open Disposal Area
  - SWMU 2 - Boca Chica DDT Mixing Area
  - SWMU 3 - Boca Chica Fire-Fighting Training Area

TABLE 1-3

INSTALLATION RESTORATION PROGRAM SITES
NAS KEY WEST

RCRA Site	Site Name	Known or Suspected Contaminants	Site Status
SWMU 1	Boca Chica Open Disposal Area	Household and construction debris, metals, solvents	IRA and RFI completed in 1996
SWMU 2	Boca Chica DDT Mixing Area Building 915	Pesticides	IRA and RFI completed in 1996
SWMU 3	Boca Chica Fire-Fighting Training Area	Metals, petroleum	IRA and RFI completed late 1995 - 1996
SWMU 4	AIMD Building A-980	Metals, solvents	Currently in RFI
SWMU 5	AIMD Sandblasting Area (by Building A-990)	Metals	Currently in RFI
SWMU 6	Wastewater Treatment Plant		Further investigation not required due to operating permit status
SWMU 7	Former Hazardous Waste Storage Building A-824	PCBs	IRA completed 1995; currently in RFI
SWMU 8	Current Hazardous Waste Storage Building	Solvents	Further investigation not required due to operating permit status
SWMU 9	Jet Engine Test Cell Building A-969	Petroleum, solvents	Interim groundwater cleanup currently operating; RFI completed in 1996
CERCLA Site	**Site Name**	**Known or Suspected Contaminants**	**Site Status**
IR 1	Truman Annex Refuse Disposal Area	Household and construction debris, metals, solvents	IRA completed in early 1996; currently in RI
IR 3	Truman Annex DDT Mixing Area	Pesticides	IRA completed in early 1995; currently in RI
IR 7	Fleming Key North Landfill	Household and construction debris, metals, solvents	IRA completed in early 1995
IR 8	Fleming Key South Landfill	Household and construction debris, metals, solvents	IRA planned for 1997
AOC A	Demolition Key Disposal Open Area	Unexploded ordnance, metals	Further investigation and cleanup suspended pending EPA review of site status
AOC B	Big Coppitt Key Abandoned Civilian Disposal Area	Discarded motor vehicles, metals	IRA completed in 1996

Source: NAS (1996).
Notes: SWMU = Solid Waste Management Unit.
DDT = Dichlorodiphenyltrichloroethane.
AIMD = Aircraft Intermediate Maintenance Department.
PCB = Polychlorinated biphenyl.
IR = Installation Restoration.
AOC = Area of Concern.
RFI = RCRA Facility Investigation.
RI = Remedial Investigation.
IRA = Interim Remedial Action.



Brown & Root Environmental

0 1.5 3.0

Scale in Miles (Approximate)

FIGURE 1-3. NAS KEY WEST
INSTALLATION RESTORATION AND BACKGROUND SITES

NAS KEY WEST — KEY WEST, FLORIDA

DRAWN BY: RAS	SCALE:	DATE: 01/16/98	REV. 2
CHECKEY BY: CB	CONTRACT NO.:	FILE NAME: 7046-23PC-Mod1/R2-RFI/F1-3NASk	

- Sites requiring an RFI
  - SWMU 4 - AIMD Building A-980
  - SWMU 5 - AIMD Building A-990
  - SWMU 7 - Building A-824

- Sites requiring additional RI work
  - IR 1 - Truman Annex Refuse Disposal Area
  - IR 3 - Truman Annex DDT Mixing Area
  - IR 7 - Fleming Key North Landfill
  - IR 8 - Fleming Key South Landfill

- Sites requiring preliminary RI work
  - AOC A - Demolition Key Open Disposal Area
  - AOC B - Big Coppitt Key Abandoned Civilian Disposal Area

Between 1992 and 1994, IT Corporation conducted soil, surface-water, sediment, and groundwater sampling at all 12 of the sites as part of the original RFI/RI sampling program. IT reported these activities in the RFI/RI Final Report (IT Corporation, 1994). In 1995, Bechtel Environmental, Inc. (BEI), the Remedial Action Contractor (RAC) for the installation, began implementing Interim Remedial Actions (IRAs) at some of the sites. Table 1-4 lists the status of IRAs as of March 12, 1997.

Subsequently, in January 1996, B&R Environmental conducted Supplemental RFI/RI investigations at four of the sites:

- SWMU 1: Boca Chica Engine Test Cell, Building A-969
- SWMU 2: Boca Chica DDT Mixing Area
- SWMU 3: Boca Chica Fire-Fighting Training Area
- SWMU 9: Boca Chica Jet Engine Test Cell, Building A-969

The sites covered by the supplemental investigation received a high priority based on the relative risk ranking system used by NAVFACENGCOM - Southern Division. The report also documented the investigation of three Boca Chica-wide background locations.

TABLE 1-4

STATUS OF INTERIM REMEDIAL ACTIONS
NAS KEY WEST

IR Site	Activity Completed	Notes[1]
SWMU 1	6,275 cubic yards (cy) of soil excavated for off-site treatment and disposal	Reduced highest lead concentration from 12,300 ppm to 436 ppm
SWMU 2	1,943 cy of DDT-contaminated soil and sediments excavated for off-site treatment and disposal	Reduced DDT concentration in sediment from 1,400 ppm to 14 ppm
SWMU 3	835 cy of contaminated soil excavated for off-site treatment and disposal	
SWMU 7	26 cy of PCB-contaminated soil excavated for off-site treatment and disposal	
SWMU 9	Groundwater pump and treat system installed early 1996 and is currently operating	3 recovery wells with air stripper and oil/water separator and infiltration gallery
IR-1	4,878 cy of soil excavated for off-site treatment and disposal	Reduced highest lead concentration from 35,200 ppm to 680 ppm
IR-3	735 cy of DDT-contaminated soil excavated for off-site treatment and disposal	Reduced DDT from 60 to 11 ppm in soil
IR-7	Low areas filled/graded to promote runoff and eliminate ponding. Vegetative cover established to prevent erosion.	
IR-8	Subcontract awarded to Ocean Breeze Inc. for beach erosion/shoreline protection system (1,800 linear feet)	Construction scheduled for April - July 1997
AOC-B	993 cy of soil excavated for off-site treatment and disposal	

1 Of the 15 installation restoration sites at NAS Key West, the above IRAs are the only IRAs completed or currently planned. All interim actions have been shown for completeness.

The current Supplemental RFI/RI Report further characterizes the nature and extent of hazardous waste contamination at the following eight sites:

- SWMU 4 - AIMD Building A-980
- SWMU 5 - AIMD Building A-990
- SWMU 7 - Building A-824
- IR 1 - Truman Annex Refuse Disposal Area
- IR 3 - Truman Annex DDT Mixing Area
- IR 7 - Fleming Key North Landfill
- IR 8 - Fleming Key South Landfill
- AOC B - Big Coppitt Key Abandoned Civilian Disposal Area

1.6.2 Interim Remedial Actions

BEI implemented IRAs in 1995 and early 1996 at some NAS Key West sites (BEI 1995). BEI collected many soil, sediment, and surface-water samples before and after excavation, treatment, and disposal activities associated with IRAs at these sites. These data were collected to delineate limits of excavation and to confirm the removal of impacted soils. Table 1-4 provides the status of the IRAs as of March 12, 1997.

1.6.3 Investigation Procedures

This section contains information regarding the field activities conducted during the Supplemental RFI/RI field activities at NAS Key West from August to October 1996 to address the information deficiencies noted by EPA, Region IV and FDEP (see Section 1.1). This section presents an overview of the methods by which B&R Environmental investigated the eight sites. Appendix C describes the procedures and protocols that were used. These procedures and protocols were performed in accordance with the Supplemental RFI/RI Workplan (ABB, 1995), which presents the proposed investigation methods and sampling summaries for 12 sites requiring characterization at NAS Key West. B&R Environmental conducted field sampling and risk assessments for four sites (SWMUs 1, 2, 3, and 9) early in 1996 (B&R Environmental, 1997).

B&R Environmental assessed and evaluated all data collected as part of the second phase of the Supplemental RFI/RI program upon completion of the field program. These data were used to develop recommendations and conclusions about the nature and extent of potential releases of hazardous waste

or constituents from each of the sites presented in Chapters 2 through 9. If needed, these data will be used to support a CMS or an FS.

1.6.3.1 Overview of Sampling Conducted and Investigation Procedures

This section presents an overview of the sampling and investigation procedures B&R Environmental used during this Supplemental RFI/RI to investigate and report on SWMUs 4, 5, and 7; IRs 1, 3, 7, and 8; and AOC B. NAVFACENGCOM-Southern Division ranked the sites in priority by their relative risk.

1.6.3.2 Sampling Conducted

In August 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 three SWMUs, four IRs, one AOC, and five background locations. Field activities were conducted during August, September, and October 1996. The RFI/RI included surface soil sampling; subsurface soil sampling; groundwater well installation and sampling; and surface-water, sediment, vegetation, fish, mollusk, and crustacean sampling. Table 1-5 lists all non-biota samples collected as part of this investigation. Chemical analyses of samples were conducted by subcontracted laboratories. All metal analyses in aqueous samples measured total metals. In addition, a subcontractor under B&R Environmental oversight conducted drilling activities. B&R Environmental personnel conducted land surveys of well installation locations. B&R Environmental subsequently performed a limited validation of the analytical data and organized the data into summary reports.

The Supplemental RFI/RI SAP includes the installation of 15 new shallow monitoring wells; the collection of surface soil (0 to 1 foot), sediment, and surface-water samples; and the sampling of groundwater from several existing and newly installed monitoring wells. In addition, surface soil, sediment, surface-water, and biological samples were obtained from five background locations. Table 1-6 provides depths and screen intervals for all monitoring wells installed during the 1996 Supplemental RFI/RI, as well as for all wells installed at the eight sites during previous investigations (where data was available).

Background conditions were characterized by samples collected and analyzed in previous studies and by the analyses of samples collected by B&R Environmental during January 1996, as well as during this investigation. The background data set consisted of samples collected from site-specific locations and from eight locations chosen to represent the Key West area as a whole. Section 1.6.6 further summarizes the determination of background levels, and Appendix F (Background Report) contains additional details regarding the background data set.

TABLE 1-5

SAMPLE SUMMARY FIELD WORK
NAS KEY WEST
PAGE 1 OF 6

Sample ID	Duplicate Location*	Media	Date	VOC	SVOC	Pest./PCB	Herb.	TAL Metals	Cyanide
ABDPSS	**ABSS-1**	sediment	9/17/96			x	x	x	x
ABSS-06	NA	sediment	10/2/96			x	x	x	x
ABSS-1	NA	sediment	9/17/96			x	x	x	x
ABSS-10	NA	sediment	10/2/96			x	x	x	x
ABSS-2	NA	sediment	9/17/96			x	x	x	x
ABSS-3	NA	sediment	9/17/96			x	x	x	x
ABSS-4	NA	sediment	9/17/96			x	x	x	x
ABSS-5	NA	sediment	9/17/96			x	x	x	x
ABSS-7	NA	sediment	9/17/96			x	x	x	x
ABSS-8	NA	sediment	9/17/96			x	x	x	x
ABSS-9	NA	sediment	9/17/96			x	x	x	x
B4SD-01	NA	sediment	9/16/96	x	x	x	x	x	x
B4SD-02	NA	sediment	9/16/96	x	x	x	x	x	x
B5SD-01	NA	sediment	9/16/96	602	610	x	x	x	x
B6SS	NA	sediment	10/5/96	602	610	x	x	x	x
B7SS-01	NA	sediment	9/27/96	602	610	x	x	x	x
B7SS-02	NA	sediment	9/27/96	602	610	x	x	x	x
B8SS	NA	sediment	10/4/96	602	610	x	x	x	x
I1DPSS	**I1SS-1**	sediment	9/17/96		610	x	x	x	x
I1SS-1	NA	sediment	9/17/96		610	x	x	x	x
I1SS-2	NA	sediment	9/17/96		610	x	x	x	x
I1SS-3	NA	sediment	9/17/96		610	x	x	x	x
I1SS-4	NA	sediment	9/17/96		610	x	x	x	x
I1SS-5	NA	sediment	9/17/96		610	x	x	x	x
I1SS-6	NA	sediment	9/17/96		610	x	x	x	x
I1SS-7	NA	sediment	9/17/96		610	x	x	x	x
I7DPSS	**I7SS-4**	sediment	9/30/96			x	x	x	x
I7SS-01	NA	sediment	9/30/96			x	x	x	x
I7SS-02	NA	sediment	9/30/96			x	x	x	x
I7SS-03	NA	sediment	9/30/96			x	x	x	x
I7SS-04	NA	sediment	9/30/96			x	x	x	x
I7SS-05	NA	sediment	9/30/96			x	x	x	x
I7SS-06	NA	sediment	9/30/96			x	x	x	x
I7SS-07	NA	sediment	9/30/96			x	x	x	x
I7SS-08	NA	sediment	9/30/96			x	x	x	x
I7SS-09	NA	sediment	9/30/96			x	x	x	x
I7SS-10	NA	sediment	9/30/96			x	x	x	x

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SAMPLE SUMMARY FIELD WORK
NAS KEY WEST
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Sample ID	Duplicate Location*	Media	Date	VOC	SVOC	Pest./PCB	Herb.	TAL Metals	Cyanide
I8DPSS-01	**I8SS-3**	sediment	8/18/96			x	x	x	
I8SS-1	NA	sediment	8/18/96			x	x	x	
I8SS-10	NA	sediment	8/18/96			x	x	x	
I8SS-2	NA	sediment	8/18/96			x	x	x	
I8SS-3	NA	sediment	8/18/96			x	x	x	
I8SS-4	NA	sediment	8/18/96			x	x	x	
I8SS-5	NA	sediment	8/18/96			x	x	x	
I8SS-6	NA	sediment	8/18/96			x	x	x	
I8SS-7	NA	sediment	8/18/96			x	x	x	
I8SS-8	NA	sediment	8/18/96			x	x	x	
I8SS-9	NA	sediment	8/18/96			x	x	x	
S4DPSS	**S4SS-7**	sediment	9/29/96	x	x			x	x
S4SS-4	NA	sediment	9/29/96	x	x			x	x
S4SS-5	NA	sediment	9/29/96	x	x			x	x
S4SS-6	NA	sediment	9/29/96	x	x			x	x
S4SS-7	NA	sediment	9/29/96	x	x			x	x
S5DPSS	**S5SS-5**	sediment	9/29/96	x	x			x	x
S5SS-3	NA	sediment	9/29/96	x	x			x	x
S5SS-4	NA	sediment	9/29/96	x	x			x	x
S5SS-5	NA	sediment	9/29/96	x	x			x	x
S5SS-6	NA	sediment	9/29/96	x	x			x	x
S7DPSS	**S7SS-5**	sediment	10/1/96		x	x	x	x	x
S7SS-04	NA	sediment	10/1/96		x	x	x	x	x
S7SS-05	NA	sediment	10/1/96		x	x	x	x	x
S7SS-06	NA	sediment	10/1/96		x	x	x	x	x
S7SS-07	NA	sediment	10/1/96		x	x	x	x	x
S7SS-08	NA	sediment	10/1/96		x	x	x	x	x
B4SB	NA	soil	10/4/96	602	610	x	x	x	x
B6SB	NA	soil	10/4/96	602	610	x	x	x	x
B7SB	NA	soil	10/4/96	602	610	x	x	x	x
B8SB	NA	soil	10/4/96	602	610	x	x	x	x
I3SB-1	NA	soil	10/3/96			x	x	x	
I3SB-2	NA	soil	10/3/96			x	x	x	
I8SB-4	NA	soil	8/20/96			x	x		
I8SB-5	NA	soil	8/20/96			x	x		
I8SB-6	NA	soil	8/20/96			x	x		
I8SB-7	NA	soil	8/20/96			x	x		

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SAMPLE SUMMARY FIELD WORK
NAS KEY WEST
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Sample ID	Duplicate Location*	Media	Date	VOC	SVOC	Pest./PCB	Herb.	TAL Metals	Cyanide
S4SB-1	NA	soil	10/4/96	x	x	x	x	x	x
S4SB-2	NA	soil	10/4/96	x	x	x	x	x	x
S5SB-1	NA	soil	10/4/96					x	
S7DPSB	**S7SB-23**	soil	10/4/96	x	x	x	x	x	x
S7SB-21	NA	soil	10/4/96	x	x	x	x	x	x
S7SB-22	NA	soil	10/4/96	x	x	x	x	x	x
S7SB-23	NA	soil	10/4/96	x	x	x	x	x	x
S7SB-24	NA	soil	10/4/96	x	x	x	x	x	x
ABDPGW	**ABMW-1**	water	10/3/96	602	610	x	x	x	x
ABMW-1	NA	water	10/3/96	602	610	x	x	x	x
ABMW-2	NA	water	10/3/96	602	610	x	x	x	x
ABMW-3	NA	water	10/3/96	602	610	x	x	x	x
ABSW-06	NA	water	10/2/96			x	x	x	x
ABSW-1	NA	water	9/14/96			x	x	x	x
ABSW-10	NA	water	10/2/96			x	x	x	x
ABSW-2	NA	water	9/14/96			x	x	x	x
ABSW-3	NA	water	9/14/96			x	x	x	x
ABSW-4	NA	water	9/14/96			x	x	x	x
ABSW-5	NA	water	9/14/96			x	x	x	x
ABSW-7	NA	water	9/14/96			x	x	x	x
ABSW-8	NA	water	9/14/96			x	x	x	x
ABSW-9	NA	water	9/14/96			x	x	x	x
B4SW	NA	water	9/16/96	602	610	x	x	x	x
B5SW	NA	water	9/16/96	602	610	x	x	x	x
B6SW	NA	water	10/5/96	602	610	x	x	x	x
B7SS-01	NA	sediment	9/27/96	602	610	x	x	x	x
B7SW-01	NA	water	9/27/96	602	610	x	x	x	x
FB01-082096	NA	qc water	8/20/96	x	x	x	x	x	x
FB03-091896**	NA	qc water	9/18/96	x	x	x	x	x	x
FB04-091896	NA	qc water	9/18/96	x	x	x	x	x	x
FB05-092796	NA	qc water	9/27/96	x	x	x	x	x	x
I1DPGW	**I1MW-3**	water	9/13/96			x	x	x	x
I1DPGW-2	**I1MW-7**	water	9/16/96			x	x	x	x
I1KMW-01	NA	water	9/14/96			x	x	x	x
I1KMW-02	NA	water	9/13/96			x	x	x	x
I1KMW-03	NA	water	9/12/96			x	x	x	x
I1MW-1	NA	water	9/12/96			x	x	x	x

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SAMPLE SUMMARY FIELD WORK
NAS KEY WEST
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Sample ID	Duplicate Location*	Media	Date	VOC	SVOC	Pest./PCB	Herb.	TAL Metals	Cyanide
I1MW-3	NA	water	9/12/96			x	x	x	x
I1MW-5	NA	water	9/13/96			x	x	x	x
I1MW-6	NA	water	9/12/96			x	x	x	x
I1MW-7	NA	water	9/16/96			x	x	x	x
I1MW1-1	NA	water	9/12/96			x	x	x	x
I1MW1-2	NA	water	9/13/96			x	x	x	x
I1MW1-3	NA	water	9/13/96			x	x	x	x
I3DPGW	**I3MW-4**	water	9/28/96			x	x	x	
I3MW-3	NA	water	10/2/96			x	x	x	
I3MW-4	NA	water	9/28/96			x	x	x	
I3MW-5	NA	water	9/27/96			x	x	x	
I3MW-6	NA	water	9/28/96			x	x	x	
I3MW-7	NA	water	9/27/96			x	x	x	
I7DPGW	**I7MW7-3**	water	9/11/96			x	x	x	x
I7KWM-12	NA	water	9/11/96			x	x	x	x
I7MW-1	NA	water	9/10/96			x	x	x	x
I7MW7-1	NA	water	9/11/96			x	x	x	x
I7MW7-10	NA	water	9/10/96			x	x	x	x
I7MW7-2	NA	water	9/10/96			x	x	x	x
I7MW7-3	NA	water	9/11/96			x	x	x	x
I7MW7-4	NA	water	9/10/96			x	x	x	x
I7MW7-5	NA	water	9/10/96			x	x	x	x
I7MW7-6	NA	water	9/11/96			x	x	x	x
I8DPGW-01	**I8MW8-3**	water	8/12/96			x	x	x	
I8KMW-15	NA	water	8/11/96			x	x	x	
I8KWM-13R	NA	water	8/12/96			x	x	x	
I8KWM-16R	NA	water	8/11/96			x	x	x	
I8KWM-14	NA	water	8/11/96			x	x	x	
I8MW8-1	NA	water	8/12/96			x	x	x	
I8MW8-2	NA	water	8/12/96			x	x	x	
I8MW8-3	NA	water	8/12/96			x	x	x	
I8MW8-4	NA	water	8/12/96			x	x	x	
I8MW8-5	NA	water	8/11/96			x	x	x	
I8MW8-6	NA	water	8/12/96			x	x	x	
RB01-080996	NA	qc water	8/9/96	x	x	x	x	x	x
RB02-081996	NA	qc water	8/19/96	x	x	x	x	x	x
RB03-091896	NA	qc water	9/18/96	x	x	x	x	x	x

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SAMPLE SUMMARY FIELD WORK
NAS KEY WEST
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Sample ID	Duplicate Location*	Media	Date	VOC	SVOC	Pest./PCB	Herb.	TAL Metals	Cyanide
RB04-092896	NA	qc water	9/28/96	x	x	x	x	x	x
RB05-092896	NA	qc water	9/28/96	x	x	x	x	x	x
RB06-092996	NA	qc water	9/29/96	x	x	x	x	x	x
RB07-100196	NA	qc water	10/1/96	x	x	x	x	x	x
RB08-100396	NA	qc water	10/3/96	x	x	x	x	x	x
RB09-100796	NA	qc water	10/7/96	x	x	x	x	x	x
S4DPGW	**S4MW-3**	water	9/29/96	x	x			x	x
S4DPSW	**S4SW-1**	water	9/15/96	x	x	x	x	x	x
S4MW-2	NA	water	9/29/96	x	x			x	x
S4MW-3	NA	water	9/29/96	x	x			x	x
S4MW-4	NA	water	9/28/96	x	x			x	x
S4MW-5	NA	water	9/28/96	x	x			x	x
S4MW-6	NA	water	9/28/96	x	x			x	x
S4MW-7	NA	water	9/28/96	x	x			x	x
S4SW-1	NA	water	9/15/96	x	x			x	x
S4SW-2	NA	water	9/15/96	x	x			x	x
S4SW-3	NA	water	9/15/96	x	x			x	x
S4SW-4	NA	water	9/16/96	x	x			x	x
S5DPGW	**S5MW-3**	water	9/30/96	x	x			x	x
S5DPSW	**S5SW-5**	water	9/18/96	x	x			x	x
S5MW-2	NA	water	9/30/96	x	x			x	x
S5MW-3	NA	water	9/30/96	x	x			x	x
S5MW-4	NA	water	9/30/96	x	x			x	x
S5MW-5	NA	water	9/30/96	x	x			x	x
S5SW-3	NA	water	9/18/96	x	x			x	x
S5SW-4	NA	water	9/18/96	x	x			x	x
S5SW-5	NA	water	9/18/96	x	x			x	x
S5SW-6	NA	water	9/28/96	x	x			x	x
S7MW-1	NA	water	10/1/96			x	x	x	x
S7MW-2	NA	water	10/1/96			x	x	x	x
S7MW-3	NA	water	10/1/96			x	x	x	x
S7SW-04	NA	water	10/1/96		x	x	x	x	x
S7SW-05	NA	water	10/1/96		x	x	x	x	x
S7SW-06	NA	water	10/1/96		x	x	x	x	x
S7SW-07	NA	water	10/1/96		x	x	x	x	x
S7SW-08	NA	water	10/1/96		x	x	x	x	x
TB01-081296	NA	qc water	8/7/96	x					

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SAMPLE SUMMARY FIELD WORK
NAS KEY WEST
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Sample ID	Duplicate Location*	Media	Date	VOC	SVOC	Pest./PCB	Herb.	TAL Metals	Cyanide
TB02-082096	NA	qc water	8/7/96	x					
TB03-091696	NA	qc water	9/9/96	x					
TB04-091796	NA	qc water	9/9/96	x					
TB05-091896	NA	qc water	9/18/96	x					
TB06-092796	NA	qc water	9/26/96	x					
TB07-093096	NA	qc water	9/26/96	x					
TB08-100196	NA	qc water	9/26/96	x					
TB09-100596	NA	qc water	10/5/96	x					
TB10-100796	NA	qc water	10/7/96	x					

Note: Bold sample ID indicate duplicate samples.
*Duplicate samples will not be discussed further in the site-specific chapters. All duplicate results were averaged with the results from the original sample, as discussed in Appendix C. The single set of calculated average values is used for all further analysis and discussion relating to a sample location where duplicates were collected, and is identified with the original sample ID/location.
VOC analyses Appendix IX 8260 unless otherwise noted.
SVOC analyses Appendix IX 8270 unless otherwise noted.
Pesticide/PCB analyses Appendix IX 8080.
Herbicide analyses Appendix IX 8150.
TAL Metal analyses ILMO 3.0.
Cyanide analyses ILMO 3.0.
602 = EPA Method 602 for VOC analyses.
610 = EPA Method 610 for SVOC analyses.
qc water = quality control water sample.
**Sequence broken; no FB02 taken during field effort.
NA = Not Applicable.

Additional Note: Information on the locations of the samples can be found in the site-specific chapters (Chapters 2 through 9) and Appendix C of this report. Appendix C and Chapters 2 through 9 also provide detailed discussions of the biota sampling that was performed during this Supplemental RFI/RI.

TABLE 1-6

MONITORING WELL DEPTHS AND SCREEN INTERVALS
NAS KEY WEST
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1986 G & M Monitoring Well Number	Total Depth (ft bls)	Length of Screen (ft)	Screened Interval (ft bls)	Screened Interval[a] (ft msl)	Measuring Point Elevation (ft msl)
IR 1					
I1KWM-01	18.0	5.0	13.0 to 18.0	(4.96) to (9.96)	8.04
I1KWM-02	18.0	5.0	13.0 to 18.0	(4.96) to (9.96)	7.55
I1KWM-03	18.0	5.0	13.0 to 18.0	(4.96) to (9.96)	7.59
I1KWM-04	18.0	5.0	13.0 to 18.0	(4.96) to (9.96)	8.87
IR 7					
I7KWM-09	10.0	5.0	5.0 to 10.0	(2.39) to (7.39)	5.61
I7KWM-10	12.0	5.0	7.0 to 12.0	(2.82) to (7.82)	7.18
I7KWM-11	12.0	5.0	7.0 to 12.0	(2.82) to (7.82)	6.27
I7KWM-12	9.5	5.0	4.5 to 9.5	(3.81) to (8.81)	3.69
IR 8					
I8KWM-13	14.0	5.0	9.0 to 14.0	(3.15) to (8.15)	8.85
I8KWM-14	12.0	5.0	7.0 to 12.0	1.51 to (3.49)	11.51
I8KWM-15	13.0	5.0	8.0 to13.0	(2.09) to (7.09)	8.09
I8KWM-16	12.5	5.0	7.5 to 12.5	(2.52) to (7.52)	7.98
I8KWM-17	22.0	5.0	17.0 to 22.0	(5.12) to (10.12)	14.88

1990 IT Monitoring Well Number	Total Depth (ft bls)	Length of Screen (ft)	Screened Interval[a] (ft bls)	Screened Interval (ft msl)	Measuring Point Elevation (ft msl)
IR 1					
I1MW 1-1	15.5	12.5	3.0 to 15.5	5.57 to (6.93)	11.57
I1MW 1-2	15.5	12.5	3.0 to 15.5	3.31 to (9.19)	9.31
I1MW 1-3	14.0	10.0	4.0 to 14.0	3.61 to (6.39)	10.61
IR 7					
I7MW7-1	17.0	15.0	2.0 to 17.0	2.03 to (12.97)	7.03
I7MW7-2	17.0	15.0	2.0 to 17.0	3.06 to (11.94)	8.06
I7MW7-3	20.0	17.5	2.5 to 20	(1.19) to (18.69)	4.31
I7MW7-4	18.0	15.0	3.0 to 18.0	4.05 to (10.95)	10.05
I7MW7-5	18.0	15.0	3.0 to 18.0	4.12 to (10.88)	9.12
I7MW7-6	17.0	15.0	2.0 to 17.0	2.15 to (12.85)	7.15
IR 8					
I8MW-1	18.0	15.0	3.0 to 18.0	7.56 to (7.44)	13.56
I8MW-2	17.0	15.0	2.0 to 17.0	0.64 to (14.36)	5.64
I8MW-3	18.5	14.0	4.5 to 18.5	3.22 to (10.78)	10.72
I8MW-4	25.0	20.0	5.0 to 25.0	4.50 to (15.50)	12.50
I8MW-5	18.5	15.0	3.5 to 18.5	3.05 to (12.45)	9.05
I8MW-6	18.0	15.0	3.0 to 18.0	3.36 to (11.64)	9.36
I8KWM-16R	18.0	15	3.0 to 18.0	2.09 to (12.91)	8.09

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MONITORING WELL DEPTHS AND SCREEN INTERVALS
NAS KEY WEST
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1994 IT Monitoring Well Number[c]	Total Depth (ft bls)	Length of Screen (ft)	Screened Interval (ft bls)	Screened Interval[a] (ft msl)	Measuring Point Elevation[b] (ft msl)
SWMU-4					
S4MW-2	13.0	10.0	3.0 to 13.0	2.62 to (7.38)	5.27
S4MW-3	12.0	10.0	2.0 to 12.0	3.32 to (6.68)	5.28
SWMU-5					
S5MW-2	13.5	10.0	2.0 to 12.0	1.77 to (8.23)	3.53
S5MW-3	13.5	10.0	2.0 to 12.0	1.82 to (8.18)	3.68
SWMU-7					
S7MW-1	11.0	10.0	1.0 to 11.0	3.38 to (6.62)	7.49
S7MW-2	11.0	10.0	1.0 to 11.0	3.86 to (6.14)	7.59
S7MW-3	11.0	10.0	1.0 to 11.0	3.84 to (6.16)	7.80
IR 1					
I1MW-1	15.5	10.0	5.5 to 15.5	2.40 to (7.60)	10.35
I1MW-2					9.74
I1MW-3	17.0	10.0	7.0 to 17.0	2.27 to (7.60)	9.75
I1MW-5	14.0	10.0	4.0 to 14.0	4.16 to (5.84)	12.77
IR 7					
I7MW-3[d]	11.0	NA	NA	NA	NA
I7MW-4[d]	7.0	NA	NA	NA	NA
I7MW-5[d]	9.0	NA	NA	NA	NA
I7MW-10[d]	9.0	NA	NA	NA	NA
I7MW-1	17.0	NA	NA	NA	7.44
I7MW7-10	12.5	NA	NA	NA	7.02

1996 B&RE Monitoring Well Number	Total Depth (ft bls)	Length of Screen (ft)	Screened Interval (ft bls)	Screened Interval[a] (ft msl)	Measuring Point Elevation[b] (ft msl)
SWMU 4					
S4MW-4	14.0	10.0	4.0 to 14.0	1.54 to (8.46)	5.46
S4MW-5	13.0	10.0	3.0 to 13.0	1.71 to (8.29)	7.58
S4MW-6	13.0	10.0	3.0 to 13.0	2.21 to (7.79)	8.05
S4MW-7	12.0	10.0	2.0 to 12.0	3.38 to (6.62)	5.25
SWMU 5					
S5MW-3	13.0	10.0	3.0 to 13.0	0.85 to (9.15)	3.67
S5MW-4	13.0	10.0	3.0 to 13.0	1.0 to (9.0)	7.25
IR 1					
I1MW-6	18.0	10.0	8.0 to 18.0	3.24 to (6.76)	14.89
I1MW-7	18.0	10.0	8.0 to 18.0	1.43 to (8.57)	9.24
IR 3					
I3MW-3	12.5	10.0	2.5 to 12.5	3.28 to (6.72)	5.71
I3MW-4	14.0	10.0	4.0 to 14.0	3.22 to (6.78)	7.04
I3MW-5	14.0	10.0	4.0 to 14.0	2.87 to (7.13)	6.71

TABLE 1-6

MONITORING WELL DEPTHS AND SCREEN INTERVALS
NAS KEY WEST
PAGE 3 OF 3

1996 B&RE Monitoring Well Number	Total Depth (ft bls)	Length of Screen (ft)	Screened Interval (ft bls)	Screened Interval[a] (ft msl)	Measuring Point Elevation[b] (ft msl)
IR 3 (continued)					
I3MW-6	14.0	10.0	4.0 to 14.0	3.12 to (6.88)	7.24
I3MW-7	13.0	10.0	3.0 to 13.0	4.15 to (5.85)	7.11
AOC B					
ABMW-1	12.0	10.0	2.0 to 12.0	(0.36) to (10.36)	4.73
ABMW-2	12.0	10.0	2.0 to 12.0	(0.45) to (10.45)	4.49
ABMW-3	12.0	10.0	2.0 to 12.0	(0.93) to (10.93)	3.96

a Calculated values extrapolated from existing data.
b B&R Environmental 1996 Survey Data.
c Temporary well construction data not available for IR 8.
d Temporary well construction data.

NA - Not Available.

Before biological tissue samples were collected for chemical analyses as part of this Supplemental RFI/RI, biological samples had only been collected during the January 1996 Supplemental RFI/RI sampling at NAS Key West. The objective of the supplemental biological field investigations during August through October was to characterize the nature and extent of contamination in biota at SWMUs 4, 5, and 7; IRs 1, 3, 7, and 8; and AOC B, and to assess ecological effects of site-associated contamination. B&R Environmental initiated the biological investigation with a detailed review of existing analytical chemistry data and a review of the results of the preliminary ecological risk evaluation performed by IT Corporation. Following these reviews, B&R Environmental biologists visited the sites and determined the need for additional biological sampling at each site based on the results of this process.

Biologists collected fish tissue samples from SWMUs 4 and 5 and AOC B and collected mollusks (conchs) from IRs 1, 7, and 8. Crustaceans (crabs and/or lobsters) were collected from IRs 1, 7, and 8 and AOC B, and vegetation sampled at all sites except AOC B. The procedures followed those outlined in an Ecological Sampling Technical Memorandum (Appendix B, Part 1) as summarized in the marine organism collection report submitted to FDEP (Appendix B, Part 2). Appendix C describes detailed procedures regarding biological sampling. Chapters 2 through 9 discuss the location of the soil, sediment, surface-water, groundwater, vegetation, fish, mollusk, and crustacean samples obtained from each site during the investigation.

1.6.3.3 Investigation Procedures

The Supplemental RFI/RI workplan (ABB, 1995), which was prepared in response to regulatory concerns over data gaps in the initial RFI/RI report (IT Corporation, 1994), contains field investigation and risk assessment procedures. The ABB workplan refers to procedures contained in the RFI/RI workplan prepared by IT Corporation (IT Corporation, 1993) for the initial RFI/RI. In some instances, the ABB workplan and the IT workplan presented conflicting procedural information. In other instances, procedures were not identified. Procedures developed for the Supplemental RFI/RI resolved conflicts between the two workplaces and filled any voids. Appendix C presents these procedures, and Appendix D contains procedures that required modifications or deviations to the ABB workplan and SAP (ABB, 1995) during the implementation of field work under the Supplemental RFI/RI.

1.6.3.4 Data Quality Assessment

Section 2.0 of Appendix C describes the industry-accepted process used to partially validate the data obtained from field sampling at the eight sites. All 1996 data received a limited validation review; approximately 10 percent of the data received full validation. Historical data (Section 1.6.1 describes

previous investigations) were not subjected to data quality assessment by B&R Environmental. They were assumed to have been assessed during their respective investigation activities and were accepted at face value since records of validation were not available. While this assumption might not have been correct for all historical data points, it is conservative. Questionable historical data points in the data set (data that otherwise might have been discarded as false positives or blank contamination if they had undergone a data quality assessment) only increase the potential for making a positive remedial determination for a particular site.

1.6.3.5 Data Interpretation and Presentation

This section summarizes the data interpretation and presentation process employed for data obtained from the eight sites. B&R Environmental integrated data from previous investigations (see Section 1.6.1) with the current data set to create a comprehensive data set and used this comprehensive data set in the evaluations and assessments presented in this RFI/RI report. Section 3.0 of Appendix C provides additional details about the data interpretation and presentation process.

1.6.3.6 Data from Analytical Results

Chapters 2 through 9 of this report present the results of this Supplemental RFI/RI for the eight sites. Each chapter discusses the specific site and presents the contaminants detected at the site, the spatial and (if applicable) temporal extent to which contaminants have impacted environmental media, and a relationship between the findings and the activities that occurred during base operations. All of the detected contaminants were compared to ARARs, SALs, and background concentrations for each medium. Appendix C lists the values for comparison and describes the process. Section 3.1 in Appendix C also contains detailed information on data interpretation for use in estimating the nature and extent of contamination, evaluating chemical fate and transport, and calculating risk to human health and the environment. Estimating the nature and extent of contamination and evaluating chemical fate and transport provide critical information for use in both the human health and ecological risk assessments.

1.6.4 Human Health Risk Assessment

The human health risk assessment (HHRA) estimated actual or potential risks to human health from the presence of contamination in surface soil, subsurface soil, sediment, groundwater, surface water, and appropriate biological organisms and provided the basis for determining the need for remedial measures. Three major aspects of chemical contamination must be considered when assessing public health risks: contaminants with toxic characteristics must be found in environmental media or biological organisms and

must be released by either natural processes or by human action; potential exposure points must exist either at the source or via migration pathways if exposure occurs at a remote location other than the source; and human or environmental receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure; without any one of the three factors listed above, there is no risk.

The risk assessment estimated the potential for human health risk attributable to each NAS Key West site addressed in this report. Information regarding the toxicity of the compounds detected in the various media, the distribution of contamination, potential migration pathways, and a site-specific estimate of chemical intake via assumed exposure routes were combined to estimate potential risks for each of the sites. The risk assessment processes were performed in accordance with current EPA risk assessment guidance (EPA, 1989; EPA, 1991; EPA, 1995a) and as also referenced in the Supplemental RFI/RI Workplan (ABB, 1995). Appendix C, Section 3.2 includes detailed procedures for the risk assessment processes. Chapters 2 through 9 provide the results of the Baseline HHRA for each site and recommendations for additional remedial action to address these risks, where applicable.

1.6.5 Ecological Risk Assessment

Ecological receptors on NAS Key West, such as aquatic and terrestrial biota, may be at risk from contaminants released from the eight sites under investigation. Accordingly, B&R Environmental performed an ecological risk assessment (ERA) to characterize the potential risks from site-specific contaminants to ecological receptors that inhabit the installation. The ERA was based on the laboratory analyses of samples collected from each site. B&R Environmental biologists compared concentrations of contaminants in soil, surface water, groundwater, and sediment to concentrations protective of ecological receptors. Concentrations of contaminants in biological samples were compared to background concentrations and to ecological toxicity threshold values and were also used in foodchain modeling. Modeling of contaminant intake doses for terrestrial and piscivorous receptors was performed, and estimated doses were compared to toxicity reference values. Appendix C, Section 3.3 includes detailed procedures for the ERA processes. Chapters 2 through 9 provide results of the site-specific ERAs and recommendations for additional remedial action to address these risks, where applicable.

1.6.6 Determination of Background Levels

In an RFI/RI, knowledge of levels of constituents in background areas allows evaluation of whether contaminants detected at a site have been released from that source or were previously present. A determination of human health and ecological risk also considers background levels.

The background data set consisted of samples collected from site-specific locations and from eight locations chosen to represent the Key West area as a whole. B&R Environmental used three of the eight representative background locations during the Supplemental RFI/RI written in January 1996 (B&R Environmental, 1997). All eight representative background locations were selected based on a review of historical maps, historical aerial photographs, and field visits. B&R Environmental collected groundwater, surface-water, sediment, and soil samples from the site-specific background locations and soil, sediment, surface-water, and biological samples for chemical analysis at the five new representative locations.

The development of the background data set occurred in three general steps. In the first step, potentially usable background locations were selected based on physical location, and data from the previous studies were combined with samples collected during Supplemental RFI/RI activities. This step included discarding data collected by previous contractors from areas that could have been affected by site operations. The second step involved the removal of data that could bias the statistical results. For example, data outliers (constituents detected at unusually high values when compared to other background samples) were removed from the background data set. The third step involved the statistical evaluation of the final background data set.

For the ecological and human health risk assessments, the study excluded inorganic contaminants in soil, sediment, groundwater, and surface water with a maximum detected concentration less than twice the average background concentration as contaminants of potential concern for that particular medium. Concentrations of analytes in fish, mollusk, crustacean, and vegetation tissue collected at background sites were compared to values collected in the same species as appropriate in the ecological risk assessment for each site.

Appendix F (Comprehensive Background Report) and Section 4.0 of Appendix C (Investigation Procedures) contain a detailed explanation of the development and use of the background data set.

2.0 SOLID WASTE MANAGEMENT UNIT 4 (SWMU 4)

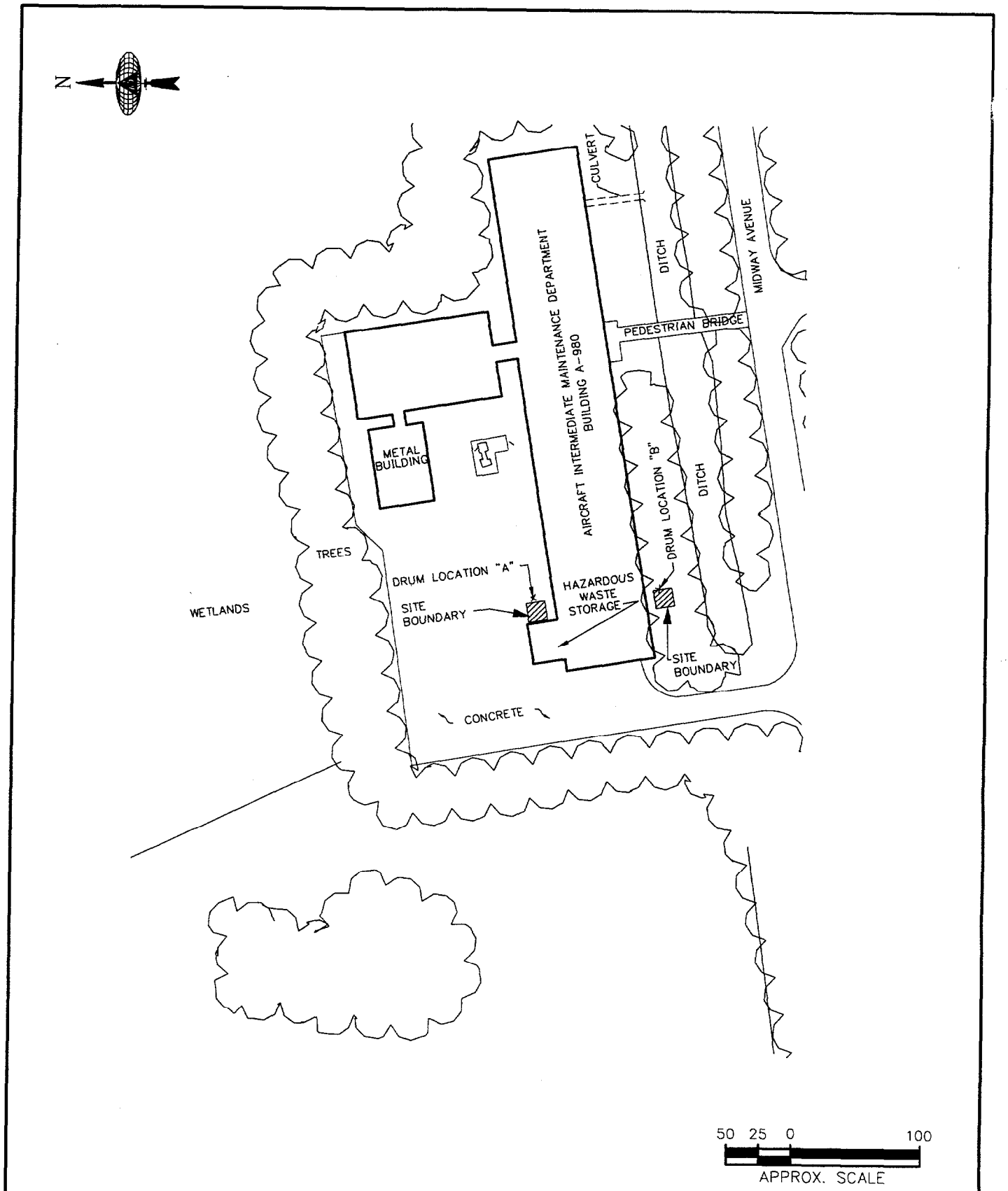
This chapter describes the site-specific evaluation of data for SWMU 4 (Boca Chica Aircraft Intermediate Maintenance Building, AIMD Building A-980). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 2.8 presents a summary and conclusions with recommendations for SWMU 4.

2.1 UNIT DESCRIPTION

AIMD Building A-980 (Figure 2-1) was constructed in the late 1960s at a location that had been filled with 6 feet of crushed lime rock. Fill material was brought in from any of three locations: Boca Chica channel, Key West harbor, and Flagler Railroad. Wetlands lie to the north and west of Building A-980 and a weedy stormwater retention basin is located to the east. A lawn, drainage ditch, and paved road (Midway Avenue) are located south of Building A-980. The site is flat, except it slopes down approximately 4 feet to the wetlands and ditch. The site was the location of two in-ground plastic 55-gallon drums used to receive and store solvents and oil mixtures that were generated during maintenance activities within the building.

In August 1981, the first of these 55-gallon plastic drums was installed in-ground on the north side of Building A-980 and was used to collect approximately 3 gallons per month of hazardous waste containing approximately 70-percent trichlorotrifluoromethane (TF) freon 113 and 30-percent electrical insulating mineral oil (coolanol-35R). This in-ground drum was abandoned in May 1987. The second drum was installed on the south side of the building and was used at the AIMD during the same time period by the Tire Shop. This drum received a mixture of 96 percent water, 2 percent PD-680 (chlorinated organic solvent), 2 percent Turco (a phenolic based aircraft cleaner), and a residue of a PCA 44 Type C (emulsifier cleaner). The Navy ceased using this drum in May 1987 as well. The contents of the drums at the two facilities were routinely pumped out every 60 to 90 days and disposed of by NAS Key West personnel (ABB, 1995).

These drums were gravity fed by a piping system that drained the various mixtures from the interior of the building to the in-ground drums. The north drum was connected to a floor drain inside Building A-980. This drain collected incidental spillage from the work area operations. The drain pipe consisted of a 2-inch polyvinyl chloride (PVC) pipe and was encased in cement mortar. The drain pipe carried the spillage



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DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCM	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704698021	PROJ. NO.: HK7046

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FIGURE 2-1
SITE LOCATION MAP
SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA

directly into the in-ground drum; reportedly, the drain system did not leak. The south drum was connected to a dip tank via a similar floor trench drain. The dip tank was used by the Tire Shop for rinsing aircraft wheel rims during routine maintenance. During an inspection, FDEP observed stained soil in the building. As a result, a Notice of Violation (NOV) was received from FDEP on May 11, 1987; subsequently, NAS Key West cut and plugged the connecting piping and disconnected the use of the in-ground drums for wastewater collection. In December 1989, both drums were removed and a 6-inch layer of soil from around and under each drum was excavated and disposed of offsite by the U.S. Navy. Soil sampling conducted during the removal of the in-ground drums is discussed in Section 2.2.1 below.

2.2 INVESTIGATION HISTORY

Several investigations have been performed at SWMU 4 since the mid-1980s to identify, confirm, or delineate contamination. The previous investigations are summarized in Section 2.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 2.2.2.

2.2.1 Previous Investigations

Initial soil sampling was performed at SWMU 4 in conjunction with the removal of the in-ground drums and associated soil in December 1989. Analysis indicated soil contamination from metals (e.g., cadmium, chromium, lead, and mercury) and petroleum hydrocarbons in the area of the drums. Subsequently, IT Corporation conducted soil, sediment, surface-water, and groundwater sampling during the RFI/RI of this site in 1993. Characterization of releases at the site indicated that contaminants exceeding regulatory standards did not appear to be the result of onsite waste disposal operations (IT Corporation, 1994). The Final RFI/RI Report prepared by IT Corporation recommended resampling of monitoring wells to confirm concentrations of vinyl chloride, cyanide, and 1,1-dichloroethane.

2.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at SWMU 4 and the scope of those field activities performed from August to October 1996. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 2-2 through 2-5 show the location of all soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as those from previous investigations.

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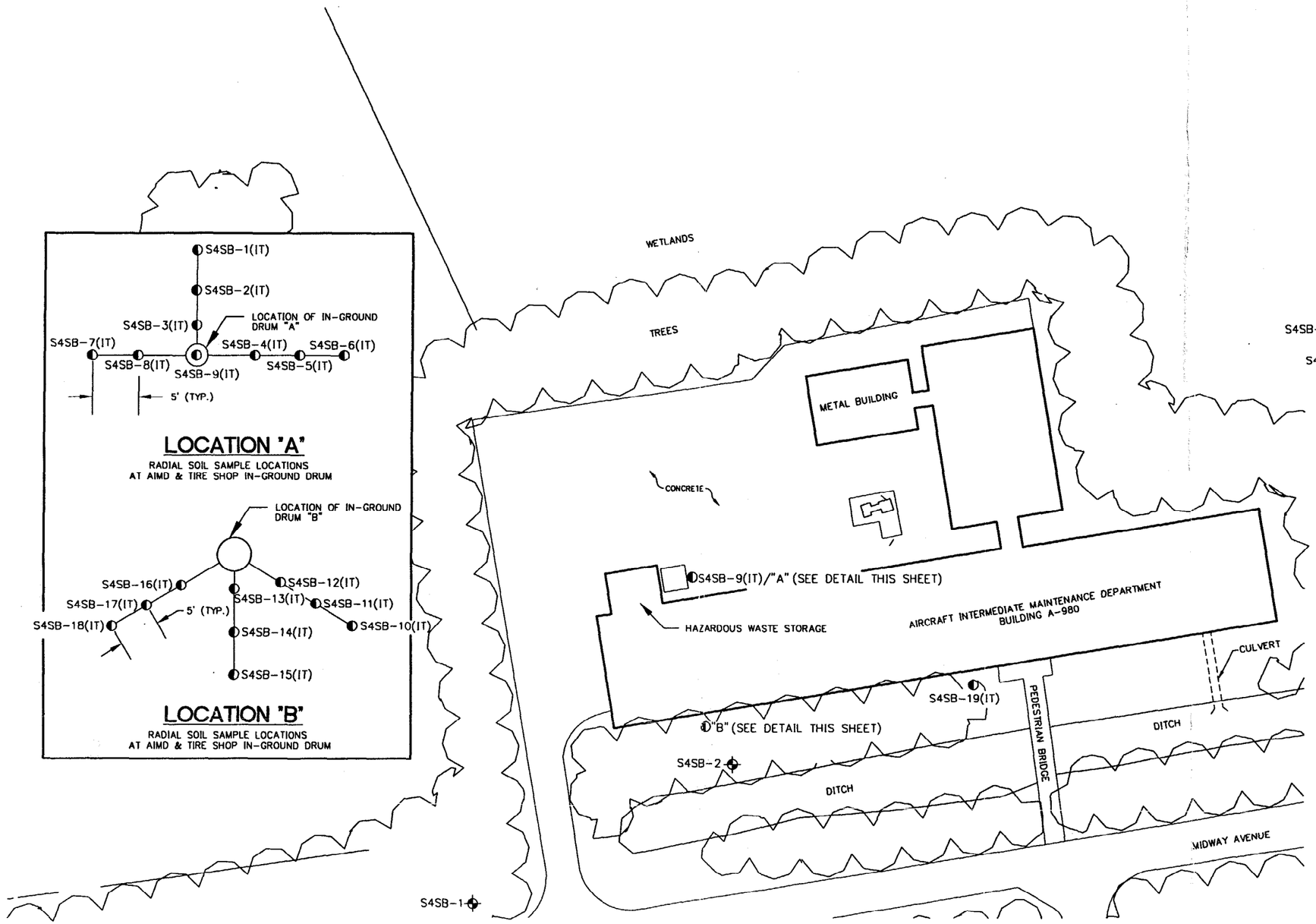

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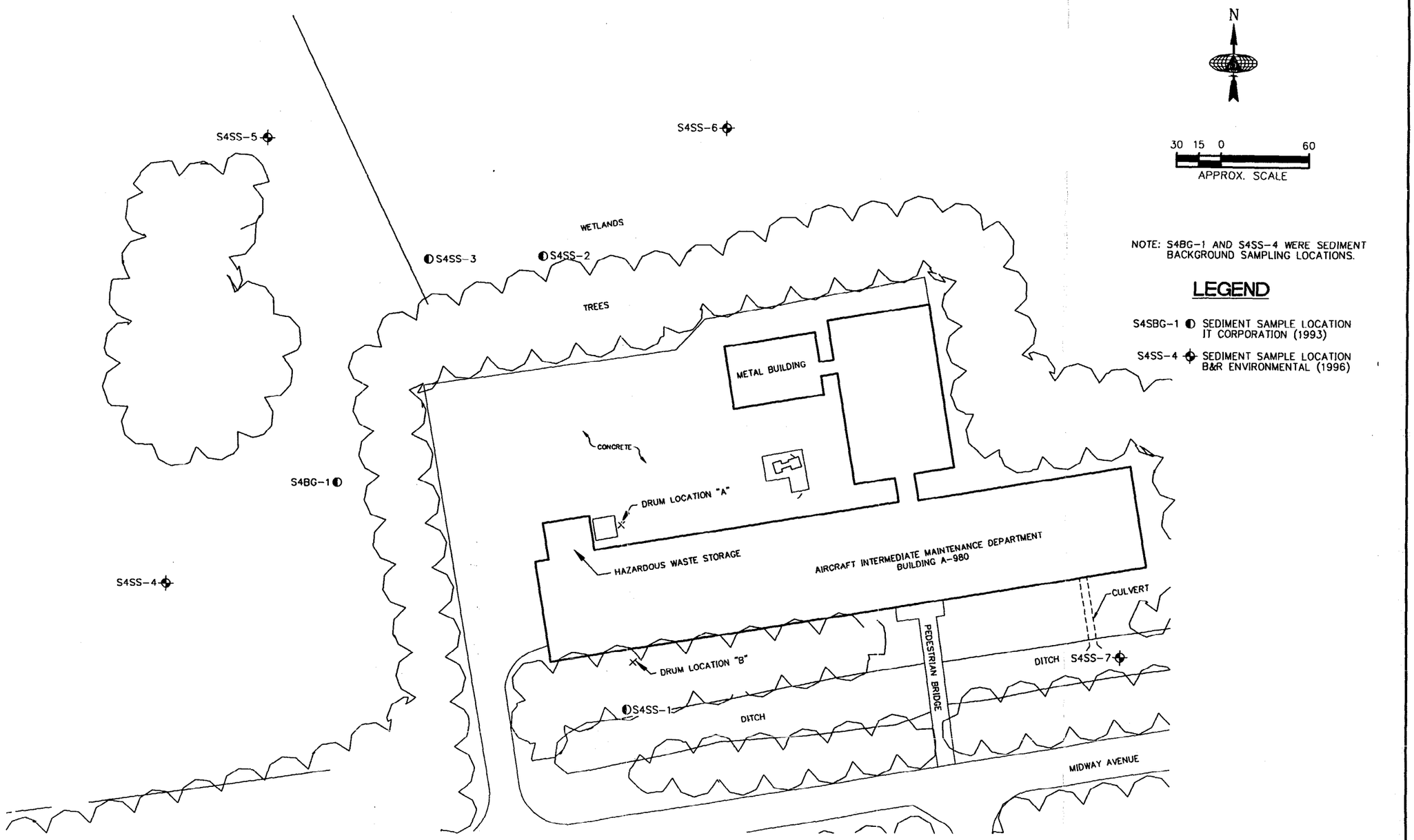
FIGURE 2-2
SOIL SAMPLE LOCATIONS SWMU 4
NAVAL AIR STATION KEY WEST, FLORIDA

0101FB1Z



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SURVEYED BY: TCB	SURVEY DATE: 9/16/96
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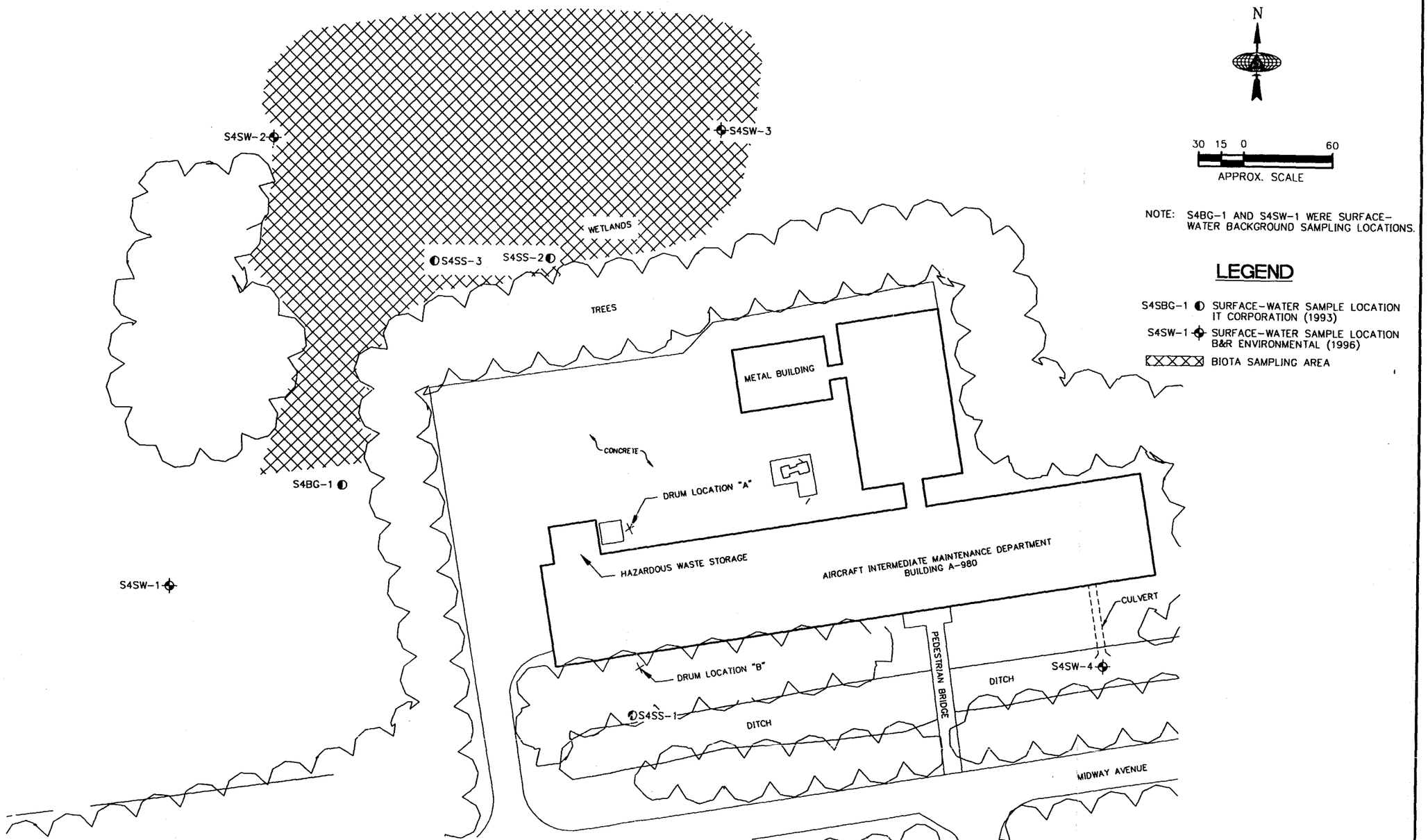
FIGURE 2-3
SEDIMENT SAMPLE LOCATIONS SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA



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SURVEYED BY: TCB	SURVEY DATE: 9/16/96
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CAD DWG. NO.: 704698024	PROJ. NO.: HK7046

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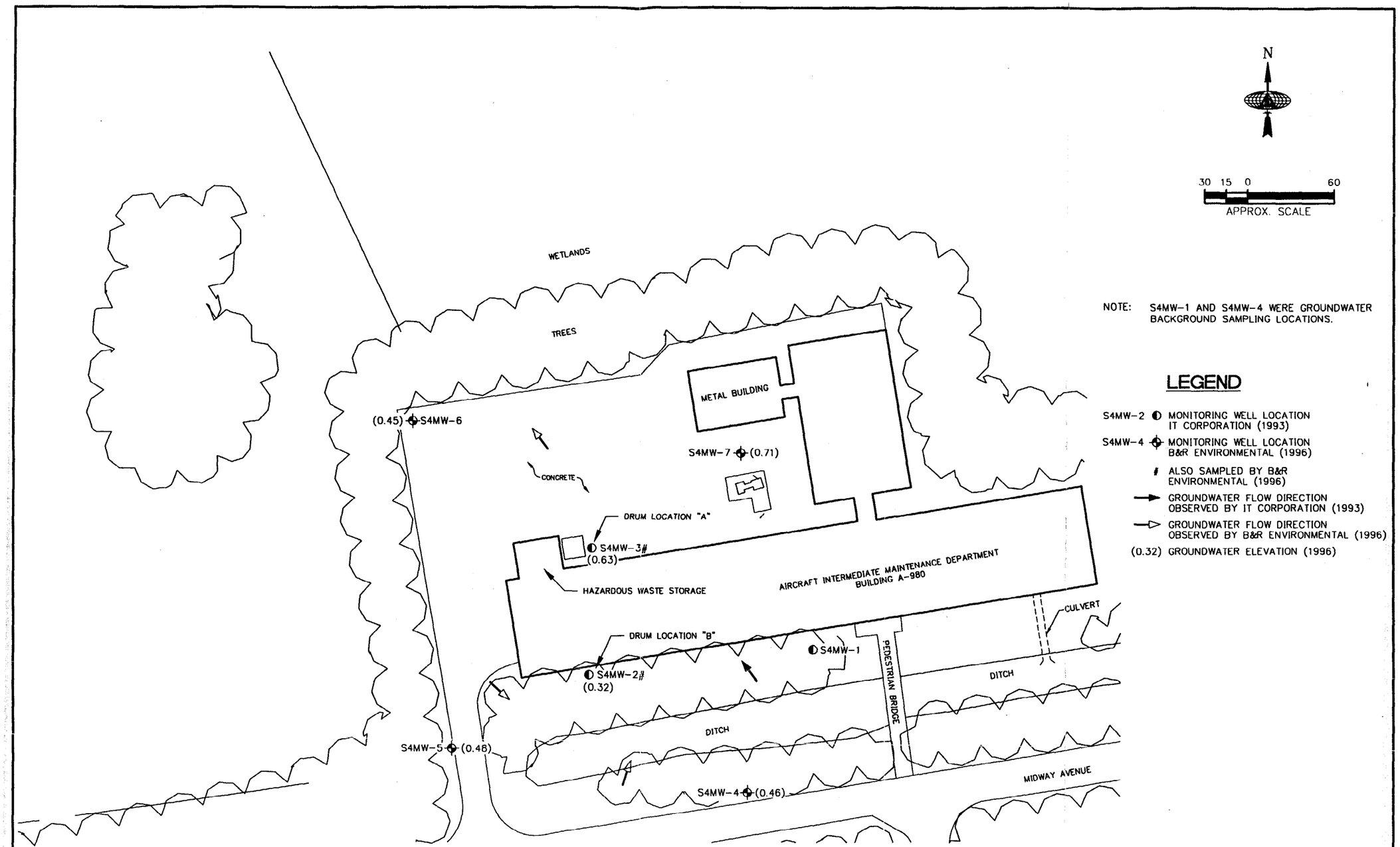
FIGURE 2-4
SURFACE-WATER AND BIOTA SAMPLE LOCATIONS
SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA



NOTE: S4MW-1 AND S4MW-4 WERE GROUNDWATER BACKGROUND SAMPLING LOCATIONS.

LEGEND

S4MW-2 MONITORING WELL LOCATION IT CORPORATION (1993)

S4MW-4 MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)

ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

GROUNDWATER FLOW DIRECTION OBSERVED BY IT CORPORATION (1993)

GROUNDWATER FLOW DIRECTION OBSERVED BY B&R ENVIRONMENTAL (1996)

(0.32) GROUNDWATER ELEVATION (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704698025	PROJ. NO.: HK7046

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FIGURE 2-5
GROUNDWATER SAMPLE LOCATIONS SWMU 4
NAVAL AIR STATION KEY WEST, FLORIDA

2.2.2.1 Investigation Rationale

Additional sampling of all media was conducted at SWMU 4 to provide more information on which appropriate risk assessments can be based. Surface soil samples were collected to supplement the contaminant data from the previous surface soil sampling activities. Sediment and surface-water samples were collected to assess the extent of lead concentrations previously detected above background screening values within the wetland area adjoining the site. Resampling of existing monitoring wells and installing and sampling new monitoring wells were performed to delineate the extent of cyanide and chlorinated solvents previously detected in groundwater samples collected during the original RFI/RI sampling.

2.2.2.2 Scope of Current Field Investigation

Supplemental field activities at SWMU 4 included surface soil sampling to further characterize surface soil conditions, surface-water and sediment sampling to further delineate the contaminants detected in earlier activities, and monitoring well installation and groundwater sampling to verify previously detected contamination.

2.2.2.2.1 Soil

Since previous investigation activities at SWMU 4 had sufficiently characterized surface soil adjacent to the former waste storage tanks, the supplemental investigation restricted soil sampling to off-site areas along the boundary of SWMU 4. These soils were characterized for use with previously collected soil background and contaminant data. Two soil samples were collected, one from a surface location and one from an interval of 0.5 feet to 1.5 feet below the surface. All SWMU 4 soil samples were analyzed for the following parameters:

- Appendix IX VOCs
- Appendix IX Semivolatile organic compounds (SVOCs)
- Appendix IX Herbicides
- Appendix IX Pesticides and PCBs
- Target Analyte List (TAL) metals
- Cyanide

2.2.2.2.2 Surface Water and Sediment

Surface-water and sediment samples were collected in the adjoining wetlands where the extent of lead contamination had not been sufficiently delineated, particularly within the areas to the north and west of the site. The SWMU 4 sediment and surface-water samples were analyzed for the following parameters:

- Appendix IX VOCs
- Appendix IX SVOCs
- TAL metals
- Cyanide

2.2.2.2.3 Groundwater

Groundwater sampling was conducted to characterize background (hydraulically upgradient) groundwater quality and areas hydraulically downgradient, particularly with respect to cyanide and chlorinated solvents (i.e., vinyl chloride and 1,1-dichloroethane). The SWMU 4 groundwater samples were analyzed for the following parameters:

- Appendix IX VOCs
- Appendix IX SVOCs
- TAL metals
- Cyanide

2.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at NAS Key West is included in Section 1.4 (Base Environmental Setting) of this document. Applicable unit surface features are described in Section 2.1, while hydrogeology and soils at SWMU 4 are discussed below.

2.3.1 Hydrogeology

The depth to groundwater at the site ranges from 4.23 feet to 5.08 feet bls. Monitoring well construction logs are presented in Appendix E for the wells installed during this investigation (S4MW-4 through S4MW-7). Data obtained from the logs indicate that the primary unit underlying the site is the surficial oolite limestone aquifer. Recharge of the aquifer is through direct infiltration of precipitation. Wetlands north of the site also act as a recharge area for the aquifer.

Groundwater elevation data obtained during this monitoring event vary from 0.32 foot to 0.71 foot. In 1993, IT Corporation observed that groundwater flow at SWMU 4 was generally to the northwest with a hydraulic gradient of 0.001 foot/foot (IT Corporation, 1994). 1996 data also indicated a northerly groundwater flow at SWMU 4. The direction of groundwater flow is indicated on Figure 2-5.

2.3.2 Soils

The lithologic description of soil samples was recorded during the installation of soil borings and monitoring wells in 1993. The lithologic logs were presented in Appendix E of the Final RFI/RI Report (IT Corporation, 1994). Review of the lithologic descriptions reveal the presence of two distinguishable units in the subsurface of the site. The uppermost unit is a light brown, poorly sorted mixture of sand and limestone fill material varying in thickness from 4 to 5 feet. The fill material varies in size from a pebble to a fine-grained material. Natural oolitic limestone was encountered below the fill material and was found to continue to the depths at which monitoring wells were terminated.

2.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from subsurface and surface soil, sediment, surface water, and groundwater in the vicinity of AIMD Building A-980. The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various state and Federal agencies and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media, in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix H contains the full data set used in site characterization and assessment. Appendix I contains the laboratory analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI.

2.4.1 Subsurface Soil

Data from the 1993 IT Corporation RFI/RI was considered in the analysis of subsurface soil contamination at SWMU 4. Chemicals that were detected in subsurface soil samples are listed in Table 2-1. Figure 2-6 shows the occurrence of analytes that exceeded screening values and indicated possible subsurface soil contamination. IT Corporation collected a number of samples in the vicinity of the two in-ground storage drums at SWMU 4. These samples are shown in the inset on Figures 2-2, 2-6, and 2-7. Both drums were excavated in 1986. The drum on the north side of the building is referred to as "Drum A," while the drum on the south side of the building is referred to as "Drum B."

Metals accounted for most of the chemicals detected in the soil at AIMD Building A-980. In general, metals were detected in subsurface soil throughout the site, while VOCs and SVOCs were detected with much lower frequency and were limited to the samples immediately adjacent to Building A-980.

Screening values were obtained from a variety of sources including Oak Ridge National Laboratory Benchmark Toxicity Values (ORNL BTVs), EPA Region III Biotechnical Assistance Group (BTAG) Screening Levels, Proposed RCRA Action Levels (ALs), FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil Risk-Based Concentrations (RBCs), and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of subsurface soil samples.

2.4.1.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the subsurface soil samples. However, cis-1,2-dichloroethene, methylene chloride, and xylene were detected at low levels south of AIMD Building A-980.

2.4.1.2 Semivolatile Organic Compounds

One SVOC, naphthalene, exceeded the 100 micrograms per kilogram (µg/kg) subsurface soil screening criteria in two samples collected near the former location of Drum B. These IT Corporation 1993 subsurface soil samples, S4SB-12(IT) and S4SB-13(IT), contained 260 µg/kg and 340 µg/kg of naphthalene, respectively. At other sampling locations, benzo(a)pyrene, benzo(k)fluoranthene, and bis(2-ethylhexyl)phthalate were detected at levels below their screening values. No SVOCs were detected in the B&R Environmental subsurface soil sample collected in 1996.

TABLE 2-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT SWMU 4
NAS KEY WEST
PAGE 1 OF 3

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
S4SB-16(IT)	4	IT 1993	Antimony	4.4	B_1
S4SB-2(IT)	3	IT 1993	Antimony	4	B_1
S4SB-14(IT)	4	IT 1993	Antimony	4	B_1
S4SB-12(IT)	4	IT 1993	Antimony	4	B_1
S4SB-13(IT)	4	IT 1993	Antimony	3.9	B_1
S4SB-19(IT)	1	IT 1993	Antimony	3.6	B_1
S4SB-16(IT)	4	IT 1993	Arsenic	1.3	
S4SB-13(IT)	4	IT 1993	Arsenic	1.1	B_1
S4SB-7(IT)	3.5	IT 1993	Arsenic	0.81	B_1
S4SB-4(IT)	4.5	IT 1993	Arsenic	0.74	B_2
S4SB-18(IT)	4	IT 1993	Arsenic	0.35	B_1
S4SB-19(IT)	1	IT 1993	Arsenic	0.35	B_1
S4SB-3(IT)	3	IT 1993	Arsenic	0.35	B_1
S4SB-15(IT)	4	IT 1993	Arsenic	0.32	B_1
S4SB-14(IT)	4	IT 1993	Arsenic	0.31	B_1
S4SB-11(IT)	4	IT 1993	Arsenic	0.27	B_1
S4SB-5(IT)	3.5	IT 1993	Arsenic	0.26	B_2
S4SB-1(IT)	3.5	IT 1993	Arsenic	0.24	B_2
S4SB-6(IT)	3.5	IT 1993	Arsenic	0.22	B_2
S4SB-16(IT)	4	IT 1993	Barium	6.2	B_1
S4SB-13(IT)	4	IT 1993	Barium	5.4	B_1
S4SB-4(IT)	4.5	IT 1993	Barium	4.5	B_2
S4SB-7(IT)	3.5	IT 1993	Barium	4.5	B_1
S4SB-14(IT)	4	IT 1993	Barium	4.1	B_1
S4SB-3(IT)	3	IT 1993	Barium	4.1	B_1
S4SB-19(IT)	1	IT 1993	Barium	3.6	B_1
S4SB-15(IT)	4	IT 1993	Barium	3.5	B_1
S4SB-9(IT)	4	IT 1993	Barium	3.2	B_1

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
S4SB-5(IT)	3.5	IT 1993	Barium	3.1	B_2
S4SB-1(IT)	3.5	IT 1993	Barium	3	B_2
S4SB-2(IT)	3	IT 1993	Barium	3	B_1
S4SB-8(IT)	3.5	IT 1993	Barium	3	B_1
S4SB-18(IT)	4	IT 1993	Barium	2.9	B_1
S4SB-11(IT)	4	IT 1993	Barium	2.9	B_1
S4SB-12(IT)	4	IT 1993	Barium	2.9	B_1
S4SB-6(IT)	3.5	IT 1993	Barium	2.4	B_2
S4SB-16(IT)	4	IT 1993	Beryllium	0.27	B_1
S4SB-14(IT)	4	IT 1993	Beryllium	0.2	B_1
S4SB-13(IT)	4	IT 1993	Beryllium	0.2	B_1
S4SB-12(IT)	4	IT 1993	Beryllium	0.2	B_1
S4SB-4(IT)	4.5	IT 1993	Beryllium	0.17	B_2
S4SB-1(IT)	3.5	IT 1993	Beryllium	0.15	B_2
S4SB-11(IT)	4	IT 1993	Beryllium	0.14	B_1
S4SB-6(IT)	3.5	IT 1993	Beryllium	0.12	B_2
S4SB-5(IT)	3.5	IT 1993	Beryllium	0.12	B_2
S4SB-14(IT)	4	IT 1993	Cadmium	0.58	
S4SB-16(IT)	4	IT 1993	Chromium	7.1	
S4SB-14(IT)	4	IT 1993	Chromium	6.3	
S4SB-13(IT)	4	IT 1993	Chromium	6.2	
S4SB-7(IT)	3.5	IT 1993	Chromium	5.1	
S4SB-4(IT)	4.5	IT 1993	Chromium	5.1	
S4SB-3(IT)	3	IT 1993	Chromium	4.9	
S4SB-15(IT)	4	IT 1993	Chromium	4.4	
S4SB-5(IT)	3.5	IT 1993	Chromium	4.2	
S4SB-11(IT)	4	IT 1993	Chromium	4.1	
S4SB-9(IT)	4	IT 1993	Chromium	4.1	
S4SB-12(IT)	4	IT 1993	Chromium	3.9	
S4SB-18(IT)	4	IT 1993	Chromium	3.9	
S4SB-19(IT)	1	IT 1993	Chromium	3.9	

TABLE 2-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT SWMU 4
NAS KEY WEST
PAGE 2 OF 3

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
S4SB-8(IT)	3.5	IT 1993	Chromium	3.9	
S4SB-2(IT)	3	IT 1993	Chromium	3.8	
S4SB-1(IT)	3.5	IT 1993	Chromium	3.7	
S4SB-6(IT)	3.5	IT 1993	Chromium	3.4	
S4SB-14(IT)	4	IT 1993	Copper	8.3	
S4SB-4(IT)	4.5	IT 1993	Copper	6.9	
S4SB-16(IT)	4	IT 1993	Copper	3.2	
S4SB-5(IT)	3.5	IT 1993	Copper	3.2	
S4SB-19(IT)	1	IT 1993	Copper	2.6	B_1
S4SB-15(IT)	4	IT 1993	Copper	2.5	B_1
S4SB-13(IT)	4	IT 1993	Copper	1.5	B_1
S4SB-15(IT)	4	IT 1993	Cyanide	18	
S4SB-2	0.5	B&RE 1996	Iron	530	
S4SB-7(IT)	3.5	IT 1993	Lead	15.4	
S4SB-14(IT)	4	IT 1993	Lead	9.3	
S4SB-4(IT)	4.5	IT 1993	Lead	8	
S4SB-16(IT)	4	IT 1993	Lead	3.9	
S4SB-5(IT)	3.5	IT 1993	Lead	2.9	
S4SB-13(IT)	4	IT 1993	Lead	2.9	
S4SB-15(IT)	4	IT 1993	Lead	2.2	
S4SB-9(IT)	4	IT 1993	Lead	1.7	
S4SB-8(IT)	3.5	IT 1993	Lead	1.3	
S4SB-18(IT)	4	IT 1993	Lead	1.2	
S4SB-12(IT)	4	IT 1993	Lead	0.91	
S4SB-11(IT)	4	IT 1993	Lead	0.77	
S4SB-2(IT)	3	IT 1993	Lead	0.75	
S4SB-19(IT)	1	IT 1993	Lead	0.56	
S4SB-3(IT)	3	IT 1993	Lead	0.51	B_1
S4SB-6(IT)	3.5	IT 1993	Lead	0.4	B_2
S4SB-1(IT)	3.5	IT 1993	Lead	0.28	B_2
S4SB-2	0.5	B&RE 1996	Manganese	7.8	
S4SB-4(IT)	4.5	IT 1993	Mercury	0.16	
S4SB-5(IT)	3.5	IT 1993	Mercury	0.07	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
S4SB-12(IT)	4	IT 1993	Mercury	0.03	
S4SB-2	0.5	B&RE 1996	Nickel	1.2	
S4SB-4(IT)	4.5	IT 1993	Silver	1.8	
S4SB-5(IT)	3.5	IT 1993	Silver	0.61	B_2
S4SB-19(IT)	1	IT 1993	Sulfide	1,500	
S4SB-15(IT)	4	IT 1993	Sulfide	60	
S4SB-8(IT)	3.5	IT 1993	Tin	12	B_1
S4SB-16(IT)	4	IT 1993	Tin	4	B_1
S4SB-16(IT)	4	IT 1993	Vanadium	5.3	B_1
S4SB-13(IT)	4	IT 1993	Vanadium	3.6	B_1
S4SB-7(IT)	3.5	IT 1993	Vanadium	1.8	B_1
S4SB-19(IT)	1	IT 1993	Vanadium	1.5	B_1
S4SB-14(IT)	4	IT 1993	Vanadium	1.4	B_1
S4SB-3(IT)	3	IT 1993	Vanadium	1.4	B_1
S4SB-4(IT)	4.5	IT 1993	Vanadium	1.2	B_2
S4SB-12(IT)	4	IT 1993	Vanadium	1.2	B_1
S4SB-5(IT)	3.5	IT 1993	Vanadium	1.1	B_2
S4SB-9(IT)	4	IT 1993	Zinc	190	
S4SB-8(IT)	3.5	IT 1993	Zinc	18.7	
S4SB-7(IT)	3.5	IT 1993	Zinc	15.6	
S4SB-4(IT)	4.5	IT 1993	Zinc	14.6	
S4SB-16(IT)	4	IT 1993	Zinc	8.8	
S4SB-5(IT)	3.5	IT 1993	Zinc	7.4	
S4SB-14(IT)	4	IT 1993	Zinc	7	
S4SB-19(IT)	1	IT 1993	Zinc	5.1	
S4SB-15(IT)	4	IT 1993	Zinc	3.7	
S4SB-6(IT)	3.5	IT 1993	Zinc	3.7	
S4SB-13(IT)	4	IT 1993	Zinc	3.4	
S4SB-3(IT)	3	IT 1993	Zinc	2.5	
S4SB-12(IT)	4	IT 1993	Zinc	2.4	
S4SB-18(IT)	4	IT 1993	Zinc	2.3	B_1

TABLE 2-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT SWMU 4
NAS KEY WEST
PAGE 3 OF 3

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
S4SB-2(IT)	3	IT 1993	Zinc	1.7	B_1
S4SB-1(IT)	3.5	IT 1993	Zinc	1.5	B_2
S4SB-11(IT)	4	IT 1993	Zinc	1.5	B_1
PESTICIDES/PCBs (µg/kg)					
S4SB-2	0.5	B&RE 1996	Endosulfan I	1.4	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
S4SB-9(IT)	4	IT 1993	Benzo(a)pyrene	12	
S4SB-7(IT)	3.5	IT 1993	Benzo(k)fluoranthene	21	
S4SB-8(IT)	3.5	IT 1993	Benzo(k)fluoranthene	14	
S4SB-9(IT)	4	IT 1993	Benzo(k)fluoranthene	12	
S4SB-15(IT)	4	IT 1993	Bis(2-ethylhexyl)phthalate	2,800	
S4SB-13(IT)	4	IT 1993	Naphthalene	340	
S4SB-12(IT)	4	IT 1993	Naphthalene	260	
VOLATILE ORGANIC COMPOUNDS (µg/kg)					
S4SB-15(IT)	4	IT 1993	Cis-1,2-dichloroethene	2	J
S4SB-15(IT)	4	IT 1993	Methylene chloride	10	B_2
S4SB-19(IT)	1	IT 1993	Methylene chloride	7	B_2
S4SB-12(IT)	4	IT 1993	Xylenes, total	6.6	

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

1 Depths are in feet and represent top of sampling interval.

2 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

3 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.

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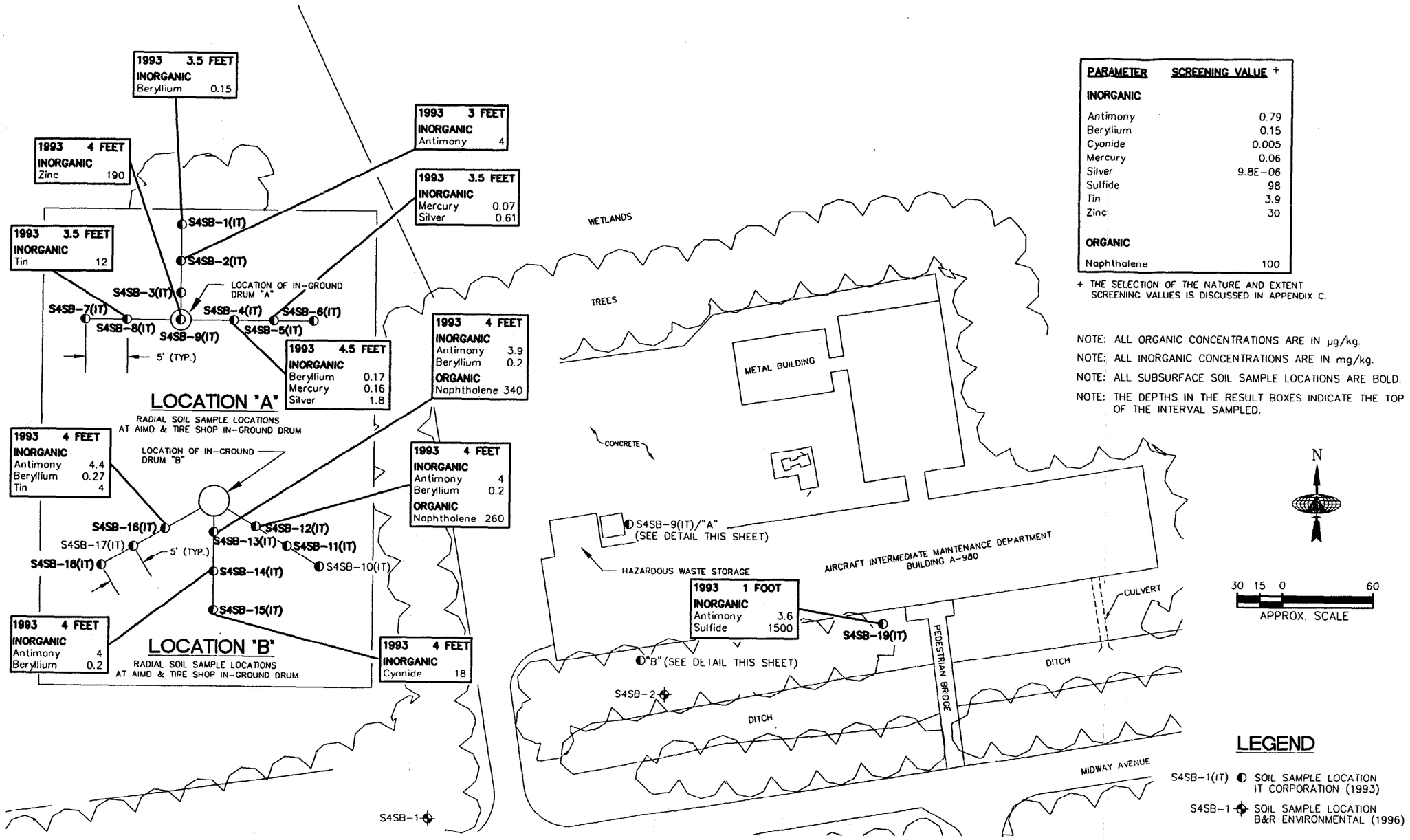


PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Beryllium	0.15
Cyanide	0.005
Mercury	0.06
Silver	9.8E-06
Sulfide	98
Tin	3.9
Zinc	30
ORGANIC	
Naphthalene	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: ALL SUBSURFACE SOIL SAMPLE LOCATIONS ARE BOLD.

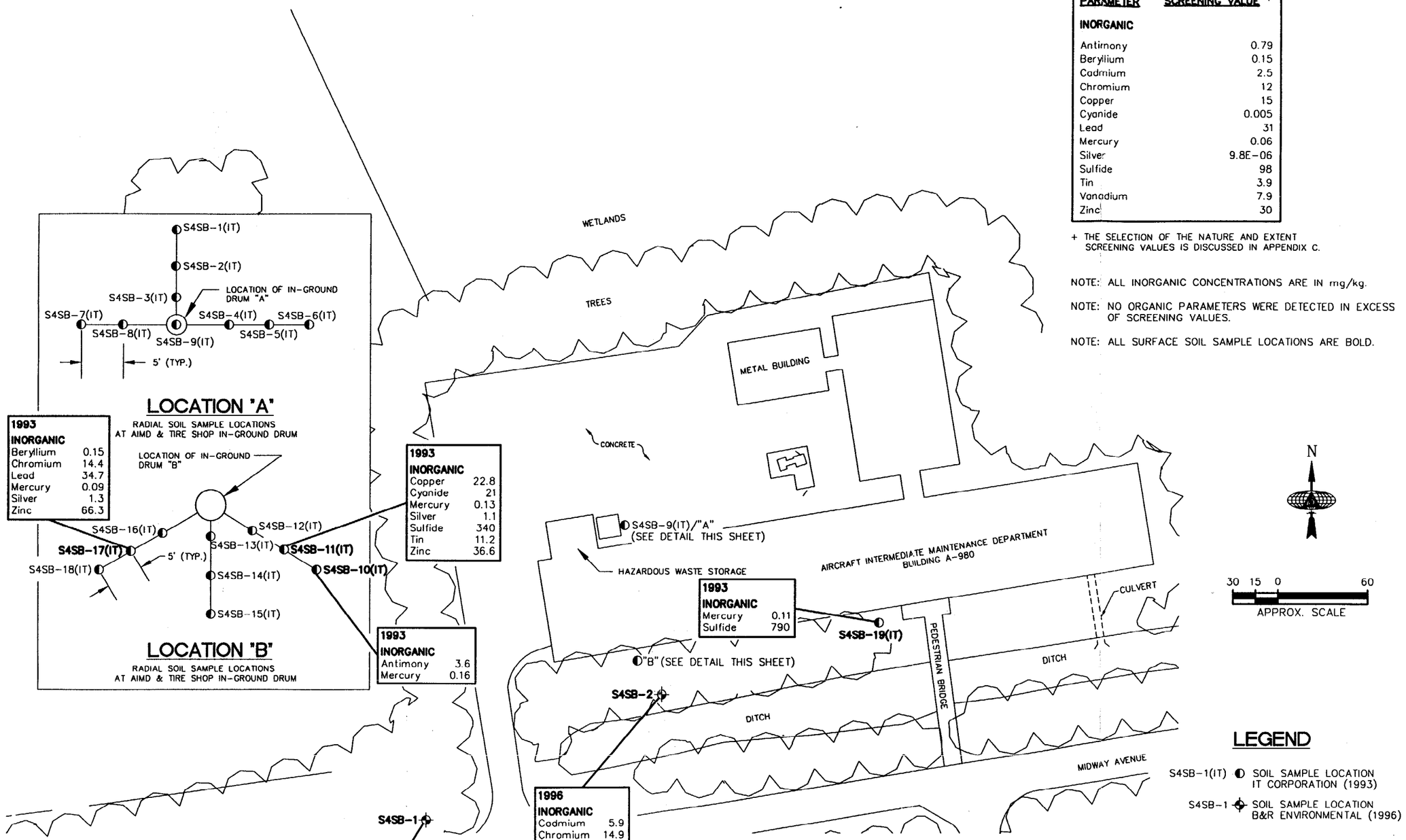
NOTE: THE DEPTHS IN THE RESULT BOXES INDICATE THE TOP OF THE INTERVAL SAMPLED.

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704698026	PROJ. NO.: HK7046

Brown & Root Environmental

FIGURE 2-6
SUBSURFACE SOIL CHEMICAL CONCENTRATIONS SWMU 4
NAVAL AIR STATION KEY WEST, FLORIDA

010FB22



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Beryllium	0.15
Cadmium	2.5
Chromium	12
Copper	15
Cyanide	0.005
Lead	31
Mercury	0.06
Silver	9.8E-06
Sulfide	98
Tin	3.9
Vanadium	7.9
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: NO ORGANIC PARAMETERS WERE DETECTED IN EXCESS OF SCREENING VALUES.

NOTE: ALL SURFACE SOIL SAMPLE LOCATIONS ARE BOLD.

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704698027	PROJ. NO.: HK7046

Brown & Root Environmental

FIGURE 2-7
SURFACE SOIL CHEMICAL CONCENTRATIONS
SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA

2.4.1.3 Pesticides

No pesticides exceeded the screening criteria in any of the subsurface soil samples. However, a low level of endosulfan I was detected in the B&R Environmental subsurface soil sample (S4SB-2) collected south of the building.

2.4.1.4 Polychlorinated Biphenyls

No PCBs were detected in the subsurface soil at SWMU 4.

2.4.1.5 Inorganics

Inorganics were detected at several sample locations in the vicinity of the former drum locations. The maximum concentrations of antimony [4.4 milligrams per kilogram (mg/kg)], beryllium (0.27 mg/kg), cyanide (18 mg/kg), and sulfide (1,500 mg/kg) that exceeded screening criteria were detected near the former location of Drum B. Maximum concentrations located north of the building at the former Drum A location included mercury (0.16 mg/kg), silver (1.8 mg/kg), tin (12 mg/kg), and zinc (190 mg/kg). The most frequently detected inorganics in subsurface soil at SWMU 4 included barium, chromium, lead, and zinc, all of which were detected in all 17 samples. Aluminum, arsenic, barium, iron, manganese, nickel, and vanadium were detected but did not exceed the screening values in any subsurface soil samples.

2.4.2 Surface Soil

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI, were considered in the analysis of surface soil contamination at SWMU 4. Chemicals that were detected in surface soil samples are listed in Table 2-2. This table includes laboratory analytical results from all applicable historical sampling events as well as the Supplemental RFI/RI. Figure 2-7 shows the occurrence of compounds that exceeded screening criteria in surface soil. IT Corporation collected three samples in the vicinity of in-ground storage Drum B's former location at SWMU 4. These samples are shown in the inset on Figures 2-2, 2-6, and 2-7. All surface soil samples were collected on the south side of AIMD Building A-980. Metals accounted for most of the chemicals detected in the surface soil at AIMD Building A-980.

TABLE 2-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 4
NAS KEY WEST
PAGE 1 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
S4SB-1	B&RE 1996	Aluminum	3,180	
S4SB-2	B&RE 1996	Aluminum	243	
S4SB-10(IT)	IT 1993	Antimony	3.6	B_1
S4SB-1	B&RE 1996	Arsenic	1.4	
S4SB-19(IT)	IT 1993	Arsenic	0.37	B_2
S4SB-11(IT)	IT 1993	Arsenic	0.24	B_1
S4SB-2	B&RE 1996	Barium	11.9	
S4SB-1	B&RE 1996	Barium	10.6	
S4SB-17(IT)	IT 1993	Barium	9.5	B_1
S4SB-11(IT)	IT 1993	Barium	7.8	B_1
S4SB-19(IT)	IT 1993	Barium	5.6	B_2
S4SB-10(IT)	IT 1993	Barium	4.9	B_1
S4SB-17(IT)	IT 1993	Beryllium	0.15	B_1
S4SB-10(IT)	IT 1993	Beryllium	0.14	B_1
S4SB-2	B&RE 1996	Cadmium	5.9	
S4SB-17(IT)	IT 1993	Cadmium	1.6	
S4SB-11(IT)	IT 1993	Cadmium	1.4	
S4SB-17(IT)	IT 1993	Chromium	14.4	
S4SB-1	B&RE 1996	Chromium	9.3	
S4SB-11(IT)	IT 1993	Chromium	6.2	
S4SB-2	B&RE 1996	Chromium	14.9	
S4SB-19(IT)	IT 1993	Chromium	6	
S4SB-10(IT)	IT 1993	Chromium	5.5	
S4SB-2	B&RE 1996	Cooper	66.3	
S4SB-11(IT)	IT 1993	Copper	22.8	
S4SB-1	B&RE 1996	Copper	15.9	
S4SB-17(IT)	IT 1993	Copper	14.9	
S4SB-10(IT)	IT 1993	Copper	9.4	
S4SB-19(IT)	IT 1993	Copper	7.1	

Location	Source[1]	Parameter	Result	Qual.[2]
S4SB-11(IT)	IT 1993	Cyanide	21	
S4SB-1	B&RE 1996	Iron	2,050	
S4SB-2	B&RE 1996	Lead	60.8	
S4SB-1	B&RE 1996	Lead	47.5	
S4SB-17(IT)	IT 1993	Lead	34.7	
S4SB-11(IT)	IT 1993	Lead	17.2	
S4SB-19(IT)	IT 1993	Lead	13.5	
S4SB-10(IT)	IT 1993	Lead	8.7	
S4SB-1	B&RE 1996	Manganese	18.9	
S4SB-10(IT)	IT 1993	Mercury	0.16	
S4SB-11(IT)	IT 1993	Mercury	0.13	
S4SB-19(IT)	IT 1993	Mercury	0.11	
S4SB-17(IT)	IT 1993	Mercury	0.09	
S4SB-2	B&RE 1996	Mercury	0.08	
S4SB-1	B&RE 1996	Nickel	2.7	
S4SB-2	B&RE 1996	Silver	1.5	
S4SB-17(IT)	IT 1993	Silver	1.3	
S4SB-11(IT)	IT 1993	Silver	1.1	
S4SB-19(IT)	IT 1993	Sulfide	790	
S4SB-11(IT)	IT 1993	Sulfide	340	
S4SB-11(IT)	IT 1993	Tin	11.2	B_1
S4SB-1	B&RE 1996	Vanadium	8.3	
S4SB-2	B&RE 1996	Vanadium	1.7	
S4SB-19(IT)	IT 1993	Vanadium	1.1	B_2
S4SB-17(IT)	IT 1993	Zinc	66.3	
S4SB-2	B&RE 1996	Zinc	65.5	
S4SB-11(IT)	IT 1993	Zinc	36.6	
S4SB-19(IT)	IT 1993	Zinc	26.1	
S4SB-10(IT)	IT 1993	Zinc	24.5	
S4SB-1	B&RE 1996	Zinc	7.7	

TABLE 2-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 4
NAS KEY WEST
PAGE 2 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
PESTICIDES/PCBs (µg/kg)				
S4SB-1	B&RE 1996	4,4'-DDE	29.5	J
S4SB-11(IT)	IT 1993	4,4'-DDE	22	
S4SB-1	B&RE 1996	4,4'-DDT	36.4	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
S4SB-11(IT)	IT 1993	Bis(2-ethylhexyl)phthalate	220	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
S4SB-11(IT)	IT 1993	2-chloro-1,3-butadiene	2	J
S4SB-1	B&RE 1996	Acetone	70	
S4SB-11(IT)	IT 1993	Acetone	5	J
S4SB-11(IT)	IT 1993	Carbon tetrachloride	3	J
S4SB-11(IT)	IT 1993	Cis-1,2-dichloroethene	19	
S4SB-1	B&RE 1996	Methylene chloride	69	
S4SB-19(IT)	IT 1993	Methylene chloride	22	B_2
S4SB-11(IT)	IT 1993	Methylene chloride	12	B_2
S4SB-1	B&RE 1996	Tetrachloroethene	0.48	J

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

2.4.2.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the surface soil samples. A number of VOCs, including 2-chloro-1,3-butadiene, acetone, carbon tetrachloride, cis-1,2-dichloroethene, methylene chloride, and tetrachloroethene were detected at low levels south of AIMD Building A-980.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. 2-chloro-1,3-butadiene and acetone were selected as ecological COPCs (see Section 2.7.4.1.2) because no suitable ecological thresholds were available. The selected nature and extent screening values for 2-chloro-1,3-butadiene and acetone were not ecological screening levels.

2.4.2.2 Semivolatile Organic Compounds

A single SVOC, bis(2-ethylhexyl)phthalate, was detected at SWMU 4 at levels below the surface soil screening criteria. It occurred in S4SB-11(IT), which also contained several VOCs.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Bis(2-ethylhexyl)phthalate was selected as an ecological COPC (see Section 2.7.4.1.2) because no suitable ecological threshold was available. The selected nature and extent screening value for bis(2-ethylhexyl)phthalate was not an ecological screening level.

2.4.2.3 Pesticides

No pesticides exceeded the screening criteria in any of the surface soil samples. However, a low level of 4,4'-DDT was detected southwest of AIMD Building A-980 in a single 1996 B&R Environmental surface soil sample, S4SB-1. 4,4'-DDE was detected at S4SB-1 and S4SB-11(IT) (near the former location of Drum B).

2.4.2.4 Polychlorinated Biphenyls

No PCBs were detected in the surface soil at SWMU 4.

2.4.2.5 Inorganics

Inorganics were detected at several sample locations south of the AIMD Building. The maximum concentrations commonly occurred near the former location of Drum B. The maximum concentrations of antimony (3.6 mg/kg), beryllium (0.15 mg/kg), cyanide (21 mg/kg), mercury (0.16 mg/kg), sulfide (790 mg/kg), tin (11.2 mg/kg), and zinc (66.3 mg/kg), which exceeded screening criteria, were detected in this area. The maximum concentrations of cadmium (5.9 mg/kg), chromium (14.9 mg/kg), copper (66.3 mg/kg), lead (60.8 mg/kg), and silver (1.5 mg/kg) were detected slightly southeast of the former location of Drum B. The maximum concentrations of vanadium was detected further southwest at S4SB-1 (8.3 mg/kg). Aluminum, arsenic, barium, iron, manganese, and nickel were detected in surface soil but did not exceed the screening values. Tin analyses were performed only on IT Corporation 1993 samples.

2.4.3 Sediment

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI, were considered in the analysis of sediment contamination at SWMU 4. Chemicals that were detected in sediment samples are listed in Table 2-3. This table lists laboratory analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Sediment samples were taken from the ditch south of the AIMD Building and in the northern wetland portion of SWMU 4. Figure 2-8 shows the occurrence of analytes that exceeded screening values and indicated possible sediment contamination.

Screening values were obtained from a variety of sources including FDEP Sediment Quality Assessment Guidelines (SQAGs), EPA Region IV Screening Values, EPA Sediment Quality Criteria (SQCs) for Marine and Freshwater Sediments, Effects Range- Low (ER-L) Criteria, Effects Range-Medium (ER-M) Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples.

TABLE 2-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 4
NAS KEY WEST
PAGE 1 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
S4SS-6	B&RE 1996	Aluminum	2,680	
S4SS-7	B&RE 1996	Aluminum	2,075	
S4SS-5	B&RE 1996	Aluminum	1,230	
S4SS-1	IT 1993	Antimony	8.8	B_1
S4SS-5	B&RE 1996	Arsenic	2.9	
S4SS-1	IT 1993	Arsenic	2.6	B_1
S4SS-3	IT 1993	Arsenic	2.5	B_1
S4SS-6	B&RE 1996	Arsenic	2.2	
S4SS-2	IT 1993	Arsenic	1.9	B_1
S4SS-7	B&RE 1996	Arsenic	1.5	
S4SS-3	IT 1993	Barium	8.1	B_1
S4SS-7	B&RE 1996	Barium	8.1	
S4SS-6	B&RE 1996	Barium	7.7	
S4SS-5	B&RE 1996	Barium	6.5	
S4SS-1	IT 1993	Barium	6.2	B_1
S4SS-2	IT 1993	Barium	6	B_1
S4SS-3	IT 1993	Chromium	17.2	
S4SS-2	IT 1993	Chromium	10.7	
S4SS-1	IT 1993	Chromium	9.8	
S4SS-6	B&RE 1996	Chromium	7.6	
S4SS-7	B&RE 1996	Chromium	4.8	
S4SS-1	IT 1993	Copper	15.6	
S4SS-3	IT 1993	Copper	13.4	
S4SS-7	B&RE 1996	Copper	11.7	
S4SS-2	IT 1993	Copper	6.4	B_1
S4SS-6	B&RE 1996	Copper	5.2	
S4SS-5	B&RE 1996	Copper	4.7	
S4SS-6	B&RE 1996	Iron	1,670	
S4SS-5	B&RE 1996	Iron	1,410	
S4SS-7	B&RE 1996	Iron	1,214	
S4SS-1	IT 1993	Lead	38.1	
S4SS-2	IT 1993	Lead	27.9	
S4SS-7	B&RE 1996	Lead	21.4	
S4SS-6	B&RE 1996	Lead	16.1	
S4SS-5	B&RE 1996	Lead	15.3	
S4SS-3	IT 1993	Lead	2.5	
S4SS-6	B&RE 1996	Manganese	36.5	
S4SS-5	B&RE 1996	Manganese	26.3	
S4SS-7	B&RE 1996	Manganese	21.9	
S4SS-6	B&RE 1996	Nickel	2.3	
S4SS-7	B&RE 1996	Nickel	1.9	
S4SS-5	B&RE 1996	Nickel	1.2	
S4SS-1	IT 1993	Sulfide	480	
S4SS-1	IT 1993	Tin	22.8	B
S4SS-6	B&RE 1996	Vanadium	8.9	
S4SS-5	B&RE 1996	Vanadium	6	
S4SS-7	B&RE 1996	Vanadium	6	
S4SS-3	IT 1993	Vanadium	5.9	B_1
S4SS-2	IT 1993	Vanadium	5.7	B_1
S4SS-1	IT 1993	Vanadium	4.7	B_1
S4SS-3	IT 1993	Zinc	107	
S4SS-2	IT 1993	Zinc	54.6	
S4SS-1	IT 1993	Zinc	47.6	
S4SS-7	B&RE 1996	Zinc	12.1	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
S4SS-1	IT 1993	Bis(2-ethylhexyl)phthalate	490	J
S4SS-3	IT 1993	Chrysene	37	
S4SS-3	IT 1993	Fluoranthene	70	
S4SS-3	IT 1993	Phenanthrene	60	

TABLE 2-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 4
NAS KEY WEST
PAGE 2 OF 2

Location	Source(1)	Parameter	Result	Qual.(2)
S4SS-3	IT 1993	Pyrene	82	
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
S4SS-1	IT 1993	2-butanone	11	J
S4SS-1	IT 1993	Acetone	200	
S4SS-7	B&RE 1996	Acetone	38	
S4SS-1	IT 1993	Methylene chloride	19	B_2
S4SS-6	B&RE 1996	Tetrachloroethene	1.5	J
S4SS-7	B&RE 1996	Tetrachloroethene	1.2	J
S4SS-5	B&RE 1996	Tetrachloroethene	0.97	J

*All sediment samples at SWMU 4 were surface samples.
Shading indicates a concentration in excess of the screening values (See Table C.3-2).

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limits.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.

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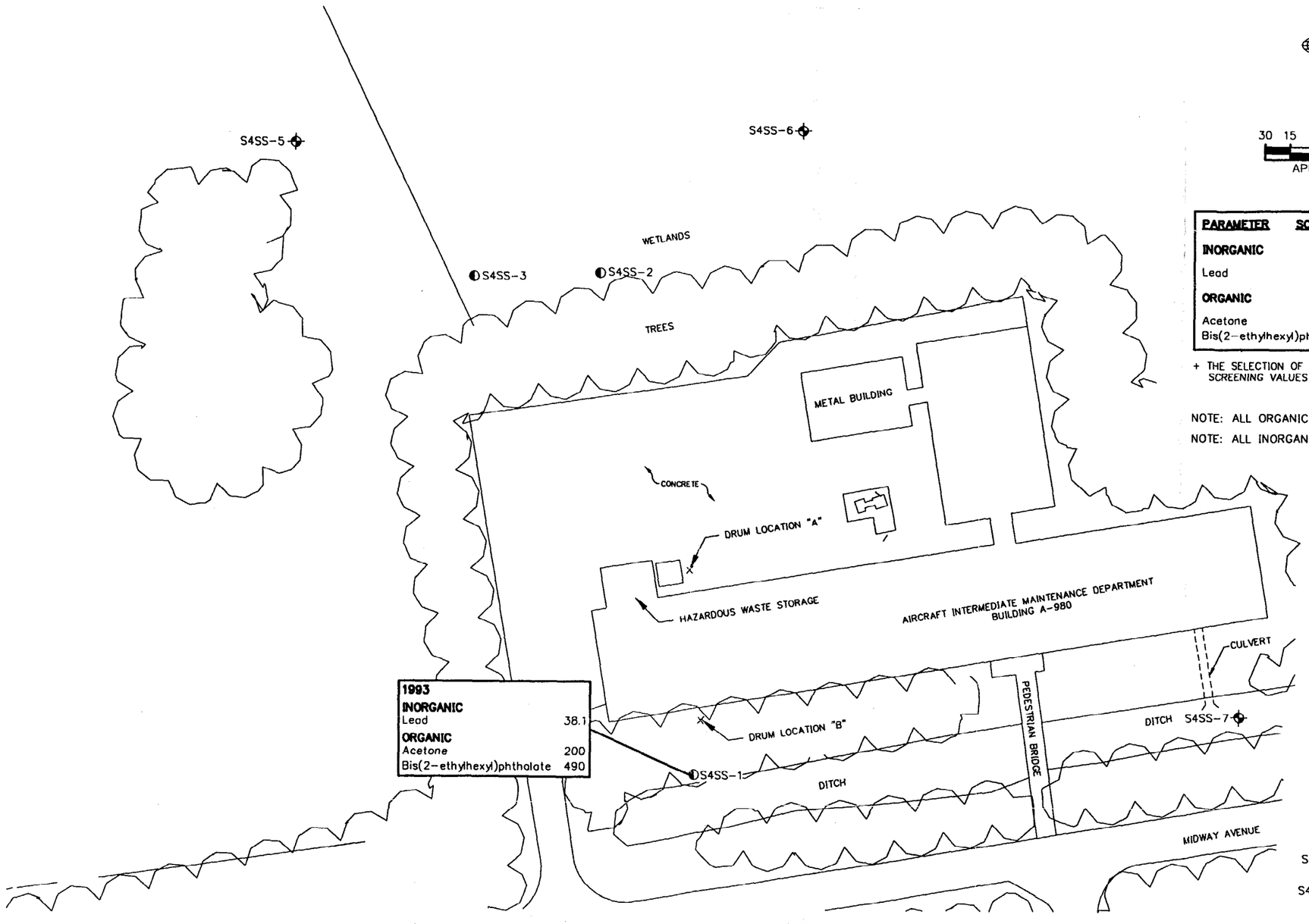

PARAMETER	SCREENING VALUE +
INORGANIC	
Lead	35
ORGANIC	
Acetone	64
Bis(2-ethylhexyl)phthalate	182

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

LEGEND

S4SS-1 ◐ SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)

S4SS-5 ⊕ SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704698028	PROJ. NO.: HK7046

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FIGURE 2-8
SEDIMENT CHEMICAL CONCENTRATIONS SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA

2.4.3.1 Volatile Organic Compounds

A single VOC, acetone, was detected in excess of the 64 µg/kg screening criteria in sediment at the AIMD Building A-980. Acetone was detected at two sample locations (S4SS-1 and S4SS-7) at opposite ends of the ditch south of the building, but exceeded the screening criteria only at the western end of the ditch at S4SS-1 (200 µg/kg) sampled by IT Corporation in 1993. Other volatiles, including 2-butanone, methylene chloride, and tetrachloroethene were also detected at the site, although none were detected in excess of screening levels.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. 2-butanone was selected as an ecological COPC (see Section 2.7.4.1.2) because no suitable ecological threshold was available. The selected nature and extent screening value for 2-butanone was not an ecological screening level.

2.4.3.2 Semivolatile Organic Compounds

A single SVOC, bis(2-ethylhexyl)phthalate, was detected in excess of the 182 µg/kg screening criteria at a single sample location, S4SS-1 (490 µg/kg). IT Corporation collected this sample from the ditch south of the AIMD Building in 1993. Chrysene, fluoranthene, phenanthene, and pyrene were detected at levels below the screening criteria at S4SS-3 also sampled by IT Corporation in 1993. No SVOCs were detected in the sediment samples collected by B&R Environmental in 1996.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Phenanthrene was identified as a COPC (see Section 2.6.2.2) in the human health risk assessment based on a qualitative evaluation, since it does not have an RBC. The concentration of phenanthrene in sediment was less than the Florida SQAG selected for nature and extent screening.

2.4.3.3 Pesticides

No pesticides were detected in sediment at SWMU 4.

2.4.3.4 Polychlorinated Biphenyls

No PCBs were detected in sediment at SWMU 4.

2.4.3.5 Inorganics

Although inorganic compounds were detected in sediment throughout SWMU 4, only one metal, lead, exceeded screening criteria. Although lead was detected at six of the seven sample locations, the concentrations were below the screening criteria in five of the samples, and only slightly in excess of the 35 mg/kg criteria level at S4SS-1 (38.1 mg/kg). Other inorganics detected at SWMU 4 included aluminum, antimony, arsenic, barium, chromium, copper, iron, manganese, nickel, sulfide, tin, vanadium, and zinc.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Antimony was identified as a COPC (see Section 2.6.2.2) in the human health risk assessment, but did not exceed the selected nature and extent screening level due to the conservative non-cancer hazard index applied to the EPA RBCs during the risk assessment process. Aluminum was selected as an ecological COPC (see Section 2.7.4.1.2) based on a comparison with twice the average background concentration, because no suitable ecological threshold was available. The selected nature and extent screening value for aluminum was not an ecological screening level and was higher than twice the average background concentration.

2.4.4 Surface Water

Data from a number of sampling efforts including the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI were considered in the analysis of surface-water contamination at SWMU 4. Chemicals that were detected in surface-water samples are listed in Table 2-4. This table lists laboratory analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Figure 2-9 shows the occurrence of analytes that exceeded screening values and indicated possible surface-water contamination. Inorganics were the dominant class of contaminants detected in these samples.

Screening values were obtained from a variety of sources including: FDEP Surface-Water Quality Standards (SWQSs), EPA Region IV Freshwater and Marine Screening Values, EPA Ambient Water Quality Criteria (AWQCs) for Fresh and Marine Waters, Proposed RCRA ALs, EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive

TABLE 2-4

CHEMICALS DETECTED IN SURFACE WATER AT SWMU 4
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
S4SS-2	IT 1993	Antimony	90.2	
S4SS-3	IT 1993	Antimony	87.5	
S4SS-2	IT 1993	Barium	7.3	B_1
S4SS-3	IT 1993	Barium	6.6	B_1
S4SS-1	IT 1993	Barium	3.8	B_1
S4SW-3	B&RE 1996	Iron	49.2	
S4SW-2	B&RE 1996	Iron	17.1	
S4SW-1	B&RE 1996	Iron	8.5	
S4SS-2	IT 1993	Lead	3.4	B_1
S4SW-4	B&RE 1996	Manganese	3.9	
S4SW-1	B&RE 1996	Mercury	0.6	
S4SW-2	B&RE 1996	Mercury	0.53	
S4SS-1	IT 1993	Sulfide	3,000	
S4SS-2	IT 1993	Thallium	2.8	B_1
S4SS-3	IT 1993	Tin	44.5	B_1
S4SS-1	IT 1993	Tin	30	B_1
S4SS-2	IT 1993	Tin	27.8	B_1
S4SS-2	IT 1993	Zinc	13.3	B_1
S4SS-1	IT 1993	Zinc	9.6	B_1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
S4SW-3	B&RE 1996	N-nitroso-di-n-propylamine	7	J
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S4SS-2	IT 1993	1,1,1-trichloroethane	0.23	
S4SW-3	B&RE 1996	Dibromomethane	1.7	J
S4SS-1	IT 1993	Methylene chloride	2	B_2J

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.

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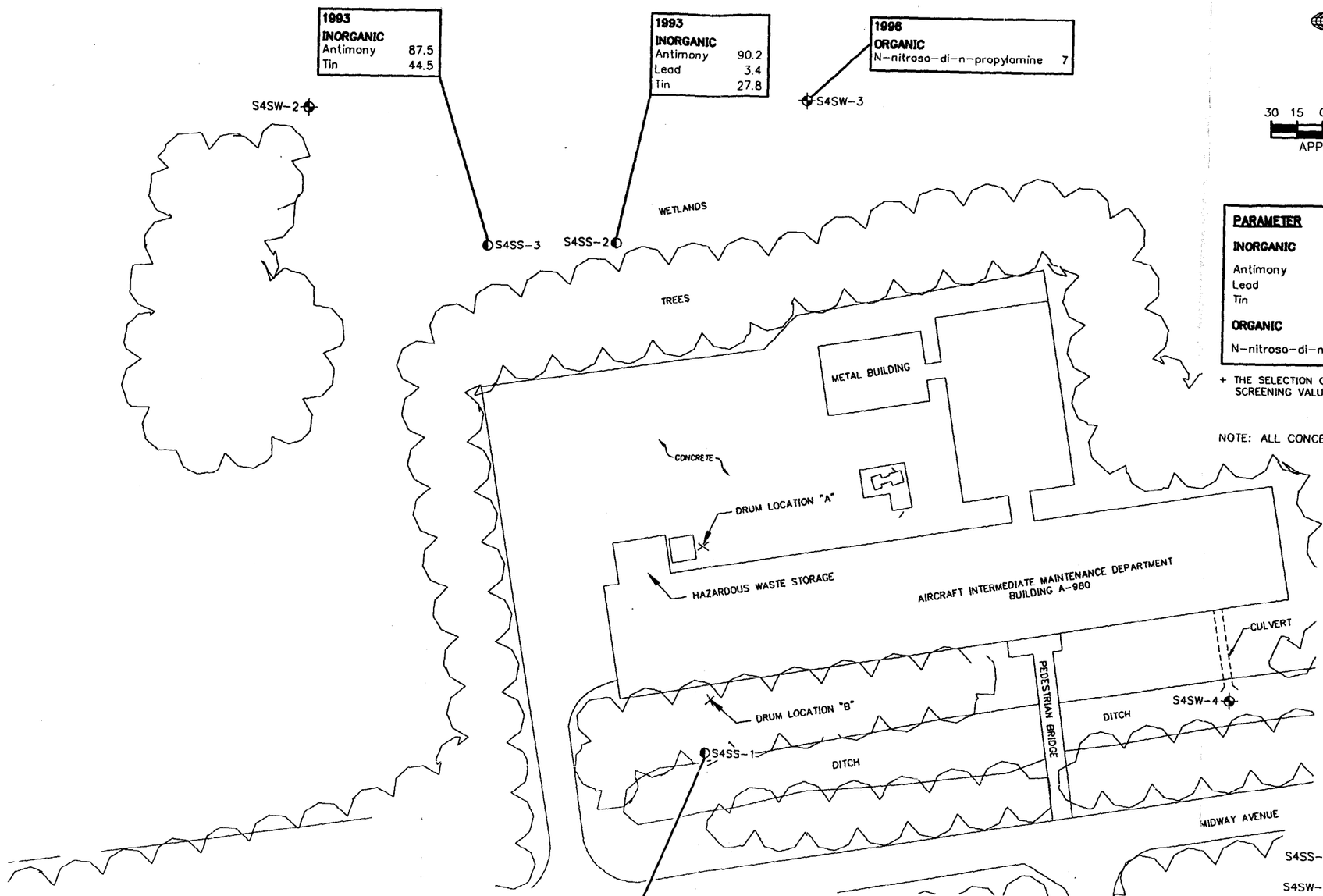

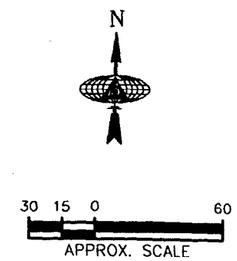

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	67
Lead	1.32
Tin	0.01
ORGANIC	
N-nitroso-di-n-propylamine	0.005

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

LEGEND

S4SS-1 ◐ SURFACE-WATER SAMPLE LOCATION IT CORPORATION (1993)

S4SW-1 ⊕ SURFACE-WATER SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704698029	PROJ. NO: HK7046

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FIGURE 2-9
SURFACE-WATER CHEMICAL CONCENTRATIONS SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F042

Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples.

2.4.4.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the surface-water samples at SWMU 4. VOCs detected at SWMU 4 included 1,1,1-trichlorethane, dibromomethane, and methylene chloride. Each was detected at only one sample location in the vicinity of the AIMD Building.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Dibromomethane was identified as a COPC (see Section 2.6.2.2) in the human health risk assessment based on a qualitative evaluation, since it does not have an RBC. The concentration of dibromomethane in surface water at SWMU 4 was less than the EPA Region III Marine BTAG Surface Water Screening Level selected for nature and extent screening.

2.4.4.2 Semivolatile Organic Compounds

The 0.005 microgram per liter (µg/L) proposed RCRA action level for n-nitroso-di-n-propylamine was exceeded at S4SW-3 (7 µg/L) in the northern portion of the site. No other SVOCs were detected in surface-water samples at SWMU 4.

2.4.4.3 Pesticides

No pesticides were detected in surface water at SWMU 4.

2.4.4.4 Polychlorinated Biphenyls

No PCBs were detected in surface water at SWMU 4.

2.4.4.5 Inorganics

Antimony, lead, and tin exceeded the screening criteria in surface water at SWMU 4. Antimony was detected at only two sample locations [S4SS-2 (90.2 µg/L) and S4SS-3 (87.5 µg/L)] and both occurrences were in excess of the 67 µg/L criteria limit. These samples were located in the wetland area north of the

AIMD Building and were collected by IT Corporation in 1993. At 3.4 μg/L, lead exceeded the 1.32 μg/L screening value in S4SS-2, the only surface-water sample where it was detected. Tin was detected in three samples collected by IT Corporation in 1993, and exceeded the surface-water screening value in each case. S4SS-2 (27.8 μg/L) and S4SS-3 (44.5 μg/L) were located in the wetland area north of the AIMD Building, while S4SS-1 (30 μg/L) was located in the ditch south of the AIMD Building. Other inorganics detected in the surface water at SWMU 4 include barium, iron, manganese, mercury, sulfide, thallium, and zinc.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Barium and zinc were identified as COPCs (see Section 2.6.2.2) in the human health risk assessment due to toxicity, since they do not have RBCs. All barium concentrations in surface water at SWMU 4 were less than the proposed RCRA AL selected for surface-water screening in this section. All zinc concentrations in surface water at SWMU 4 were less than the EPA Region III Marine BTAG Surface Water Screening Level selected for nature and extent screening.

2.4.5 Groundwater

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI, were considered in the analysis of groundwater contamination at SWMU 4. Chemicals that were detected in groundwater samples are listed in Table 2-5. This table includes laboratory analytical results from all applicable historical sampling as well as this Supplemental RFI/RI. Figures 2-10 and 2-11 show the occurrence of analytes that exceeded screening values and indicated possible groundwater contamination. Groundwater contamination beneath the site is predominantly attributable to metals and VOCs.

Screening values were obtained from a variety of sources including Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs), SDWA Secondary MCLs, SDWA Maximum Contaminant Level Goals (MCLGs), FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP Guidance Concentrations (GCs), Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

TABLE 2-5

CHEMICALS DETECTED IN GROUNDWATER AT SWMU 4
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
S4MW-2	IT 1993	Antimony	78.7	
S4MW-3	IT 1993	Arsenic	11.3	
S4MW-2	IT 1993	Arsenic	7.6	B_1
S4MW-2	IT 1993	Barium	34.9	B_1
S4MW-3	IT 1993	Barium	16.2	B_1
S4MW-2	IT 1993	Chromium	28.9	
S4MW-3	IT 1993	Chromium	17	
S4MW-2	IT 1993	Cyanide	250	
S4MW-2	IT 1993	Lead	7.6	
S4MW-3	IT 1993	Lead	2.3	B_1
S4MW-2	IT 1993	Sulfide	32,000	
S4MW-2	IT 1993	Tin	50.6	B_1
S4MW-2	IT 1993	Vanadium	12.5	B_1
S4MW-3	IT 1993	Vanadium	10.4	B_1
S4MW-2	IT 1993	Zinc	19.4	B_1
S4MW-3	IT 1993	Zinc	14.2	B_1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
S4MW-6	B&RE 1996	1,4-dioxane	11.9	
S4MW-2	IT 1993	2,4-dimethylphenol	5	J
S4MW-3	B&RE 1996	Bis(2-ethylhexyl)phthalate	12.2	J
S4MW-3	IT 1993	Phenanthrene	3.3	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S4MW-3	IT 1993	1,1-dichloroethane	4.5	
S4MW-6	B&RE 1996	1,1-dichloroethane	4	
S4MW-2	B&RE 1996	1,1-dichloroethane	2	
S4MW-2	IT 1993	Acetone	7	J
S4MW-2	IT 1993	Carbon disulfide	2	J
S4MW-6	B&RE 1996	Chloroform	0.28	J
S4MW-3	B&RE 1996	Dichlorodifluoromethane	6.2	
S4MW-5	B&RE 1996	Ethylbenzene	2.3	
S4MW-2	IT 1993	Methylene chloride	1	B_2J
S4MW-5	B&RE 1996	Styrene	44.6	
S4MW-6	B&RE 1996	Styrene	3.1	
S4MW-3	B&RE 1996	Vinyl chloride	3.1	
S4MW-3	IT 1993	Vinyl chloride	2.7	
S4MW-2	B&RE 1996	Vinyl chloride	0.77	J
S4MW-5	B&RE 1996	Xylenes, total	3.2	J

Shading indicates a concentration in excess of the screening values (See Table C.3-4).

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
B_2 - Analyte was found in the blank as well as the sample.

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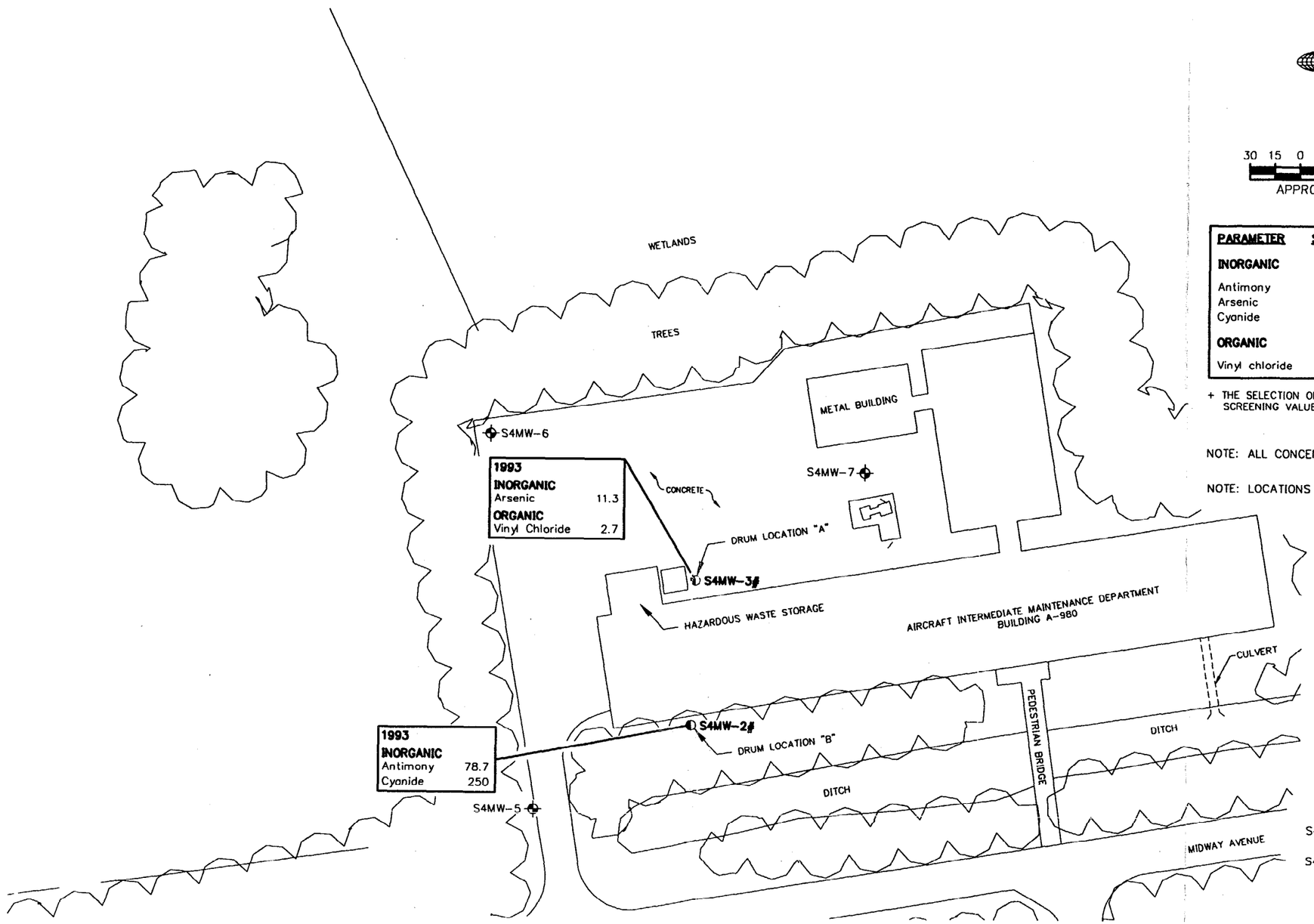

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6
Arsenic	9.3
Cyanide	200
ORGANIC	
Vinyl chloride	0.019

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

LEGEND

S4MW-2 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

S4MW-4 ⊕ MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)

ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.:7046980210	PROJ. NO.: HK7046

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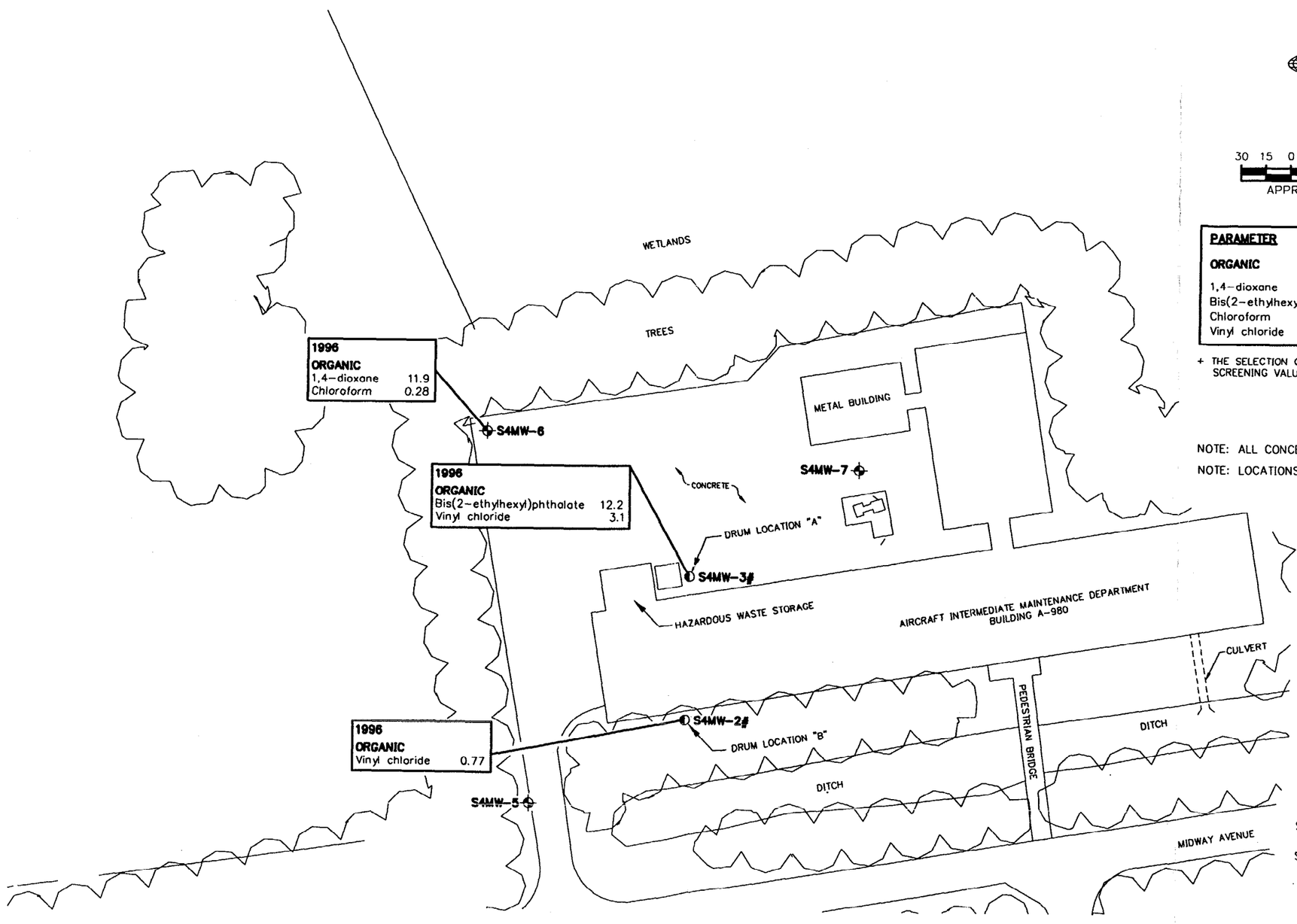
FIGURE 2-10
1993 GROUNDWATER CHEMICAL CONCENTRATIONS
SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
ORGANIC	
1,4-dioxane	3
Bis(2-ethylhexyl)phthalate	3
Chloroform	0.15
Vinyl chloride	0.019

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN μg/L.

NOTE: LOCATIONS SAMPLED IN 1996 ARE BOLD.

LEGEND

S4MW-2 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

S4MW-4 ⊕ MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)

\# ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/16/96
SCALE: AS SHOWN	
CAD DWG. NO.:7046980211	PROJ. NO.: HK7046

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FIGURE 2-11
1996 GROUNDWATER CHEMICAL CONCENTRATIONS
SWMU 4
NAVAL AIR STATION
KEY WEST, FLORIDA

2.4.5.1 Volatile Organic Compounds

VOCs were identified in the groundwater underlying the site in 1993 and 1996. During IT Corporation's 1993 RFI/RI investigation, 1,1-dichloroethane, acetone, carbon disulfide, methylene chloride, and vinyl chloride were detected in monitoring wells. Detected at 2.7µg/L in S4MW-3 (near the former location of Drum A), vinyl chloride was the only chemical that exceeded its screening criteria (1 µg/L) in 1993 groundwater samples. In 1996, vinyl chloride was detected in the same well at a slightly higher concentration (3.1 µg/L) and also in the well at S4MW-2 (0.77 µg/L). Chloroform was also detected in excess of its screening value in a single well in 1996. It was detected in excess of its 0.15 µg/L screening value at S4MW-6 (0.28 µg/L) northwest of AIMD Building A-980. 1,1-dichloroethane and dichlorodifluoromethane were detected below their respective screening values in 1996 in wells where they were tested, but not detected in 1993. Several other VOCs were detected in 1996 in wells that were installed during the Supplemental RFI/RI investigation. These included ethylbenzene, styrene, and xylene; none of which were detected by IT Corporation in 1993.

2.4.5.2 Semivolatile Organic Compounds

In 1993, 2,4-dimethylphenol and phenanthrene were identified in two wells at levels below the screening criteria. In 1996, 1,4-dioxane (11.9 µg/L) and bis(2-ethylhexyl)phthalate (12.2 µg/L) were detected in S4MW-6 and S4MW-3, respectively. Both chemicals exceeded their screening values and neither had been previously detected in groundwater at SWMU 4.

2.4.5.3 Pesticides

No pesticides were detected in groundwater at SWMU 4.

2.4.5.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at SWMU 4.

2.4.5.5 Inorganics

Inorganics were only detected during the 1993 RFI/RI investigation. Antimony (78.7 µg/L) and cyanide (250 µg/L) were detected in the groundwater sampled from S4MW-2, near the former location of Drum B. These two chemicals were not detected at any other SWMU 4 groundwater sampling location. Arsenic was detected at two monitoring wells, but was in excess of its screening criteria only at S4MW-3

(11.3 µg/L). Other inorganics detected at low levels included barium, chromium, lead, sulfide, tin, vanadium, and zinc.

2.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at SWMU 4. Section 2.5.1 presents those chemicals detected in excess of the screening values discussed in the nature and extent sections, along with apparent temporal and spatial trends. Section 2.5.2 addresses potential routes of migration, and Section 2.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. Section 3.1.5.1 of Appendix C quantifies the physical and chemical properties of the detected contaminants.

2.5.1 Summary of Contaminant Release

Solvents and oil mixtures generated during maintenance activities in the AIMD Building are potential sources of contamination at SWMU 4. Two in-ground drums were used to collect spillage from the building and were removed in 1989. These drums received trichlorotrifluoromethane (freon 113), electrical insulating mineral oil (coolanol-35R), water, PD-680 (a chlorinated organic solvent), Turco (a phenolic based aircraft cleaner), and PCA 44 Type C (an emulsifier cleaner).

Metals were the most common contaminants in soil at SWMU 4. Metals detected in excess of the screening criteria included antimony, beryllium, cadmium, chromium, copper, cyanide, lead, mercury, silver, sulfide, tin, vanadium, and zinc. Naphthalene was the only SVOC or VOC detected in excess of screening values in soil. It was detected in excess of the screening criteria at two locations, both on the south side of AIMD Building A-980 in the vicinity of Drum B's former location. Soil was the only media in which pesticides were detected at SWMU 4; however, none were detected in excess of screening values.

Inorganic contamination of sediment appeared to be fairly widespread throughout SWMU 4. However, only lead was detected in excess of the screening criteria at a single sample location. Lead was also detected at lower levels, below the screening criteria, in five other samples. A single VOC and a single SVOC were detected in excess of the screening criteria in sediment. Although acetone was detected at two locations in the ditch south of the AIMD Building, it exceeded the screening criteria in only one of the samples. Bis(2-ethylhexyl)phthalate was also detected in excess of its screening criteria in the ditch at the same location where the acetone exceedance occurred.

Inorganics were also the dominant class of contaminants detected in surface water at SWMU 4. Antimony, lead, and tin were detected in excess of the screening criteria mainly in locations in the wetland area north of the AIMD Building. Only one organic compound, the SVOC n-nitroso-di-n-propylamine, was detected in excess of surface-water screening criteria. This exceedance occurred in a sample from the northern portion of the site.

Vinyl chloride and chloroform were the only VOCs detected above screening values in groundwater at SWMU 4. Chloroform was detected in excess of its screening value at a single well in 1996. Vinyl chloride was detected in excess at one well in 1993 and two wells in 1996. 1,4-dioxane and bis(2-ethylhexyl)phthalate were both detected in excess of screening values in groundwater in 1996 samples. Other VOCs and SVOCs were detected, but at levels below the screening values. Inorganics were detected only in 1993 samples collected by IT Corporation. Antimony, arsenic, and cyanide were the only inorganics detected at concentrations in excess of screening criteria, each detected only at one well.

PCBs were not detected in any media at SWMU 4.

2.5.2 Potential Routes of Migration

The contaminant sources at SWMU 4 consist of two former in-ground 55-gallon drums. Both drums, as well as a 6-inch layer of soil under and around each drum, were excavated and removed in 1989. Former contaminant release pathways include volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in the site soil could have volatilized from surficial material or become airborne via resuspension. Contaminated fugitive dust could have been generated during ground-disturbing activities, such as construction or excavation, causing possible contaminant dispersion in the surrounding environment and transportation to downwind locations where they could have repartitioned to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. However, volatilization, wind erosion, and overland runoff from the former drum locations are previous pathways (for the most part) that no longer exist, since the drums and surrounding soil were removed in 1989. The only area from which these pathways could presently exist is a 40-foot-wide strip of soil between the paved parking lot north of Building A-980 and the adjacent marsh. Erosion from wind and runoff in this area would be minimal due to the vegetation cover and thick ground layer of Australian pine needles. In addition, it does not appear likely that contaminants from either of the two former drums migrated to the marsh.

Present contaminant release pathways are primarily limited to possible subsurface soil contaminants that could potentially infiltrate into the water table and be carried with the flow of groundwater to downgradient

locations. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. Groundwater at the site is shallow and probably is connected hydrologically to surface water in the marsh north of the site, or to surface water in the ditch south of Building A-980. Contaminants can be deposited subsequently in sediment or surface water and can potentially accumulate in the tissues of aquatic organisms. The extensive area of surface water in the marsh and swamp minimizes the airborne transport of volatile contaminants. Since the drums and surrounding soil were removed in 1989, the groundwater exposure pathway is applicable only for any residual soil and groundwater contamination.

2.5.3 Contaminant Transport Potential and Persistence

The primary sources of contamination at SWMU 4 were the two in-ground drums used to collect spillage from maintenance activities at the AIMD building. Initial releases from the drums and the building would have been to the air and soil. Inorganics were the most common contaminants in soil and sediment at SWMU 4. Metals generally are adsorbed onto soil and sediment particles, greatly reducing their mobility. Inorganics were also the dominant contaminant detected in surface water at SWMU 4. Organic compounds, particularly VOCs, were detected in all media, but occurrences were generally isolated.

Precipitation runoff can carry constituents to nearby surface waters, sediments, and surface soils, especially to surface water and sediments downgradient of the former drum locations. Infiltrating precipitation can cause the contamination of subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in soil are likely to migrate at a slower rate. Upon infiltrating the soil column and reaching the water table, a contaminant can be carried with the flow of groundwater to downgradient locations. Groundwater from the site is shallow and probably is connected with surface water in the wetlands area; providing a potential pathway for sediment deposition and accumulation in the tissues of aquatic organisms.

Although many metals are water-insoluble and preferentially adsorb onto soil and sediment, they may exist in dissolved or suspended forms. Some soluble species of metals have increased mobility. For example, the transport of lead in the environment is strongly influenced by speciation of the ion. Sorption processes appear to exert a dominant effect on the distribution of lead in the environment and the subsurface movement of lead is expected to be minimal in most aquifers because of its low solubility and strong tendency to sorb to aquifer materials. Lead is strongly complexed to organic materials present in both aquatic systems and soil (Clement Associates, 1985).

Although sorption of inorganics tends to reduce their mobility in the subsurface, strong association with soil and sediment particles may increase the persistence of inorganic contamination at a site. Contaminants that persist in the solid media will also continue to be present in surface water and groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations would remain low.

Organic substances exhibit very limited biodegradation rates in soil, with the heavier organic compounds considered more persistent. Organics can be biodegraded, but the rate of degradation is slower for compounds with higher molecular weights (Clement Associates, 1985). In addition, the low persistence of VOCs in soil is influenced greatly by their solubility and high volatility.

2.6 BASELINE HUMAN HEALTH RISK ASSESSMENT - SWMU 4

This section presents the baseline human health risk assessment for SWMU 4. It describes a qualitative and quantitative assessment of actual or potential risks for SWMU 4. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and remedial goal options. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 2.6.8.

2.6.1 Preliminary Risk Evaluation

A preliminary risk evaluation (PRE) was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 2-6 and 2-7 summarize the preliminary risk evaluation for SWMU 4 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. However, the risk ratios calculated for the residential land use scenario are greater than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. Therefore, a baseline human health risk assessment is necessary for SWMU 4. The primary contributor to carcinogenic risk in soil and sediment is arsenic. The primary

TABLE 2-6

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
SWMU 4
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	1.4	2.9	ND	0.43	0.43	0.045	3.8	3E-06	7E-06	NA	4E-07
Beryllium	0.15	ND	ND	0.15	0.15	0.016	1.3	1E-06	NA	NA	1E-07
PESTICIDES/PCBs											
4,4'-DDE	29.5	ND	ND	1,900	1,900	0.2	17,000	2E-08	NA	NA	2E-09
4,4'-DDT	36.4	ND	ND	1,900	1,900	0.2	17,000	2E-08	NA	NA	2E-09
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	220	490	ND	46,000	46,000	4.8	410,000	5E-09	1E-08	NA	5E-10
Chrysene	ND	37	ND	88,000	88,000	9.2	780,000	NA	4E-10	NA	NA
VOLATILE ORGANIC COMPOUNDS											
1,1,1-trichloroethane	ND	ND	0.23	2,700,000	2,700,000	790	72,000,000	NA	NA	3E-10	NA
Carbon tetrachloride	3	ND	ND	4,900	4,900	0.16	44,000	6E-10	NA	NA	7E-11
Methylene chloride	69	19	2	85,000	85,000	4.1	760,000	8E-10	2E-10	5E-07	9E-11
N-nitroso-di-n-propylamine	ND	ND	7	91	91	0.0096	820	NA	NA	7E-04	NA
Tetrachloroethene	0.48	1.5	ND	12,000	12,000	1.1	110,000	4E-11	1E-10	NA	4E-12
Risk Sums by Medium								**4E-06**	**7E-06**	**7E-04**	**5E-07**
Risk Sums by Use Scenario								**7E-04**			**5E-07**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 2-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS SWMU 4
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	3,180	2,680	ND	78,000	78,000	37,000	1,000,000	4E-01	3E-01	NA	3E-02
Antimony	3.6	8.8	90.2	31	31	15	820	1E+00	3E+00	6E+01	4E-02
Arsenic	1.4	2.9	ND	23	23	11	610	6E-01	1E+00	NA	2E-02
Barium	10.6	8.1	7.3	5,500	5,500	2,600	140,000	2E-02	1E-02	3E-02	8E-04
Beryllium	0.15	ND	ND	390	390	180	1,000	4E-03	NA	NA	2E-03
Cadmium	1.6	ND	ND	39	39	18	1,000	4E-01	NA	NA	2E-02
Chromium VI	14.4	17.2	ND	390	390	180	10,000	4E-01	4E-01	NA	1E-02
Copper	22.8	15.6	ND	3,100	3,100	1,500	82,000	7E-02	5E-02	NA	3E-03
Cyanide	21	ND	ND	1,600	1,600	730	41,000	1E-01	NA	NA	5E-03
Iron	2,050	1,670	49.2	23,000	23,000	11,000	610,000	9E-01	7E-01	4E-02	3E-02
Manganese	18.9	36.5	ND	390	390	180	10,000	5E-01	9E-01	NA	2E-02
Mercury	0.16	ND	0.6	23	23	11	610	7E-03	NA	5E-01	3E-03
Nickel	2.7	2.3	ND	1,600	1,600	730	41,000	2E-03	1E-02	NA	7E-04
Silver	1.3	ND	ND	390	390	180	10,000	3E-02	NA	NA	1E-03
Thallium	ND	ND	2.8	6.3	6.3	2.9	160	NA	NA	9E+00	NA
Tin	11.2	ND	44.5	47,000	47,000	2,200	1,000,000	2E-03	NA	2E-01	1E-04
Vanadium	8.3	8.9	ND	550	550	2,600	14,000	2E-01	2E-01	NA	6E-03
Zinc	66.3	107	13.3	23,000	23,000	11,000	610,000	3E-02	5E-02	1E-02	1E-03
PESTICIDES/PCBs											
4,4'-DDT	36.4	ND	ND	39	39	18	1,000	9E+00	NA	NA	4E-01
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	220	490	ND	1,600,000	1,600,000	730	41,000,000	1E-03	3E-03	NA	5E-05
Fluoranthene	ND	70	ND	3,100,000	3,100,000	1,500	82,000,000	NA	2E-04	NA	NA
Pyrene	ND	82	ND	2,300,000	2,300,000	1,100,000	61,000,000	NA	4E-04	NA	NA
VOLATILE ORGANIC COMPOUNDS											
2-butanone	ND	11	ND	47,000,000	47,000,000	1,900	1,000,000,000	NA	2E-06	NA	NA
1,1,1-trichloroethane	ND	ND	0.23	2,700,000	2,700,000	790	72,000,000	NA	NA	3E-03	NA
cis-1,2-dichloroethene	19	ND	ND	780,000	780,000	61	20,000,000	2E-04	NA	NA	10E-06
Acetone	70	200	ND	7,80,000	7,800,000	3,700	200,000,000	9E-05	3E-04	NA	4E-06
Carbon tetrachloride	3	ND	ND	55,000			1,400,000	5E-04	NA	NA	2E-05
Methylene chloride	69	19	2	4,700,000	4,700,000	260	120,000,000	1E-04	4E-05	8E-02	6E-06
Tetrachloroethene	0.48	1.5	ND	780,000	780,000	370	20,000,000	6E-06	2E-05	NA	2E-07
							Hazard Sums by Medium	**1E+01**	**7E+00**	**7E+01**	**6E-01**
							Hazard Sums by Use Scenario	**9E+01**			**6E-01**

* All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

contributor to carcinogenic risk in surface water is N-nitroso-di-n-propylamine. The primary contributors to noncarcinogenic risks are antimony in soil, sediment, and surface water and arsenic and 4,4'-DDT in soil.

2.6.2 Data Evaluation

A list of the Chemicals of Potential Concern (COPCs) was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

2.6.2.1 Soils

Six VOCs (2-chloro-1,3-butadiene, acetone, carbon tetrachloride, cis-1,2-DCE, methylene chloride, and PCE), bis(2-ethylhexyl)phthalate, 4,4'-DDE, 4,4'-DDT, and metals were detected in one or more of the surface soil samples collected at SWMU 4. Three PAHs (benzo(a)pyrene, benzo(k)fluoranthene, and naphthalene), bis(2-ethylhexyl)phthalate, cis-1,2-DCE, methylene chloride, xylene, endosulfan I, and several metals were detected in subsurface soil samples collected at SWMU 4. The occurrence and distribution of chemicals in surface and subsurface soils are presented in Tables 2-8 through 2-11. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in SWMU 4 surface and subsurface soils are also presented in these tables.

The following chemicals were selected as COPCs at SWMU 4 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
Antimony	None Selected	None Selected	None Selected
Beryllium			
Cadmium			

Metals selected as COPCs in surface soil at SWMU 4 were detected at the following frequencies: antimony (1/6), beryllium (2/6), and cadmium (3/6). The maximum and representative concentrations for these COPCs exceeded or were equal to RBCs developed for the residential land use scenario. Organic chemicals in surface soils were detected at concentrations less than residential RBC values. Inorganic chemicals in subsurface soils were detected at levels below RBCs developed for the industrial land use scenario. Likewise, organic chemicals detected in subsurface soils were detected at concentrations less than industrial RBC values. Therefore, no COPCs were selected for subsurface soils.

TABLE 2-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT SWMU 4 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	14/14	120 - 4,250	1,887	2/2	243 - 3,180	1,712	1,712	7,800	3,180	N	A
Antimony	2/15	0.26 - 0.48	0.39	1/6	3.6 - 3.6	3.6	1.49	3.10	2.5	Y	C
Arsenic	6/15	0.63 - 2.7	1.29	3/6	0.24 - 1.4	0.67	0.46	0.43	1.4	N	G
Barium	15/15	4.4 - 17.7	10.51	6/6	4.9 - 11.9	8.38	8.38	550	10.6	N	A
Beryllium	2/15	0.13 - 0.15	0.05	2/6	0.14 - 0.15	0.15	0.01	0.15	0.15	Y	C
Cadmium	4/15	0.11 - 0.45	0.15	3/6	1.4 - 5.9	2.97	1.58	3.9	1.6	Y	C
Chromium**	15/15	1.9 - 15.5	6.02	6/6	5.5 - 14.9	9.38	9.38	39	14.3	N	A
Copper	14/15	1.3 - 15.6	5.43	6/6	7.1 - 66.3	22.73	22.73	310	22.8	N	A
Cyanide	0/15	Not detected	–	1/3	21 - 21	21	8.68	160	21	N	A
Iron	14/14	98.1 - 2,260	1,167	2/2	530 - 2,050	1,290	1,290	2,300	2,050	N	A
Lead	14/15	0.65 - 48.3	15.66	6/6	8.7 - 60.8	30.40	30.40	400	47.5	N	A
Manganese	14/14	2.6 - 33.7	17.65	2/2	7.8 - 18.9	13.35	13.35	180	18.9	N	A
Mercury	5/15	0.03 - 0.08	0.03	5/6	0.08 - 0.16	0.11	0.10	2.3	0.16	N	A
Nickel	11/15	0.63 - 4.1	1.67	2/6	1.2 - 2.7	1.95	1.37	160	2.45	N	A
Silver	0/15	Not detected	–	3/6	1.1 - 1.5	1.3	0.77	39	1.3	N	A
Sulfide	1/1	49 - 49	49	2/2	340 - 790	565	565	–	790	N	D
Tin	2/5	0.78 - 2.1	1.94	1/4	11.2 - 11.2	11.2	4	4,700	11.2	N	A
Vanadium	15/15	0.8 - 8.8	3.97	3/6	1.1 - 8.3	3.7	2.12	55	8.3	N	A
Zinc	12/15	0.63 - 89.1	15.22	6/6	7.7 - 66.3	37.78	37.78	2,300	66.3	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
D - Not COPC (nut./mineral)
G - Not COPC (Max>RBC & Max<2XBkgdAvg)
**As chromium VI

TABLE 2-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT SWMU 4 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Decetion	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	COPC Selection*
PESTICIDES/PCBs											
4,4'-DDE	7/14	1.8 - 741	63.23	2/4	22 - 29.5	25.75	15.19	1,900	29.5	N	A
4,4'-DDT	7/14	1.8 - 557	46.78	1/4	36.4 - 36.4	36.4	13.66	1,900	36.4	N	A
Endosulfan I	2/14	1 - 3.5	5.99	1/4	1.4 - 1.4	1.4	4.98	470,000	1.4	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	1/11	330 - 330	470.55	1/3	220 - 220	220	454.33	46,000	220	N	A
VOLATILE ORGANIC COMPOUNDS											
2-chloro-1,3-butadiene	0/7	Not detected	–	1/2	2 - 2	2	2.50	160,000	2	N	A
Acetone	1/12	1 - 1	3.67	2/3	5 - 70	37.5	27	780,000	70	N	A
Carbon tetrachloride	0/12	Not detected	–	1/5	3 - 3	3	1.75	4,900	3	N	A
Cis-1,2-dichloroethene	0/3	Not detected	–	1/4	19 - 19	19	5.76	78,000	19	N	A
Methylene chloride	6/12	0.11 - 14	2.8	3/5	12 - 69	34.3	23.80	85,000	69	N	A
Tetrachloroethene	0/12	Not detected	–	1/5	0.48 - 0.48	0.48	1.36	12,000	0.48	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

TABLE 2-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SUBSURFACE SOILS AT SWMU 4 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration For Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Antimony	2/15	0.26 - 0.48	0.39	6/17	3.6 - 4.4	4.0	3.75	82	4.4	N	A
Arsenic	6/15	0.63 - 2.7	1.29	13/17	0.22 - 1.3	0.51	0.42	4	0.657	N	A
Barium	15/15	4.4 - 17.7	10.51	17/17	2.4 - 6.2	3.66	3.66	14,000	4.12	N	A
Beryllium	2/15	0.13 - 0.15	0.05	9/17	0.12 - 0.27	0.17	0.16	1	0.198	N	A
Cadmium	4/15	0.11 - 0.45	0.15	1/17	0.58 - 0.58	0.58	0.43	100	0.561	N	A
Chromium**	15/15	1.9 - 15.5	6.02	17/17	3.4 - 7.1	4.59	4.59	1,000	5.05	N	A
Copper	14/15	1.3 - 15.6	5.43	7/17	1.5 - 8.3	4.03	2	8,200	3.7	N	A
Cyanide	0/15	Not detected	–	1/2	18 - 18	18	11.5	4,100	18	N	A
Lead	14/15	0.65 - 48.3	15.66	17/17	0.28 - 15/4	3.12	3.12	400	7.31	N	A
Mercury	5/15	0.03 - 0.08	0.03	3/16	0.03 - 0.16	0.09	0.02	61	0.0349	N	A
Silver	0/15	Not detected	–	2/17	0.61 - 1.8	1.21	0.6	1,000	0.885	N	A
Sulfide	1/1	49 - 49	49	2/2	60 - 1,500	780	780	–	1,500	N	D
Tin	2/5	0.78 - 2.1	1.94	2/17	4 - 12	8	2.46	100,000	2.97	N	A
Vanadium	15/15	0.8 - 8.8	3.97	9/17	1.1 - 5.3	2.06	1.36	1,400	1.95	N	A
Zinc	12/15	0.63 - 89.1	15.22	17/17	1.5 - 190	17.05	17.05	61,000	29.4	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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 industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

D - Not COPC (nut./mineral)

**As chromium VI

TABLE 2-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SUBSURFACE SOILS AT SWMU 4 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
SEMIVOLATILE ORGANIC COMPOUNDS											
Benzo(a)pyrene	0/14	Not detected	–	1/17	12 - 12	12	116.65	780	12	N	A
Benzo(k)fluoranthene	0/14	Not detected	–	1/17	12 - 21	15.7	125.51	78,000	21	N	A
Bis(2-ethylhexyl)phthalate	1/11	330 - 330	470.55	1/2	2,800 - 2,800	2,800	1,875	410,000	2,800	N	A
Naphthalene	0/14	Not detected	–	2/17	260 - 340	300	153.06	8,200,000	340	N	A
VOLATILE ORGANIC COMPOUNDS											
Cis-1,2-dichloroethene	0/3	Not detected	–	1/17	2 - 2	2	0.81	2,000,000	0.993	N	A
Methylene chloride	6/12	0.11 - 14	2.80	2/17	7 - 10	8.5	8.74	760,000	9.01	N	A
Xylenes, total	1/15	2.1 - 2.1	3.73	1/17	6.6 - 6.6	6.6	1.22	100,000,000	1.97	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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 industrial exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

2.6.2.2 Sediment and Surface Water

Four VOCs (2-butanone, acetone, methylene chloride, and PCE); four PAHs (chrysene, fluoranthene, phenanthrene, and pyrene); bis(2-ethylhexyl)phthalate; and metals were detected in one or more of the sediment samples collected at SWMU 4. 1,1,1-TCA, methylene chloride, dibromomethane, and n-nitroso-di-n-propylamine, and metals were detected in surface-water samples collected at SWMU 4. The occurrence and distribution of chemicals in sediment and surface water are presented in Tables 2-12 through 2-15. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in SWMU 4 in sediment and surface water are also presented in these tables. The following chemicals were selected as COPCs for SWMU 4 sediment and surface water:

SEDIMENT		SURFACE WATER	
Inorganics	Organics	Inorganics	Organics
Antimony	Phenanthrene*	Antimony	N-nitroso-di-n-propylamine
		Barium**	Dibromomethane*
		Iron**	
		Manganese**	
		Tin**	
		Zinc**	

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No Water Quality Standards (WQSs) (for consumption of water and organisms) are listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Only one metal, antimony, was selected as a COPC for sediment at SWMU 4. Antimony was detected in only 1 out of 6 samples at a concentration of 8.8 mg/kg. The maximum and representative concentration of antimony exceeded the RBC for residential soil exposure. Organic chemicals were detected at concentrations less than RBCs for residential soil exposure. Therefore, no organic COPCs were selected for sediment. Phenanthrene will be evaluated qualitatively in the uncertainty section because it lacks a quanitative toxicity value. RBCs for soil exposure are used because RBCs protective of human health sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health.

TABLE 2-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SEDIMENT AT SWMU 4 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	12/12	97.7 - 3,350	1,332	3/3	1,230 - 2,680	1,995	1,995	7,800	2,680	N	A
Antimony	0/13	Not detected	–	1/6	8.8 - 8.8	8.8	3.38	3.10	8.8	Y	C
Arsenic	8/12	1.5 - 7	2.63	6/6	1.5 - 2.9	2.26	2.26	0.43	2.89	N	G
Barium	13/13	5 - 15.2	9.27	6/6	6 - 8.1	7.09	7.09	550	8.05	N	A
Chromium**	8/13	2.1 - 11.7	5.01	5/6	4.8 - 17.2	10.01	8.77	39	17.2	N	A
Copper	13/13	0.76 - 34.6	8.88	6/6	4.7 - 15.6	9.5	9.50	310	15.6	N	A
Iron	12/12	109 - 3,640	1,199	3/3	1,214 - 1,670	1,431	1,431	2,300	1,670	N	A
Lead	12/13	5.5 - 56.5	17.97	6/6	2.5 - 38.1	20.20	20.20	400	38.1	N	A
Manganese	12/12	4 - 38.6	15.39	3/3	21.9 - 36.5	28.22	28.22	180	36.5	N	A
Nickel	10/13	0.7 - 5.5	2.15	3/6	1.2 - 2.3	1.78	2.54	160	2.3	N	A
Sulfide	1/1	340 - 340	340	1/1	480 - 480	480	480	–	480	N	D
Tin	1/2	0.99 - 0.99	2.85	1/3	22.8 - 22.8	22.8	11.08	4,700	22.8	N	A
Vanadium	13/13	1.6 - 11.7	5.08	6/6	4.7 - 8.9	6.18	6.18	55	7.53	N	A
Zinc	8/13	3.5 - 140	25.74	4/6	12.1 - 107	55.3	36.95	2,300	107	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Sediment RBCs are adapted using residential soil RBC.

An RBC for lead based on cancer risk or hazard index is not available. The 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
D - Not COPC (nut./mineral)
G - Not COPC (Max>RBC & Max<2XBkgdAvg)
**As chromium VI

TABLE 2-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SEDIMENT AT SWMU 4 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of of COPC Selection*
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	1/6	4,500 - 4,500	1,992	1/4	490 - 490	490	352.19	46,000	490	N	A
Chrysene	1/13	417 - 417	961.38	1/6	37 - 37	37	535.83	88,000	37	N	A
Fluoranthene	1/13	690 - 690	982.38	1/6	70 - 70	70	541.33	310,000	70	N	A
Phenanthrene	0/13	Not detected	–	1/6	60 - 60	60	539.67	–	60	Y	F
Pyrene	1/13	509 - 509	968.46	1/6	82 - 82	82	543.33	230,000	82	N	A
VOLATILE ORGANIC COMPOUNDS											
2-butanone	1/6	4 - 4	8.49	1/4	11 - 11	11	6.24	4,700,000	11	N	A
Acetone	3/6	4 - 120	30.90	2/4	38 - 200	119	64.49	780,000	200	N	A
Methylene chloride	2/6	5 - 20	7.50	1/6	19 - 19	19	13.80	85,000	19	N	A
Tetrachloroethene	1/6	2 - 2	4.33	3/6	0.97 - 1.5	1.2	1.95	12,000	1.5	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Sediment RBCs are adapted using residential soil RBC.

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

*A - Not COPC (Max<RBC)

F - COPC (eval. qual.)

TABLE 2-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE WATER AT SWMU 4 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average o Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Antimony	4/12	3.5 - 205	33.71	2/6	87.5 - 90.2	88.9	33.12	14	90.2	Y	C
Barium	11/13	4.7 - 16.3	6.93	3/6	3.8 - 7.3	5.9	3.76	–	7.3	Y	H
Iron	5/12	8.5 - 170	24.70	2/3	17.1 - 49.2	33.1	22.75	–	49.2	Y	H
Lead	0/12	Not detected	–	1/6	3.4 - 3.4	3.4	1.68	50	2.78	N	A
Manganese	2/12	3.2 - 12.3	2.00	1/3	3.9 - 3.9	3.9	1.97	–	3.9	Y	H
Mercury	6/13	0.29 - 4.2	0.52	1/6	0.53 - 0.53	0.53	0.16	0.14	0.53	N	G
Sulfide	1/1	4,000 - 4,000	4,000	1/1	3,000 - 3,000	3,000	3,000	–	3,000	N	D
Thallium	2/13	7.4 - 12	4.73	1/6	2.8 - 2.8	2.8	1.97	1.7	2.75	N	G
Tin	0/4	Not detected	–	3/3	27.8 - 44.5	34.1	34.10	–	44.5	Y	H
Zinc	5/13	1.4 - 39.6	7.19	2/6	9.6 - 13.3	11.5	4.73	–	13.3	Y	H

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg)

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

D - Not COPC (nut./mineral)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

H - COPC (lacks an RBC, but has a quantitative toxicity)

TABLE 2-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE WATER AT SWMU 4 (µg/L) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of of COPC Selection*
SEMIVOLATILE ORGANIC COMPOUNDS											
N-nitroso-di-n-propylamine	0/9	Not detected	–	1/4	7 - 7	7	5.50	0.005	6.95	Y	B
VOLATILE ORGANIC COMPOUNDS											
1,1,1-trichloroethane	0/9	Not detected	–	1/6	0.23 - 0.23	0.23	0.98	3,100	0.23	N	A
Dibromomethane	0/7	Not detected	–	1/6	1.7 - 1.7	1.7	1.37	–	1.7	Y	F
Methylene chloride	3/9	1 - 1	1.50	1/6	2 - 2	2	4.43	4.7	2	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

B - COPC (Max>RBC, organics)

F - COPC (eval. qual.)

Of the metals selected as COPCs for surface water, only antimony was detected at a maximum concentration that exceeded an applicable WQS. WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure that provides the basis for developing an applicable WQS. Thus, the use of WQSs as RBCs to select surface-water COPCs is conservative regarding protection of human health.

Dibromomethane was selected as a COPC for surface water due to its lack of a quantitative toxicity value. In order to be conservative regarding protection of human health, this chemical was included as a COPC and will be evaluated qualitatively in the uncertainty section.

Barium, iron, manganese, tin, and zinc were also selected as COPCs for surface water at SWMU 4. These chemicals do not have listed WQSs, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

2.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at SWMU 4 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

2.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at SWMU 4 are presented in Section 2.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

2.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under a reasonable maximum exposure (RME) and a central tendency exposure (CTE). CTE will only be included if the total

carcinogenic risk for an exposure pathway exceeds 1E-06 or if a hazard index (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in three parts:

- Carcinogenic risks
- Noncarcinogenic risks
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and a hazard index (HI) of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

2.6.5.1 Carcinogenic Risks - RME

Table 2-16 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents is 1E-06, which is at the lower end of the EPA "target risk range" of 1E-04 to 1E-06, although it exceeds the FDEP cancer risk of 1E-06. Incidental ingestion of surface soil for the future resident has an incremental cancer risk of 1E-06. The ingestion exposure route contributes the most to the cumulative carcinogenic risk for the future resident. The principal COPC contributing to this cancer risk is beryllium (surface soil); however, it was detected at levels that were just above background. The estimated carcinogenic risks for all other potential receptors at SWMU 4 are less than the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 2.6.8.

Table 2-17 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The estimated carcinogenic risks for all potential receptors at SWMU 4 are all below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 2.6.8.

2.6.5.2 Noncarcinogenic Risks - RME

Table 2-16 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The principal COPC contributing to the noncarcinogenic risk is antimony in

TABLE 2-16

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
SWMU 4*
NAS KEY WEST

Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	1E-06	2E-08	2E-08	1E-08	NA	1E-07
Dermal Contact	1E-07	5E-09	4E-09	3E-09	NA	3E-08
Inhalation of Fugitive Dust	3E-14	2E-16	1E-16	2E-16	NA	5E-15
Subtotal	1E-06	2E-08	3E-08	2E-08	NA	1E-07
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	1E-06	2E-08	3E-08	2E-08	**	1E-07
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	2E-01	1E-03	3E-03	7E-04	NA	6E-03
Dermal Contact	4E-02	2E-03	3E-03	7E-04	NA	7E-03
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	2E-01	3E-03	6E-03	2E-03	NA	1E-02
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	8E-02	2E-03	5E-03	NA	NA	NA
Dermal Contact	4E-03	6E-04	9E-04	NA	NA	NA
Subtotal	8E-02	3E-03	5E-03	NA	NA	NA
Surface Water						
Incidental Ingestion	5E-01	3E-02	6E-02	NA	NA	NA
Dermal Contact	4E-01	2E-02	2E-02	NA	NA	NA
Subtotal	9E-01	4E-02	9E-02	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	1E+00	5E-02	1E-01	2E-03	**	1E-02

* = Chemical-Specific Risks are presented in Section 2.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

NA = Not Applicable; pathway is not applicable for the respective media.

TABLE 2-17
CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
SWMU 4*
NAS KEY WEST

Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
Surface Soil						
Incidental Ingestion	3E-07	2E-09	9E-10	2E-09	NA	4E-08
Dermal Contact	7E-09	2E-10	8E-11	2E-10	NA	2E-09
Inhalation of Fugitive Dust	9E-15	3E-17	1E-17	9E-17	NA	2E-15
Subtotal	3E-07	2E-09	1E-09	2E-09	NA	4E-08
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	3E-07	2E-09	1E-09	2E-09	**	4E-08
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	2E-01	3E-04	6E-04	3E-04	NA	6E-03
Dermal Contact	8E-03	2E-04	5E-05	2E-03	NA	1E-03
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	2E-01	5E-04	7E-04	5E-04	NA	7E-03
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	4E-02	5E-04	1E-03	NA	NA	NA
Dermal Contact	4E-04	6E-05	1E-04	NA	NA	NA
Subtotal	4E-02	6E-04	1E-03	NA	NA	NA
Surface Water						
Incidental Ingestion	3E-01	1E-02	3E-02	NA	NA	NA
Dermal Contact	2E-01	8E-03	1E-02	NA	NA	NA
Subtotal	5E-01	2E-02	4E-02	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	7E-01	2E-02	4E-02	5E-04	**	7E-03

* = Chemical-Specific Risks are presented in Section 2.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

NA = Not Applicable; pathway is not applicable for the respective media.

surface soil and surface water. The target organ for antimony is the heart. The HI for antimony (via exposure to surface soil and surface water) is less than 1.0. The HI based on the same target organ (e.g., heart) does not exceed 1.0 for any combination of COPCs in SWMU 4 media. The HIs for all other potential receptors at SWMU 4 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 2.6.8.

Table 2-17 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The HIs for all potential receptors at SWMU 4 are less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Chemical-specific risks for COPCs are presented in Section 2.6.8.

2.6.5.3 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the SWMU 4 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 2-18 and 2-19 for inorganics and organics, respectively. The results of this preliminary comparison for SWMU 4 are presented in this section.

The maximum values of antimony, cyanide, bis(2-ethylhexyl)phthalate, and vinyl chloride exceeded both their respective MCL and RBC values. Antimony, cyanide, and bis(2-ethylhexyl)phthalate all were detected in only one sample. Vinyl chloride was detected in three samples at a range of 0.77 µg/L to 3.1 µg/L. Arsenic and chromium concentrations exceeded tap water RBCs; however, this is not uncommon for unfiltered groundwater. Arsenic concentrations were detected at concentrations significantly higher than RBC values, while only the maximum chromium hit (28.9 µg/L) exceeded the RBC value. Two organic chemicals, 1,4-dioxane and chloroform, were each detected in excess of RBC values in one sample. Other VOCs and SVOCs were detected at concentrations that did not exceed either MCLs or RBCs.

TABLE 2-18

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs INORGANICS IN GROUNDWATER AT SWMU 4 (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	–	1/7	78.7 - 78.7	78.7	14.81	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	2/7	7.6 - 11.3	9.5	4.13	50	N	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	2/7	16.2 - 34.9	25.6	8.87	2,000	N	260	N
Chromium*	3/13	0.71 - 13	2.51	2/7	17 - 28.9	23	7.27	100	N	18	Y
Cyanide	2/8	2.4 - 5.525	1.47	1/6	250 - 250	250	42.25	200	Y	73	Y
Lead	1/12	2.5 - 2.5	1.39	2/7	2.3 - 7.6	5.0	2.49	15**	N	15	N
Sulfide	3/3	10,000 - 52,000	28,000	1/1	32,000 - 32,000	32,000	32,000	–	NA	–	NA
Vanadium	4/13	3.4 - 3.9	2.62	2/7	10.4 - 12.5	11.5	3.99	–	NA	26	N
Tin	0/3	Not detected	–	1/2	50.6 - 50.6	50	32.80	–	NA	2,200	N
Zinc	3/13	3.425 - 15.3	2.82	2/7	14.2 - 19.4	16.8	5.66	–	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 2-19
OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs
ORGANICS IN GROUNDWATER AT SWMU 4 (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				
SEMIVOLATILE ORGANIC COMPOUNDS											
1,4-dioxane	0/7	Not detected	–	1/6	11.9 - 11.9	11.9	88.65	–	NA	6.1	Y
2,4-dimethylphenol	0/7	Not detected	–	1/6	5 - 5	5	5	–	NA	73	N
Bis(2-ethylhexyl)phthalate	0/7	Not detected	–	1/6	12.2 - 12.2	12.2	6.2	6	Y	4.8	Y
Phenanthrene	0/7	Not detected	–	1/7	3.3 - 3.3	3.3	4.76	–	NA	–	NA
VOLATILE ORGANIC COMPOUNDS											
1,1-dichloroethane	0/4	Not detected	–	3/7	2 - 4.5	3.5	2.29	–	NA	81	N
Acetone	1/4	5 - 5	5	1/6	7 - 7	7	10.16	–	NA	370	N
Carbon disulfide	0/4	Not detected	–	1/6	2 - 2	2	2.42	–	NA	100	N
Chloroform	0/4	Not detected	–	1/7	0.28 - 0.28	0.28	1.00	80	N	0.15	Y
Dichlorodifluoromethane	0/4	Not detected	–	1/7	6.2 - 6.2	6.2	3.01	–	NA	39	N
Ethylbenzene	0/4	Not detected	–	1/7	2.3 - 2.3	2.3	2.11	700	N	130	N
Methylene chloride	2/4	1 - 1	1.75	1/7	1 - 1	1	3	5	N	4.1	N
Styrene	1/4	3.4 - 3.4	2.73	2/6	3.1 - 44.6	23.9	8.87		N	160	N
Vinyl chloride	1/4	2.4 - 2.4	4.35	3/7	0.77 - 3.05	2.17	2.07	2	Y	0.019	Y
Xylene, total	0/4	Not detected	–	1/7	3.2 - 3.2	3.2	2.03	10,000	N	1,200	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

2.6.6 Uncertainties for SWMU 4

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of SWMU 4 risk assessment results:

- Antimony is a major contributor to the noncarcinogenic risks in surface soil and surface water, but antimony was detected sporadically in all media. Furthermore, antimony was detected at levels in surface water that may be associated with background concentrations. Antimony may not be associated with past site activities which include receiving and storing solvents and oils. The inclusion of antimony as a site-related surface soil COPC could overestimate the quantitative risk at SWMU 4 for the future residential receptor.

- Beryllium is a major contributor to the cumulative carcinogenic risks in surface soil, but beryllium was detected at levels in SWMU 4 that slightly exceed background levels. Beryllium may not be associated with past site activities which include receiving and storage of solvents and oils. The inclusion of beryllium as a site-related surface soil COPC could overestimate the quantitative risk at SWMU 4 for the future residential receptor.

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and hazard index (via surface soils and sediment) for the future residential receptors and occupational workers. The uncertainty associated with the dermal exposure route may overestimate the risk at SWMU 4.

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at SWMU 4 (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The

inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

- Two chemicals, phenanthrene in sediment and dibromomethane in surface water, did not have listed toxicity values for use in the quantitative risk assessment; therefore, no risks were estimated for exposure to the COPCs. These chemicals generally had low frequencies of detection (i.e., detected in only one sample analyzed). This could possibly underestimate the carcinogenic and noncarcinogenic risk at SWMU 4, but without additional toxicity information, this uncertainty remains unknown.

2.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected chemicals of concern and remedial goal options for SWMU 4.

From the COPCs chosen for each medium in the baseline risk assessment (based on RME), a subset of chemicals, called COCs, was selected for the evaluation of remedial clean-up goal options (RGOs). At SWMU 4, no COCs were selected in the RGO evaluation because cumulative cancer risks did not exceed 1E-04 and the HI for the same target organ did not exceed 1.0.

2.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 2-20 and 2-21. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium.
- Representative concentrations for each COPC in each applicable medium.
- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use.
- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways.

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents) receptors. COPCs in SWMU 4 media were not present at sufficient concentrations to cause adverse noncarcinogenic health

TABLE 2-20

RME--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	1.2E-01	5.5E-03	NA	8.4E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	1.0E-06	1.2E-07	3.0E-14	1.1E-06	3.8E-04	1.8E-05	NA	4.0E-04
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	7.5E-02	3.6E-02	NA	1.1E-01
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.0E-06	1.2E-07	3.0E-14	1.1E-06	1.6E-01	4.0E-02	NA	2.0E-01
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	8.0E-02	3.9E-03	NA	8.4E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0E-02	3.9E-03	NA	8.4E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	5.4E-01	3.6E-01	NA	8.9E-01
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	2.5E-04	1.7E-04	NA	4.1E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	3.9E-04	2.6E-04	NA	6.5E-04
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	4.0E-04	2.7E-04	NA	6.7E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	1.8E-04	1.2E-04	NA	2.9E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	1.1E-04	7.1E-05	NA	1.8E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.4E-01	3.6E-01	NA	9.0E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.0E-06	1.2E-07	3.0E-14	1.1E-06	7.8E-01	4.0E-01	NA	1.2E+00

TABLE 2-20

RME--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 2 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.6	NA	NA	NA	NA	8.5E-04	2.4E-04	NA	1.1E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	1.6E-08	4.7E-09	1.9E-16	2.1E-08	2.8E-06	8.1E-07	NA	3.6E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.6E-08	4.7E-09	1.9E-16	2.1E-08	8.5E-04	2.4E-04	NA	1.1E-03
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	2.1E-03	5.9E-04	NA	2.7E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.1E-03	5.9E-04	NA	2.7E-03
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	2.8E-02	1.6E-02	NA	4.3E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	1.3E-05	7.3E-06	NA	2.0E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	2.0E-05	1.2E-05	NA	3.2E-05
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	2.1E-05	1.2E-05	NA	3.3E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	9.1E-06	5.2E-06	NA	1.4E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	5.4E-06	3.1E-06	NA	8.5E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8E-02	1.6E-02	NA	4.3E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.6E-08	4.7E-09	1.9E-16	2.1E-08	3.1E-02	1.7E-02	NA	4.7E-02

TABLE 2-20

RME--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 3 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser – Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	1.8E-03	3.8E-04	NA	1.6E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	2.1E-08	4.3E-09	1.4E-16	2.5E-08	6.2E-06	1.3E-06	NA	7.4E-06
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	1.2E-03	2.5E-03	NA	3.7E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.1E-08	4.3E-09	1.4E-16	2.5E-08	2.5E-03	2.8E-03	NA	5.3E-03
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	4.5E-03	9.3E-04	NA	5.5E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.5E-03	9.3E-04	NA	5.5E-03
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	6.0E-02	2.5E-02	NA	8.5E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	2.8E-05	1.2E-05	NA	3.9E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	4.4E-05	1.8E-05	NA	6.2E-05
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	4.5E-05	1.9E-05	NA	6.4E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	2.0E-05	8.2E-06	NA	2.8E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	1.2E-05	4.9E-06	NA	1.7E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.0E-02	2.5E-02	NA	8.5E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.1E-08	4.3E-09	1.4E-16	2.5E-08	6.7E-02	2.9E-02	NA	9.6E-02

TABLE 2-20

RME--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 4 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.6	NA	NA	NA	NA	5.0E-04	1.2E-04	NA	4.3E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	1.3E-08	3.1E-09	2.5E-16	1.6E-08	1.7E-06	4.1E-07	NA	2.1E-06
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	3.3E-04	8.0E-04	NA	1.1E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.3E-08	3.1E-09	2.5E-16	1.6E-08	6.8E-04	8.8E-04	NA	1.6E-03
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.3E-08	3.1E-09	2.5E-16	1.6E-08	6.8E-04	8.8E-04	NA	1.6E-03

TABLE 2-20

RME--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 5 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.6	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.30E-04	-	-	-	-	5.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 2-20

RME--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 6 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	4.4E-03	1.0E-03	NA	3.8E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	1.1E-07	2.6E-08	5.1E-15	1.4E-07	1.5E-05	3.4E-06	NA	1.8E-05
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	2.9E-03	6.6E+00	NA	9.5E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.1E-07	2.6E-08	5.1E-15	1.4E-07	6.0E-03	7.3E-03	NA	1.3E-02
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.1E-07	2.6E-08	5.1E-15	1.4E-07	6.0E-03	7.3E-03	NA	1.3E-02

1 Units are (mg/kg)/day.

2 Units are [(mg/kg)/day]-1.

3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.

4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

TABLE 2-21

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	1.2E-01	1.1E-03	NA	1.2E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	3.2E-07	7.3E-09	9.4E-15	3.3E-07	3.8E-04	3.6E-06	NA	3.9E-04
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	7.5E-02	7.2E-03	NA	8.2E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.2E-07	7.3E-09	9.4E-15	3.3E-07	1.6E-01	8.0E-03	NA	1.7-01
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	4.0E-02	3.8E-04	NA	4.1E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.0E-02	3.8E-04	NA	4.1E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	2.7E-01	2.4E-01	NA	5.1E-01
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	1.2E-04	1.1E-04	NA	2.3E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	1.9E-04	1.7E-04	NA	3.7E-04
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	2.0E-04	1.8E-04	NA	3.8E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	8.8E-05	7.8E-05	NA	1.7E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	5.3E-05	4.7E-05	NA	9.9E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.7E-01	2.4E-01	NA	5.1E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.2E-07	7.3E-09	9.4E-15	3.3E-07	4.7E-01	2.5E-01	NA	5.5E-01

TABLE 2-21

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 2 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.6	NA	NA	NA	NA	2.1E-04	2.4E-05	NA	1.7E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	1.5E-09	1.7E-10	3.4E-17	1.7E-09	7.0E-07	8.1E-08	NA	7.9E-07
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	1.4E-04	1.6E-04	NA	3.0E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.5E-09	1.7E-10	3.4E-17	1.7E-09	2.9E-04	1.8E-04	NA	1.7E-04
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	5.2E-04	5.9E-05	NA	5.8E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.2E-04	5.9E-05	NA	5.8E-04
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	1.4E-02	7.9E-03	NA	2.2E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	6.4E-06	3.7E-06	NA	1.0E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	1.0E-05	5.8E-06	NA	1.6E-05
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	1.0E-05	6.0E-06	NA	1.6E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	4.5E-06	2.6E-06	NA	7.1E-06
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	2.7E-06	1.6E-06	NA	4.3E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4E-02	7.9E-03	NA	2.2E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.5E-09	1.7E-10	3.4E-17	1.7E-09	1.5E-02	8.2E-03	NA	2.2E-02

TABLE 2-21

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 3 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.6	NA	NA	NA	NA	4.6E-04	7.1E-06	NA	3.3E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	9.5E-10	8.0E-11	1.2E-17	1.0E-09	1.5E-06	2.4E-08	NA	1.6E-06
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	3.0E-04	4.7E-05	NA	3.5E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	9.5E-10	8.0E-11	1.2E-17	1.0E-09	6.2E-04	5.2E-05	NA	6.7E-04
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	1.1E-03	9.6E-05	NA	1.2E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1E-03	9.6E-05	NA	1.2E-03
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	3.0E-02	1.3E-02	NA	4.3E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	1.4E-05	5.9E-06	NA	2.0E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	2.2E-05	9.3E-06	NA	3.1E-05
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	2.3E-05	9.6E-06	NA	3.2E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	9.9E-06	4.2E-06	NA	1.4E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	5.9E-06	2.5E-06	NA	8.4E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0E-02	1.3E-02	NA	4.3E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	9.5E-10	8.0E-11	1.2E-17	1.0E-09	3.2E-02	1.3E-02	NA	4.5E-02

TABLE 2-21

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 4 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	2.1E-04	2.4E-05	NA	1.7E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	1.9E-09	2.2E-10	8.8E-17	2.2E-09	7.0E-07	8.1E-08	NA	7.9E-07
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	1.4E-04	1.6E-04	NA	3.0E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.9E-09	2.2E-10	8.8E-17	2.2E-09	2.9E-04	1.8E-04	NA	4.7E-04
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.9E-09	2.2E-10	8.8E-17	2.2E-09	2.9E-04	1.8E-04	NA	4.7E-04

TABLE 2-21

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 5 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 2-21

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 4
NAS KEY WEST
PAGE 6 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	2.5	NA	NA	NA	NA	4.4E-03	2.0E-04	NA	3.2E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.15	4.1E-08	1.9E-09	1.8E-15	4.2E-08	1.5E-05	6.8E-07	NA	1.5E-05
Cadmium	1.00E-03	2.00E-04	-	-	-	-	5.9	NA	NA	NA	NA	2.9E-03	1.3E-02	NA	4.2E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	4.1E-08	1.9E-09	1.8E-15	4.2E-08	6.0E-03	1.4E-03	NA	7.4E-03
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	8.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	90.2	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	7.3	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	49.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	44.5	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.1E-08	1.9E-09	1.8E-15	4.2E-08	6.0E-03	1.4E-03	NA	7.4E-03

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

effects to any current potential receptors under the RME and CTE scenarios. The cancer risks estimated for the current potential receptors were below both the 1E-04 to 1E-06 target risk range that is often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation, as well as the FDEP cancer risk target of 1E-06.

COPCs at SWMU 4 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Cancer risks for this receptor were estimated at the lower end of EPA's 1E-04 to 1E-06 target risk range and only slightly exceeded the FDEP target cancer risk of 1E-06. Noncancer risks were estimated at levels less than 1.0. Beryllium is the main contributor to the carcinogenic risk. Beryllium may be present at concentrations within or slightly above background. These metals may not be associated with any past site-related activity and could represent non-anthropogenic levels for SWMU 4.

2.7 ECOLOGICAL RISK ASSESSMENT

This section presents the results of the ecological risk assessment performed at SWMU 4 including a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

2.7.1 Problem Formulation

This section presents the problem formulation, including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

2.7.1.1 Habitat Types and Ecological Receptors

Section 2.1 (see Figure 2-12) describes the physical setting at SWMU 4. The site consists primarily of the AIMD building, other small structures, and a large paved parking area. The site is bounded on the south by a lawn and shallow drainage ditch adjacent to Midway Avenue. The ditch drains to a basin east of the AIMD building. Water depth in the ditch was approximately 12 inches, and the basin was dry during August through October 1996 sampling. The basin is surrounded by a berm, and surface water in the ditch and basin (when present) is not hydrologically connected to any other water bodies. A large, shallow marsh and scattered areas of mangrove swamp exist north and west of the site. Vegetation in the marsh and swamp consists largely of spikerush (*Eleocharis* spp.) and red mangrove, with scattered black mangrove along the water's edge. The substrate consists of one to two inches of silty sediment over

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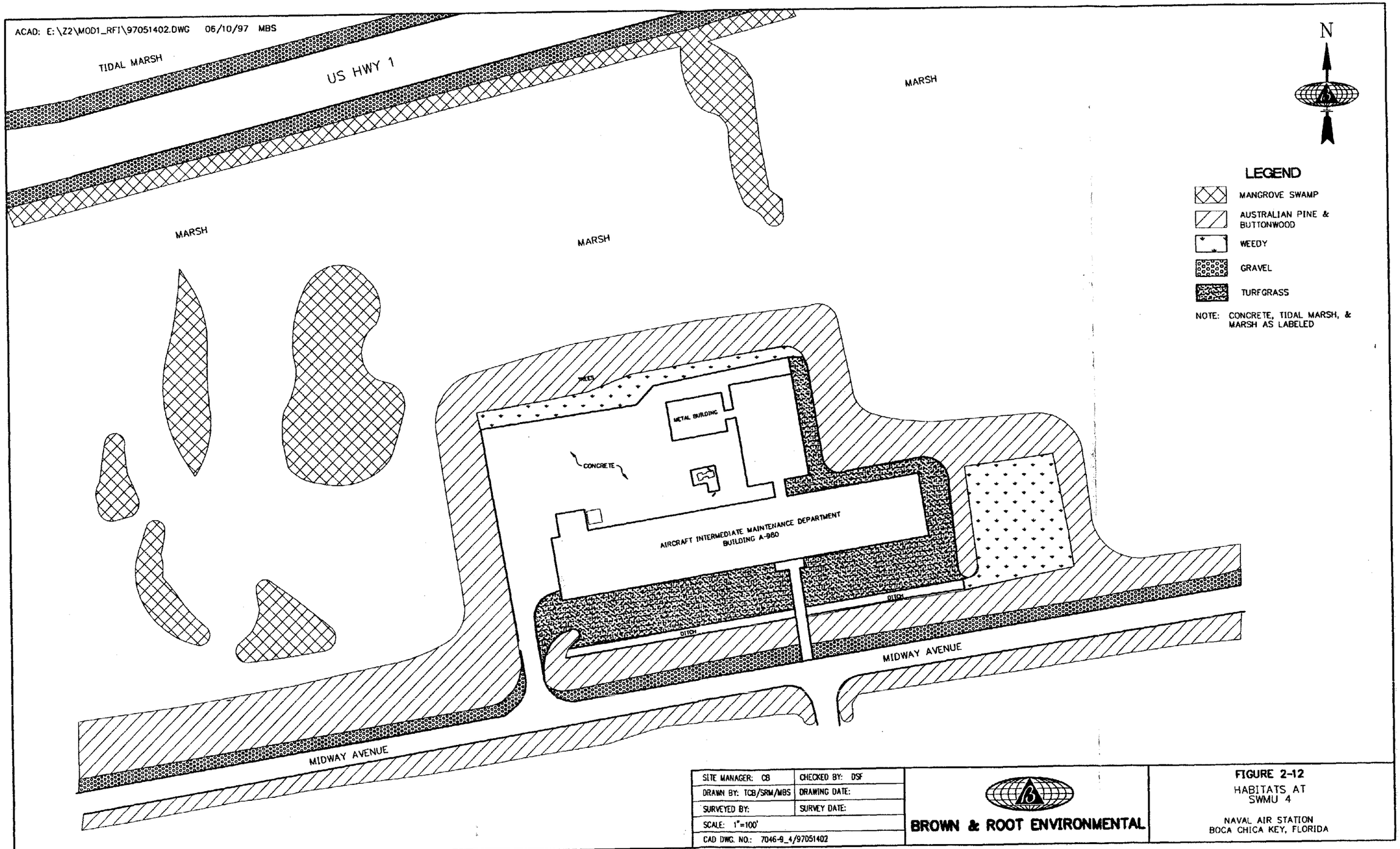


SITE MANAGER: CB	CHECKED BY: DSF
DRAWN BY: TCB/SRM/MBS	DRAWING DATE:
SURVEYED BY:	SURVEY DATE:
SCALE: 1"=100'	
CAD DWG. NO.: 7046-9_4/97051402	

BROWN & ROOT ENVIRONMENTAL

FIGURE 2-12
HABITATS AT
SWMU 4

NAVAL AIR STATION
BOCA CHICA KEY, FLORIDA

bedrock, and water depth was approximately 12 inches throughout most of the marsh during August through October, 1996. A narrow strip of vegetation dominated by buttonwood and Australian pine separates the marsh from the paved parking area at the site. The only surface freshwater at the site is in the shallow ditch adjacent to Midway Avenue.

Salinity in the marsh ranged from 2.8 to 3.9 parts per thousand (ppt) in August and September 1996 (Appendix C, Table C.1-3), indicating that the wetland is brackish, or "mixo-oligohaline" (Reid, 1961). The salinity of marine waters (open seas) generally ranges between 33 and 38 ppt, and averages about 35 ppt (Reid, 1961). The salinity of fresh water is normally less than 1.0 ppt. Conductivity in the marsh ranged from 5.51 millisiemens per centimeter (mS/cm) to 7.29 mS/cm, and varied directly with salinity, as expected. Under normal circumstances the marsh is isolated from the Gulf of Mexico, based on the relatively low salinity in the marsh and the lack of any visible connection with open marine waters. Its water quality appears to be determined largely by rainfall (frequency and amount), air temperatures, evaporation rates, and groundwater inflows from the shallow unconsolidated aquifer that underlies the lower Keys. Dissolved oxygen (DO) levels in the marsh ranged from 3.40 to 5.02 mg/L, which is high enough to support a limited community of aquatic organisms. NAS Key West waters are classified by FDEP as "Class III Marine," and have the following minimum DO standards: a daily average of 5.0 mg/L and a daily minimum of 4.0 mg/L. These standards are intended to protect recreation and the propagation and maintenance of a healthy, well-balanced population of fish and shellfish. Based on August and September 1996 fish collections, the marsh at SWMU 4 supports fairly high numbers of small, hardy schooling fish species [sheepshead minnow, sailfin molly, and *Fundulus* spp. (killifish)] that are able to tolerate extremes of temperature and DO. Because the lagoon is shallow (generally less than 12 inches deep) and unshaded, it would be subject to extreme fluctuations in water temperature and DO levels. Water temperatures in August and September 1996 ranged from 27.5°C (81.5°F) to 31.2°C (88.2°F).

The marsh also provides habitat for various reptiles and amphibians, and presumably raccoons and piscivorous wading birds. The shallow ditch south of the AIMD building is adjacent to Midway Avenue and provides negligible aquatic habitat. Terrestrial habitat at SWMU 4 is limited to paved areas, turf grass, and a narrow strip of vegetation adjacent to the parking lot. However, in spite of the minimal extent and poor quality of terrestrial habitat at the site, scat deposited by the Lower Keys marsh rabbit was observed at the edge of the marsh immediately north and northwest of SWMU 4 during sampling activities in 1996. Thus, while the site itself has little terrestrial habitat component, the nearby marsh is utilized by the marsh rabbit, and perhaps other terrestrial species.

Ecological receptors listed as threatened, endangered, or of special concern that could potentially be exposed to site related contamination are probably limited to the endangered Lower Keys marsh rabbit,

red rat snake (state-listed as an SSC), and wading birds such as the little blue heron, snowy egret, tricolored heron, and reddish egret (all state-listed as SSC). These birds presumably forage in the lagoon, at least occasionally, although none were observed during August through October 1996 sampling activities. Least terns (state-listed as threatened) have previously nested on the gravel roof of Building 931, approximately 500 feet southeast of SWMU 4 (FNAI, 1994). Terns are not expected to be exposed to site-related contamination, however, since the marsh and swamp adjacent to the site do not provide foraging habitat favored by these birds.

Minnows were collected for tissue analysis from the marsh immediately north and northwest of SWMU 4. Additionally, foliage of the red mangrove, a species known to be consumed by the Lower Keys marsh rabbit, was collected from the same locations for tissue analysis.

2.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways is presented in Section 2.5.2.

2.7.1.3 Exposure Routes

Terrestrial animals at SWMU 4 can be exposed to soil contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation. Terrestrial receptors can also come into contact with contaminants in surface water by using it for drinking, although this exposure route generally represents a negligible portion of total exposure for most receptors. In addition, the salt content in surface water in the marsh (brackish) largely precludes the use of the water for drinking. Surface freshwater exists at the site only in the shallow ditch adjacent to Midway Avenue. Some ecological receptors could use this as drinking water, but overall, the presence of the ditch in this area of high human usage and poor surrounding habitat limits the use of this water by ecological receptors. Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue. Volatile constituents could be present in some site soils, and soil-bound contaminant resuspension could occur at SWMU 4. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors. The only terrestrial habitat at SWMU 4 (other than paved areas and turf grass) is a 40-foot

wide strip of upland habitat between the paved parking lot north of Building A-980 and the adjacent marsh. Thus, the above exposure routes apply only to terrestrial receptors that utilize this small area.

Overall, terrestrial exposure routes and contaminant migration pathways at this site are minimal. Nevertheless, a risk assessment of potential soil contaminants was conducted as a conservative measure based on the presence of the endangered Lower Keys marsh rabbit at the upland/marsh margin.

Aquatic and terrestrial organisms inhabiting the marsh and swamp north of SWMU 4 can be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semiaquatic organisms can also be exposed to constituents in contaminated groundwater that flows into surface water.

2.7.1.4 Selection of Ecological Chemicals of Potential Concern

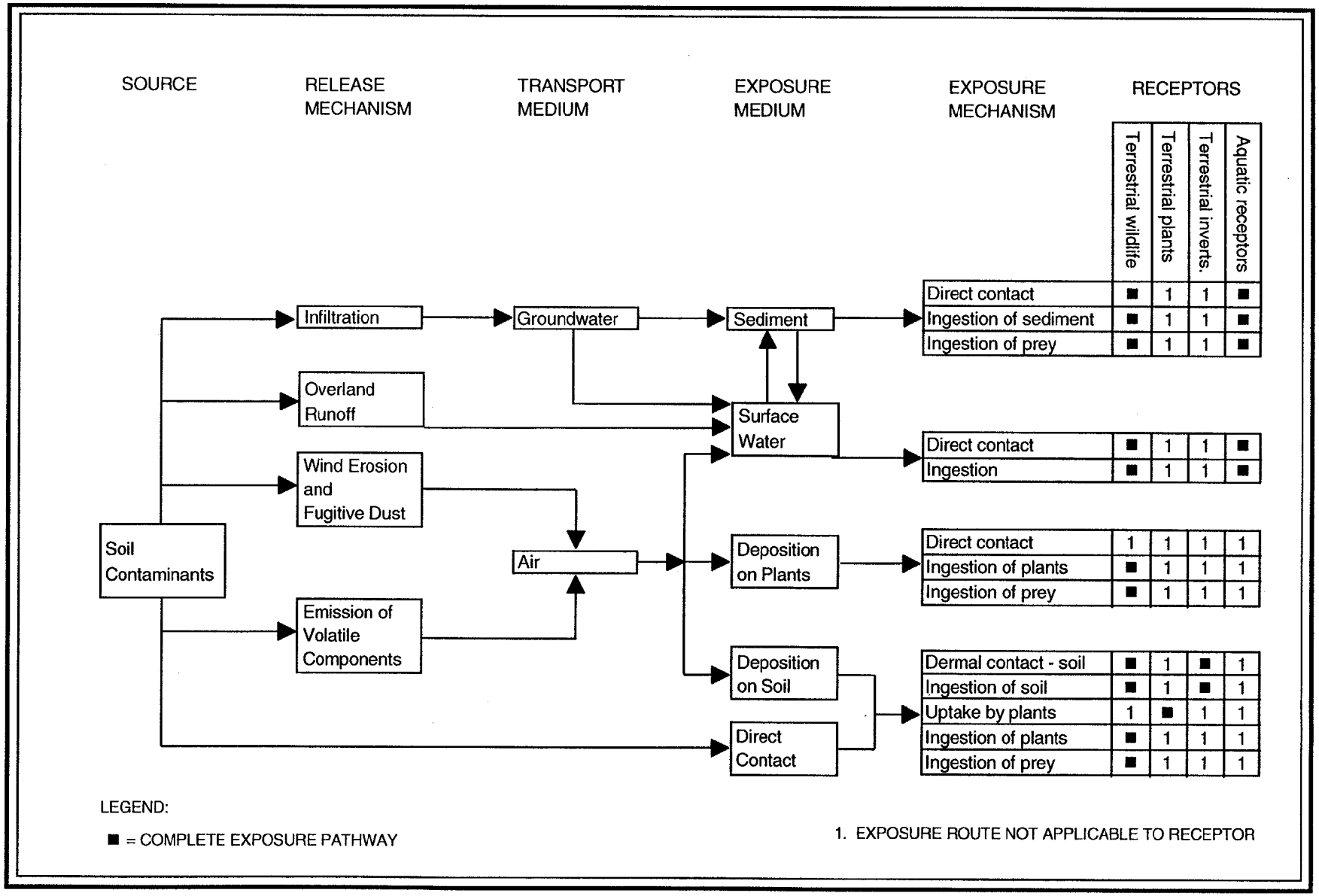
Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water and groundwater. Otherwise, analytes selected for evaluation consisted of all analytes detected during current and previous sampling of surface water, sediment, and surface soil at SWMU 4. Groundwater analytes selected for evaluation consisted of analytes detected during current sampling of the two monitoring wells nearest to the marsh. Inorganic contaminants in groundwater, surface water, sediment, and surface soil whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

2.7.1.5 Assessment and Measurement Endpoints

A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3.1.1.5 of Appendix C.

2.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 2-13 shows the conceptual model for SWMU 4. The figure shows complete



7046-24PC\Mod1-RFI-RI\F2-13.ppt

Figure 2-13. Conceptual Site Model - SWMU 4, NAS Key West, Boca Chica Key, Florida

exposure routes for the overland runoff and wind erosion pathways. However, these pathways are applicable at SWMU 4 only in a narrow strip of upland habitat between the paved parking lot north of Building A-980 and the adjacent marsh.

2.7.2 Ecological Effects Characterization

Ecologically based thresholds, e.g., concentrations of contaminants in various media protective of ecological receptors, were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at SWMU 4. Brief descriptions of each COPC are included in Appendix B, Part 3. Surface-water and groundwater contaminant concentrations were compared to surface-water thresholds for saltwater. Terrestrial plant thresholds were obtained to assess potential risks to plants from soil contaminants. Contaminant intake doses for the Lower Keys marsh rabbit, cotton rat, kestrel, and great blue heron were modeled, and estimated doses were compared to TRVs, which are doses above which potential risks might be present (Appendix B, Part 4). The raccoon was not selected as a representative mammalian carnivore in the foodchain modeling because COPCs did not include contaminants that biomagnify in the foodchain, or were detected infrequently and at low concentrations. Groundwater, surface-water, sediment, terrestrial plant, and surface soil thresholds, as well as TRVs used in foodchain modeling, are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Minnow-sized fish were collected from the marsh adjacent to the site and analyzed for pesticides, PCBs, and metals. Approximately one-third of the fish samples were also analyzed for semivolatile compounds. Concentrations of contaminants detected in the fish were compared to concentrations in fish collected at background sites, and to threshold concentrations considered to be protective of fish and piscivorous receptors (Appendix C, Table C.3-26) Maximum and mean concentrations in fish samples were also used to estimate doses to the great blue heron.

Foliage of red mangroves (a significant food source of the Lower Keys marsh rabbit) was collected from areas where rabbit scat was present at the edge of the marsh. Concentrations of metals, pesticides, and PCBs in the vegetation were compared to concentrations in vegetation collected at background sites, and maximum and mean concentrations in the vegetation samples were also used to estimate doses to the Lower Keys marsh rabbit.

2.7.3 Exposure Assessment

This section presents the ecological exposure assessment for SWMU 4 and includes a discussion of exposure point contaminant concentrations and dose calculations.

2.7.3.1 Exposure Point Contaminant Concentrations

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil were used as representative exposure point concentrations for screening against threshold values. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.

2.7.3.2 Dose Calculations

The potential risks to ecological receptors resulting from exposure to SWMU 4-related contaminants were also evaluated by estimating the total contaminant dose that representative organisms inhabiting the site might receive for each contaminant and comparing those doses to toxicity reference values (TRVs), which are doses above which adverse effects might occur. The Lower Keys marsh rabbit, cotton rat, and kestrel were selected as representative terrestrial receptors, and the great blue heron was selected as the representative piscivorous receptor for foodchain modeling at SWMU 4. Section 3.3.2.1.2 of Appendix C provides a detailed description of dose calculations and exposure parameters used for the foodchain modeling.

2.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at SWMU 4.

2.7.4.1 Results

The results of the ecological risk characterization at SWMU 4 are presented in this section, which includes a discussion of the results from the Phase I and Phase II ecological screening assessments, foodchain modeling for selected terrestrial and piscivorous receptors, and tissue analyses.

2.7.4.1.1 Phase I

The Phase I ecological screening risk assessment conducted by IT Corporation (1994) identified the following COCs: antimony, cadmium, chromium, tin, zinc, and DDT in soil; antimony in sediment; and vanadium in groundwater. Furthermore, chromium, lead, chrysene, and phenanthrene were considered to be capable of bioaccumulating sufficiently to pose risks to piscivores, although chrysene and phenanthrene probably did not originate at SWMU 4. The Phase I assessment also indicated that terrestrial receptors could be at risk from dermal exposure to DDT in soil, and from consumption of zinc in

vegetation, but concluded that no significant exposure pathways existed for terrestrial receptors, due to the site's small size and poor habitat. The overall conclusion was that SWMU 4 was unlikely to pose a risk to aquatic or terrestrial receptors, and the report recommended that no further action be taken at the site regarding ecological concerns.

2.7.4.1.2 Phase II - Ecological Screening Assessment

Six volatile compounds were detected in groundwater samples collected in 1996 from the two monitoring wells nearest the marsh (S4MW-5 and S4MW-6). Styrene and 1,4-dioxane were retained as COPCs in groundwater because no suitable thresholds were available (Table 2-22). No semivolatiles or metals were detected in these samples.

There were no COPCs in surface water (Table 2-23). The table includes data from surface-water samples collected in the marsh and from the ditch adjacent to Midway Avenue. Concentrations of analytes in surface water were compared to surface-water thresholds for saltwater, as discussed in Appendix C. However, since the two surface-water samples from the ditch (S4SS-1 and S4SW-4) were freshwater samples, a comparison of analytes detected in these samples to freshwater criteria is provided. No analytes were detected in sample S4SW-4 (Appendix H, Part 4). Analytes detected in sample S4SS-1 were limited to barium, tin, zinc, and methylene chloride (Table 2-4 and Appendix H, Part 4). Concentrations of barium (3.8 μg/L) and zinc (9.6 μg/L) in this sample were less than twice their average background values. The concentration of tin (30 μg/L) was less than the only threshold available for either freshwater or saltwater (73 μg/L). The concentration of methylene chloride (2 μg/L) was less than the 1,930 μg/L ecological threshold value for methylene chloride in freshwater (EPA, 1995e).

Lead, aluminum, and tin were retained as inorganic COPCs in SWMU 4 sediments (Table 2-24). Although lead exceeded the most conservative threshold available, it did not exceed the less conservative threshold. Aluminum and tin were conservatively retained as sediment COPCs since their maximum concentrations exceeded twice the average background concentrations and no suitable thresholds were available. For organics in SWMU 4 sediments, the maximum concentration of bis(2 ethylhexyl)phthalate exceeded the most conservative threshold available and was retained as a COPC but did not exceed a less conservative threshold. Also, the maximum detected concentration of acetone exceeded the only toxicity threshold available and was retained as a sediment COPC. One organic, 2-butanone, was conservatively retained as a COPC in sediment since no suitable threshold was available.

TABLE 2-22

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER (µg/L) - SWMU 4
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)
VOLATILE ORGANIC COMPOUNDS						
1,4-dioxane	1/2	ND	11.9	NA		Retained - no suitable threshold available
1,1-dichloroethane	1/2	ND	4	1,130	0.00	Eliminated - does not exceed threshold
Chloroform	1/2	ND	0.28	470.8	0.00	Eliminated - does not exceed threshold
Ethylbenzene	1/2	ND	2.3	4.3	0.53	Eliminated - does not exceed threshold
Styrene	2/2	2.73	3.1 - 44.6	NA		Retained - no suitable threshold available
Xylenes (total)	1/2	ND	3.2	6,000	0.00	Eliminated - does not exceed threshold

ND = Not detected.
NA = Not available.

TABLE 2-23

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L) - SWMU4
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	2/6	33.71	87.5 - 90.2	4,300	0.02	Eliminated - does not exceed threshold
Barium	3/6	6.93	3.8 - 7.3	10,000	0.0007	Eliminated - does not exceed 2 X background
Iron	3/3	24.70	8.5 - 49.2	300	0.16	Eliminated - does not exceed 2 X background
Lead	1/6	ND	3.4	5.6	0.6	Eliminated - does not exceed threshold
Mercury	2/6	0.52	0.53 - 0.6	0.025	24	Eliminated - does not exceed 2 X background
Thallium	1/6	4.73	2.8	6.3	0.4	Eliminated - does not exceed 2 X background
Tin	3/3	ND	27.8 - 44.5	73	0.61	Eliminated - does not exceed threshold
Zinc	2/6	7.19	9.6 - 13.3	86	0.15	Eliminated - does not exceed 2 X background
SEMIVOLATILE ORGANIC COMPOUNDS						
N-nitroso-di-n-propylamine	1/4	ND	7	33,000	0.0002	Eliminated - does not exceed threshold
VOLATILE ORGANIC COMPOUNDS						
1,1,1-trichloroethane	1/6	ND	0.23	312	0.0007	Eliminated - does not exceed threshold
Dibromomethane	1/6	ND	1.7	34	0.05	Eliminated - does not exceed threshold
Methylene chloride	1/6	1.50	2	2,560	0.0007	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 2-24

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - SWMU 4
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 (mg/kg)						
Aluminum	3/3	1,331.89	1,230 - 2,680	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Antimony	1/6	ND	8.8	12	0.7	Eliminated - does not exceed threshold
Arsenic	6/6	2.63	1.5 - 2.9	7.24	0.1	Eliminated - does not exceed 2 X background
Barium	6/6	9.27	6 - 8.1	40	0.2	Eliminated - does not exceed 2 X background
Chromium	5/6	5.01	4.8 - 17.2	52.3	0.3	Eliminated - does not exceed threshold
Copper	6/6	8.88	4.7 - 15.6	18.7	0.8	Eliminated - does not exceed 2 X background
Lead	6/6	17.97	2.5 - 38.1	30.2/218	1.3/0.2	Retained - exceeds 2 X background and HQ > 1
Manganese	3/3	15.39	21.9 - 36.5	460	0.1	Eliminated - does not exceed threshold
Nickel	3/6	2.15	1.2 - 2.3	15.9	0.1	Eliminated - does not exceed 2 X background
Tin	1/3	2.85	22.8	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	6/6	5.08	4.7 - 8.9	NA	-	Eliminated - does not exceed 2 X background
Zinc	4/6	25.74	12.1 - 107	124	0.9	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Bis(2-ethylhexyl)phthalate	1/4	1,992.17	490	182/2,647	2.7/0.19	Retained - HQ > 1
Chrysene	1/6	961.38	37	384	0.09	Eliminated - does not exceed threshold
Fluoranthene	1/6	982.38	70	113	0.6	Eliminated - does not exceed threshold
Phenanthrene	1/6	ND	60	86.7	0.7	Eliminated - does not exceed threshold
Pyrene	1/6	968.46	82	153	0.5	Eliminated - does not exceed threshold
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
2-butanone	1/4	8.49	11	NA	-	Retained - no suitable threshold available
Acetone	2/4	30.9	38 - 200	64	3.1	Retained - HQ > 1
Methylene chloride	1/6	7.5	19	427	0.04	Eliminated - does not exceed threshold
Tetrachloroethene	3/6	4.33	0.97 - 1.5	530	0.003	Eliminated - does not exceed threshold

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

Inorganic surface soil COPCs with maximum concentrations in excess of threshold values and twice their average background concentrations consisted of chromium, copper, cyanide (not detected in background), mercury, and tin (Table 2-25). Antimony and beryllium were conservatively retained as COPCs in surface soils since their maximum concentrations exceeded twice their average background concentrations and no suitable soil thresholds were available. No organics detected in surface soils exceeded thresholds, but 2-chloro-1,3-butadiene, bis(2-ethylhexyl)phthalate, and acetone were conservatively retained as COPCs due to the absence of suitable surface soil thresholds.

The inorganics cadmium, chromium, lead, vanadium, and zinc were retained as terrestrial plant COPCs since their maximum soil concentrations exceeded twice their average background concentrations and terrestrial plant thresholds, (Table 2-26). Cyanide was conservatively retained as a terrestrial plant COPC since it exceeded two times the average background concentration and no suitable threshold was available. Several organics detected in SWMU 4 surface soils were retained as COPCs since no thresholds were available from any source, including 4,4'-DDE, 4,4'-DDT, endosulfan I, bis(2-ethylhexyl)phthalate, 2-chloro-1,3-butadiene, acetone, carbon tetrachloride, cis-1,2-dichloroethene, and methylene chloride.

2.7.4.1.3 Tissue Analysis

Minnows (sailfin mollies, killifish, and sheepshead minnows) were collected from the marsh immediately north of SWMU 4, and were composited by species into samples of approximately 30 grams each. Analytes detected in fish consisted of barium, chromium, copper, lead, manganese, mercury, zinc, several pesticides, and pyrene (Table 2-27).

Red mangrove foliage was collected from locations at the edge of the marsh where scat of the Lower Keys marsh rabbit was observed. Analytes detected in foliage consisted of manganese, zinc, 4,4'-DDD, 4,4'-DDT, gamma-BHC (lindane), and endrin aldehyde (Table 2-28).

2.7.4.1.4 Foodchain Modeling

Aluminum was the only significant contributor of potential risks to the Lower Keys marsh rabbit under both the maximum and mean contaminant concentration scenarios (Tables 2-29 and 2-30). The HI value for aluminum was 6.85 and 3.69 for the maximum and mean scenarios, respectively, and incidental ingestion of soil was the primary contaminant exposure pathway for both scenarios. Aluminum was also the only significant contributor of potential risk to the cotton rat for both exposure scenarios (Tables 2-31 and 2-32).

TABLE 2-25

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL -SWMU 4
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	2/2	1,887.29	243-3,180	600	5.3	Eliminated - does not exceed 2 X background
Antimony	1/6	0.39	3.6	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Arsenic	3/6	1.29	0.24 - 1.4	60	0.02	Eliminated - does not exceed 2 X background
Barium	6/6	10.51	4.9 - 11.9	440	0.03	Eliminated - does not exceed 2 X background
Beryllium	2/6	0.05	0.14 - 0.15	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	3/6	0.15	1.4 - 5.9	20	0.3	Eliminated - does not exceed threshold
Chromium	6/6	6.02	5.5 - 14.9	0.4	37	Retained - exceeds 2 X background and HQ > 1
Copper	6/6	5.43	7.1 - 66.3	50	1.3	Retained - exceeds 2 X background and HQ > 1
Cyanide	1/3	ND	21	0.005	4,200	Retained - HQ > 1
Lead	6/6	15.66	8.7 - 60.8	500	0.1	Eliminated - does not exceed threshold
Manganese	2/2	17.65	7.8 - 18.9	100	0.2	Eliminated - does not exceed 2 X background
Mercury	5/6	0.03	0.08 - 0.16	0.1	1.6	Retained - exceeds 2 X background and HQ > 1
Nickel	2/6	1.67	1/2 - 2.7	200	0.01	Eliminated - does not exceed 2 X background
Silver	3/6	ND	1.1 - 1.5	50	0.03	Eliminated - does not exceed threshold
Tin	1/4	1.94	11.2	0.89	12.6	Retained - exceeds 2 X background and HQ > 1
Vanadium	3/6	3.97	1.1 - 8.3	20	0.4	Eliminated - does not exceed threshold
Zinc	6/6	15.22	7.7 - 66.3	200	0.3	Eliminated - does not exceed threshold
PESTICIDES/PCBs (µg/kg)						
4,4'-DDE	2/4	63/23	22 - 29.5	100	0.3	Eliminated - does not exceed threshold
4,4'-DDT	1/4	46.78	36.4	100	0.4	Eliminated - does not exceed threshold
Endosulfan I	1/4	5.99	1.4	100	0.01	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Bis(2-ethylhexyl)phthalate	1/3	470.55	220	NA	-	Retained - no suitable threshold available

TABLE 2-25

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL -SWMU 4
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)
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
2-chloro-1,3-butadiene	1/2	ND	2	NA	-	Retained - no suitable threshold available
Acetone	2/3	3.67	5 - 70	NA	0.01	Retained - no suitable threshold available
Carbon tetrachloride	1/5	ND	3	300		Eliminated - does not exceed threshold
Cis-1,2-dichloroethene	1/4	ND	19	300	0.06	Eliminated - does not exceed threshold
Methylene chloride	3/5	2.8	12 - 69	300	0.2	Eliminated - does not exceed threshold
Tetrachloroethene	1/5	ND	0.48	300	0.002	Eliminated - does not exceed threshold

NA = No suitable ecological threshold value was available.
ND = No detected.

TABLE 2-26

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - SWMU 4
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	2/2	1887.29	243 - 3,180	50	63.6	Eliminated - does not exceed 2 X background
Antimony	1/6	0.39	3.6	5	0.7	Eliminated - does not exceed threshold
Arsenic	3/6	1.29	0.24 - 1.4	10	0.1	Eliminated - does not exceed 2 X background
Barium	6/6	10.51	4.9 - 11.9	500	0.02	Eliminated - does not exceed 2 X background
Beryllium	2/6	0.05	0.14 - 0.15	10	0.02	Eliminated - does not exceed threshold
Cadmium	3/6	0.15	1.4 - 5.9	3	1.97	Retained - exceeds 2 X background and HQ > 1
Chromium	6/6	6.02	5.5 - 14.9	1	14.9	Retained - exceeds 2 X background and HQ > 1
Copper	6/6	5.43	7.1 - 66.3	100	0.7	Eliminated - does not exceed threshold
Cyanide	1/3	ND	21	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Lead	6/6	15.66	8.7 - 60.8	50	1.2	Retained - exceeds 2 X background and HQ > 1
Manganese	2/2	17.65	18.9	500	0.04	Eliminated - does not exceed 2 X background
Mercury	5/6	0.03	0.08 - 0.16	0.3	0.5	Eliminated - does not exceed threshold
Nickel	2/6	1.67	1.2 - 2.7	30	0.09	Eliminated - does not exceed 2 X background
Silver	3/6	ND	1.1 - 1.5	2	0.8	Eliminated - does not exceed threshold
Tin	1/4	1.94	11.2	50	0.2	Eliminated - does not exceed threshold
Vanadium	3/6	3.97	1.1 - 8.3	2	4.2	Retained - exceeds 2 X background and HQ > 1
Zinc	6/6	15.22	7.7 - 66.3	50	1.3	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs (µg/kg)						
4,4'-DDE	2/4	63.23	22 - 29.5	NA	-	Retained - no suitable threshold available
4,4'-DDT	1/4	46.78	36.4	NA	-	Retained - no suitable threshold available
Endosulfan I	1/4	5.99	1.4	NA	-	Retained - no suitable threshold available

TABLE 2-26

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - SWMU 4
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)
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Bis(2-ethylhexyl)phthalate	1/3	470.55	220	NA	-	Retained - no suitable threshold available
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
2-chloro-1,3-butadiene	1/2	ND	2	NA	-	Retained - no suitable threshold available
Acetone	2/3	3.67	5 - 70	NA	-	Retained - no suitable threshold available
Carbon tetrachloride	1/5	ND	3	NA	-	Retained - no suitable threshold available
Cis-1,2-dichloroethene	1/4	ND	19	NA	-	Retained - no suitable threshold available
Methylene chloride	3/5	2.8	12 - 69	NA	-	Retained - no suitable threshold available
Tetrachloroethene	1/5	ND	0.48	10	0.048	Eliminated - does not exceed threshold

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

TABLE 2-27

SUMMARY STATISTICS FOR ANALYTES DETECTED IN MINNOWS FROM SWMU 4 AND BACKGROUND SITES NAS KEY WEST

	SWMU 4			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Barium	9/21	1.70-2.20	1.07	39/58	0.67-9.90	2.43
Chromium	2/21	0.90-1.10	0.47	2/58	1.00-3.10	0.41
Copper	12/21	10.70-38.30	11.91	52/58	0.70-22.80	4.63
Lead	11/21	2.10-2.90	1.52	41/58	0.14-11.90	1.50
Manganese	21/21	2.60-5.50	3.79	1/24	16.20	1.38
Mercury	1/21	0.10	0.02	17/58	0.01-0.06	0.02
Zinc	21/21	31.30-109.00	59.00	58/58	13.60-84.20	41.38
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	6/20	1.10-2.40	2.05	48/58	0.25-16.60	3.95
4,4'-DDE	19/20	0.75-5.00	2.52	57/58	3.80-106.00	28.75
4,4'-DDT	17/20	1.90-24.00	7.57	4/58	0.63-2.50	1.02
Aldrin	12/20	0.27-2.70	1.07	5/58	0.28-2.00	0.70
beta-BHC	14/20	1.00-3.00	1.65	5/58	1.30-6.00	0.95
delta-BHC	15/20	0.07-1.70	1.07	13/58	0.08-1.00	0.58
gamma-BHC (lindane)	4/20	0.11-0.66	1.01	0/58		
Chlorobenzilate	13/20	8.10-68.00	28.31	3/56	73.0-190.0	483.2
Dieldrin	14/20	0.16-2.80	1.45	11/58	0.34-4.90	1.13
Endosulfan I	12/20	0.20-12.00	2.76	6/58	0.66-2.60	0.73
Endosulfan II	13/20	0.17-2.70	1.36	1/58	1.90	1.02
Endosulfan sulfate	18/20	2.10-76.00	17.07	3/58	1.60-9.80	1.30
Endrin	1/20	1.10	2.33	2/58	1.00-1.10	0.98
Endrin aldehyde	20/20	3.20-26.00	11.26	3/58	3.40-5.40	1.15
Heptachlor	5/20	0.47-4.40	1.47	0/58		
Isodrin	9/20	0.45-6.20	2.30	0/58		
Methoxychlor	9/20	3.60-27.00	12.00	1/58	1.90	3.73
Semivolatiles						
Pyrene	1/6	430.00	678.33	0/34		

1 One-half the detection limit used for all non-detected values.

TABLE 2-28

SUMMARY STATISTICS FOR ANALYTES DETECTED IN VEGETATION FROM SWMU 4 AND BACKGROUND SITES NAS KEY WEST

	SWMU 4			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Manganese	3/3	7.10-24.70	13.40	4/6	3.60-6.70	3.63
Zinc	1/3	2.20	1.27	2/6	12.80-55.50	12.42
PESTICIDE/PCBs µg/kg)						
4,4'-DDD	1/3	0.06	1.12	1/6	1.10	1.54
4,4'-DDT	1/3	0.11	1.14	1/6	0.20	1.38
gamma-BHC (lindane)	3/3	0.83-1.80	1.28	2/6	0.05-0.21	0.61
Endrin aldehyde	1/3	0.16	1.15	6/6	0.26-1.20	0.75

1 One-half the detection limit used for all non-detected values.

TABLE 2-29

MAJOR CONTRIBUTORS TO RISK FOR THE LOWER KEYS MARSH RABBIT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	6.85	94.5
Antimony	0.12	1.7
Tin	0.09	1.3
Arsenic	0.05	0.6
Lead	0.03	0.4
All others	0.11	1.5
Total receptor HI	7.25	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	7.2	99.8
Food	0.02	0.3

TABLE 2-30

MAJOR CONTRIBUTORS TO RISK FOR THE LOWER KEYS MARSH RABBIT MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	3.69	95.7
Antimony	0.05	1.3
Tin	0.03	0.9
Arsenic	0.02	0.4
Lead	0.02	0.4
All others	0.05	1.3
Total receptor HI	3.85	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	3.84	99.7
Food	0.01	0.3

TABLE 2-31

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	3.03	94.2
Antimony	0.05	1.7
Tin	0.04	1.3
Arsenic	0.02	0.6
Manganese	0.02	0.6
All others	0.05	1.6
Total receptor HI	3.22	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	3.2	99.4
Food	0.02	0.6

TABLE 2-32

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	1.63	95.4
Antimony	0.02	1.3
Tin	0.01	0.9
Manganese	0.01	0.6
Arsenic	0.00	0.4
All others	0.02	1.4
Total receptor HI	1.71	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	1.70	99.4
Food	0.01	0.6

Incidental ingestion of soil accounted for the majority of contaminant exposure for the cotton rat, and HI values for aluminum were 3.03 and 1.63 for the maximum and mean concentration scenarios, respectively. Cyanide, 4,4'-DDT, 4,4'-DDE were the primary contributors of potential risks for the kestrel under both the maximum and mean concentration scenarios, but no individual HI values exceeded 1.0 (Tables 2-33 and 2-34). Since ingestion of soil or water was not considered in the model for the kestrel, ingestion of contaminated food accounted for 100 percent of total contaminant exposure. For the great blue heron, 4,4'-DDT, zinc, barium, 4,4'-DDE, and chromium were the primary contributors of potential risks using maximum contaminant concentrations in fish (Table 2-35), while zinc, 4,4'-DDT, barium, 4,4'-DDE, and 4,4'-DDD were the primary contributors of potential risks using mean concentrations in fish (Table 2-36). HI values were 1.23 and 1.08 for 4,4'-DDT and zinc, respectively, in the maximum exposure scenarios. The highest HI from the mean exposure scenario was 0.59 for zinc.

2.7.4.2 Discussion

Styrene and 1,4-dioxane were the only COPCs in groundwater, and were retained as COPCs because no suitable ecological threshold was available. Neither of these compounds were detected in any surface-water, sediment, surface soil, or subsurface soil samples collected from the site vicinity. Thus, migration of these compounds from site-related groundwater to nearby surface waters or sediments does not appear to be occurring, and the presence of these compounds in groundwater does not appear to be due to site-related soil contamination. The lack of any surface-water COPCs suggests that surface-water contamination and related risks to aquatic receptors are negligible at SWMU 4.

Lead, tin, and aluminum were the only inorganic COPCs in SWMU 4 sediments. The only sediment sample that exceeded the most conservative threshold for lead was located south of Building A-980 (Sample S4SS-1), where aquatic habitat consists of an isolated ditch adjacent to Midway Avenue. The hazard quotient (HQ) for lead in this sample was indicative of low potential risk (HQ=1.3). No sediment samples in the marsh north of the site exceeded the most conservative threshold value for lead. Sediment thresholds were not available for tin or aluminum. Tin was detected in the same sample (S4SS-1) from the ditch south of Building A-980 and was not detected in samples from the marsh north of the site. Aluminum in one sediment sample was less than the average background value, and only one of three samples exceeded twice the average background concentration for aluminum. Aluminum was not detected in any fish or plant sample from SWMU 4. Bis(2-ethylhexyl)phthalate was detected in only one of four sediment samples (S4SS-1), and the HQ was indicative of relatively low potential risk (HQ=2.7). Phthalates are commonly detected in soils and sediments, and the concentration in this sample was much

TABLE 2-33

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Cyanide	0.85	85.4
4,4'-DDT	0.06	5.8
4,4'-DDE	0.04	4.3
Zinc	0.02	2.1
Antimony	0.01	0.8
All others	0.02	1.6
Total receptor HI	1.00	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	1.00	100.0

TABLE 2-34

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Cyanide	0.35	73.5
4,4'-DDE	0.05	11.0
4,4'-DDT	0.05	10.8
Zinc	0.01	2.5
Antimony	0.00	0.7
All others	0.01	1.5
Total receptor HI	0.5	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	0.5	100.0

TABLE 2-35

MAJOR CONTRIBUTORS TO RISK FOR THE GREAT-BLUE HERON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
4,4'-DDT	1.23	32.0
Zinc	1.08	28.0
Barium	0.63	16.2
4,4'-DDE	0.26	6.7
Chromium	0.16	4.1
All others	0.50	13.0
Total receptor HI	3.86	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	3.86	100.0

TABLE 2-36

MAJOR CONTRIBUTORS TO RISK FOR THE GREAT-BLUE HERON MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 4 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Zinc	0.59	33.7
4,4'-DDT	0.39	22.4
Barium	0.30	17.5
4,4'-DDE	0.13	7.5
4,4'-DDD	0.11	6.1
All others	0.04	12.8
Total receptor HI	1.74	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	1.74	100.0

less than the average background value for this compound. In addition, the single detected value of this compound did not exceed a less conservative threshold. Acetone exceeded its sediment threshold in only one sample (S4SS-1). Acetone is a common laboratory contaminant, and its hazard quotient was indicative of relatively low potential risk (HQ=3.1). No sediment threshold value was available for 2-butanone, but it was detected only in sediment sample S4SS-1. In conclusion, concentrations of lead, tin, acetone, 2-butanone, and bis(2-ethylhexyl)phthalate) in sediments were elevated only in sample S4SS-1 (collected in 1993), although the HQs were indicative of relatively low potential risks. This sample was collected from the ditch downslope of the former in-ground 55-gallon drum. This location was not sampled in 1996, but sediment sample S4SS-7, collected in 1996 approximately 300 feet east of sample S4SS-1, did not contain elevated concentrations of COPCs. Therefore, migration from this potential "hot spot" or from other site-related sources of contamination does not appear to have occurred.

Seven inorganic analytes and three organic compounds were identified as COPCs in surface soils. Cyanide was detected in one 1993 soil sample near the former location of the drum south of the Building A-980; the resultant hazard quotient was quite high (HQ=4,200). Tin was detected in the same sample (HQ=12.6), but in no other surface soil samples. Chromium was detected in all six surface soil samples (HQ=37), and all values exceeded the soil threshold value. These three soil COPCs do not appear to have significantly impacted sediments, since cyanide was not detected in any of four sediment samples, tin was detected in only one of three sediment samples, and chromium was not a sediment COPC. The other soil COPCs were either detected in a small proportion of samples or at concentrations with HQs indicative of low potential risk.

HQs for plant COPCs were relatively low except for chromium (HQ=14.4) and aluminum (HQ=63.6). However, neither of these metals were detected in any of the three vegetation samples collected from the site. Concentrations of copper and lead exceeded ecological thresholds in only a single sample (S4SB-2). Cyanide was conservatively retained as a terrestrial plant COPC since it exceeded two times the average background concentration and no suitable threshold was available. The authors who derived the plant thresholds for metals in soil consider the thresholds to be very conservative (Will and Suter, 1995b). This is because soluble salts of metals are applied to growth substrates as the route of exposure in most plant toxicity tests. As a result, the metals are more bioavailable than most naturally-occurring metals or metals at many waste sites (Will and Suter, 1995b). The scarcity of terrestrial plant thresholds for organic compounds precluded a detailed assessment of potential risks to terrestrial plants from organics in surface soil. However, plants do not translocate organics to the extent that they translocate inorganics. Overall, the concentrations of COPCs in soil suggest low potential risk to terrestrial receptors. Elevated values for cyanide and tin were recorded in a sample collected near the former location of the south drum adjacent to Building A-980, where terrestrial habitat consists of turf-grass. In addition, results of the foodchain modeling (discussed below) indicate low potential risks from soil COPCs.

Concentrations of most metals and pesticides in fish collected from the marsh north of SWMU 4 were similar to those in fish collected from background locations and less than concentrations considered to be hazardous to piscivorous receptors. Values for copper and zinc tended to be slightly higher than background values, but neither of these metals were COPCs in surface water or sediment. The frequency of detection of manganese was much greater than in background samples, but concentrations of this micronutrient (2.6 to 5.5 mg/kg) do not appear to be excessive. Concentrations of lead in 11 of 13 sheepshead minnow samples exceeded the 2.0 mg/kg piscivorous mammal protection criteria, but lead was not detected in other minnow species from this site. As discussed in Chapter 7 of Appendix F, lead in 9 of 11 sheepshead minnows from background sites exceeded 2.0 mg/kg, and only 2 of 47 background minnow samples of other species exceeded 2.0 mg/kg lead. Thus, sheepshead minnows appear to accumulate lead to a greater extent than the other species collected during this study. Lead was detected in 11 of 13 sheepshead minnows collected from the marsh at SWMU 4 (range = 2.1 to 2.9 mg/kg; mean = 2.22 mg/kg). These values are similar to those from background sites, where lead was detected in 11 of 11 sheepshead minnows (range = 0.33 to 11.9 mg/kg; mean = 5.76 mg/kg).

The frequency of detection of several organochlorine pesticides were greater than in background samples, but concentrations were typically similar to those in background samples. Endosulfan sulfate and endrin aldehyde were detected much more frequently and at higher concentrations in SWMU 4 samples than in background samples, but mean values do not appear to be high (17.07 mg/kg and 11.26 mg/kg for endosulfan sulfate and endrin aldehyde, respectively). Protective thresholds for these two contaminants were not available. In general, a low level of risk is associated with whole body tissue residues of organochlorine contaminants of less than 100 μg/kg in marine and estuarine organisms (Gibson and Dillon, 1989). All organochlorine pesticide values in fish tissue were below 100 μg/kg, and most values were less than 20 μg/kg.

Pyrene was the only semivolatile compound detected in fish from SWMU 4 and was detected in only one of six minnow samples. Pyrene was not detected in surface water or soil and was detected in only one sediment sample, where its concentration was well below the ecological threshold value.

Two metals and four pesticides were detected in the three vegetation samples collected from the edge of the marsh north of Building A-980. All detected concentrations for zinc, DDD, DDT, and endrin aldehyde were less than in background vegetation samples. Manganese and gamma-BHC (lindane) were detected in all vegetation samples, and values were higher than in background samples. However, the highest gamma-BHC (lindane) value at SWMU 4 was only 1.8 mg/kg. A toxicity threshold for manganese (a vital micronutrient for plants and animals) in plant tissue was not available. However, detected concentrations

in soil and sediment were considerably less than ecological thresholds, and manganese is not a COPC in soil or sediment.

Results of the foodchain modeling indicated that incidental ingestion of aluminum was the only significant contributor of potential risks to the Lower Keys marsh rabbit and the cotton rat.

Aluminum was not a COPC in surface soil since its maximum value at SWMU 4 was less than twice its average background concentration. However, analyses of soils in previous investigations did not include aluminum. Aluminum was detected at 243 mg/kg in the 1996 subsurface soil sample (6 to 18 inches below surface) collected near the location of the drum south of Building A-980 (Sample S4SB-2). This value is considerably less than the average background concentration. Aluminum is one of the most abundant metals in the earth's crust and is ubiquitous in the environment (Goyer, 1986). The single surface soil value probably reflects background conditions. Since aluminum was not elevated in soil and was not detected in vegetation, it is not believed to be a source of significant potential risks to terrestrial receptors at the site.

Cyanide was the only significant contributor of potential risk to the kestrel under both the maximum and mean concentration scenarios, but its HI value of less than 1.0 indicates negligible potential risk. Foodchain modeling for the great blue heron resulted in HI values of 1.23 and 1.08 for 4,4'-DDT and zinc, respectively, under the maximum contaminant scenario. These values indicate low potential risk and are mitigated by the assumption in the model that the heron would forage only on minnows with the highest concentrations of contaminants. Exposure to mean concentrations is a more realistic foraging scenario. Under the mean concentration scenario, all HI values were less than 1.0, and the total HI was only 0.89 for zinc and barium combined, and 0.63 for DDT and metabolites.

Overall, the foodchain modeling indicates low potential risks to terrestrial and piscivorous receptors. The estimated potential risks to these receptor species, while relatively low, are further mitigated by the other conservative assumptions used in the foodchain model. The model assumed an absorption fraction of 80 percent (i.e., 80 percent of the ingested contaminant was absorbed) for the dose calculations describing the intake of vegetation, prey, and soil. Actual absorption fractions range widely, but are often considerably less than 80 percent (Hrudey et al., 1996). In addition, the model assumed that these species forage on the site 100 percent of the time. However, terrestrial habitat is extremely limited at SWMU 4; not even the smallest mammals would forage solely on habitat available at the site. Likewise, avian piscivores would not forage exclusively in the marsh adjacent to the site.

2.7.4.3 Ecological Risk Summary

The Phase I ecological screening risk assessment conducted by IT Corporation (1994) concluded that chromium, lead, chrysene, and phenanthrene were capable of bioaccumulating sufficiently to pose risks to piscivores, although chrysene and phenanthrene probably did not originate at SWMU 4. The Phase I assessment also concluded that no significant exposure pathways existed for terrestrial receptors due to the site's small size and poor habitat. The overall conclusion was that SWMU 4 was unlikely to pose a risk to aquatic or terrestrial receptors, and the report recommended that no further action be taken at the site regarding ecological concerns.

In this Phase II assessment, several metals and organic compounds were detected in groundwater, surface-water, sediment, and soil samples collected from the site and vicinity. HQs of most COPCs were indicative of low ecological risk. Neither of two groundwater COPCs were detected in surface water or sediment. Thus, there is no evidence of contaminant migration from groundwater to surface water and sediment. There were no COPCs in surface water. Hazard quotients and frequencies of detection of sediment COPCs were indicative of low potential risk, and the highest values were from the western end of the ditch adjacent to Midway Avenue. The sediment sample from the western portion of the same ditch and samples from the marsh did not contain elevated concentrations of COPCs. Sediment COPCs for which no suitable ecological thresholds were available were infrequently detected or were detected only slightly above background values.

HQs for soil and plant COPCs indicated relatively low risks to terrestrial receptors, except for chromium and cyanide. The minimal terrestrial habitat at the site reduces the significance of cyanide and chromium concentrations detected in soil samples. In addition, the foodchain modeling identified neither of these inorganics as significant contributors to potential risks for terrestrial receptors. Results of the foodchain modeling indicate a relatively low risk to terrestrial and piscivorous receptors. The estimated risks, albeit low, are mitigated by the conservative assumptions used in the foodchain model.

Concentrations of analytes detected in minnows and vegetation from the vicinity of SWMU 4 were generally similar to background values. The essential elements copper, manganese, and zinc tended to be detected at higher values than in background samples, but concentrations do not appear to be substantially elevated. Several organochlorine pesticides and daughter products were detected more frequently in minnows from SWMU 4 than in background samples, but values tended to be low. Organochlorine pesticides have a long history of use at NAS Key West. These compounds remain in soil and sediment for extremely long periods, and are known to accumulate in tissue. Therefore, their presence at the relatively low concentrations measured in SWMU 4 samples is unremarkable.

The marsh north of SWMU 4 provides excellent aquatic habitat. Site-related contaminants do not appear to have migrated from soils to surface water and sediments to any significant extent. The risks to aquatic and semi-aquatic receptors appear to be low, based on the combined results of the foodchain modeling, surface-water and sediment screening, and tissue analyses.

In summary, the Phase I and the Phase II ecological risk assessments appear to be sufficient to characterize potential ecological risks at SWMU 4. Terrestrial habitat at the site is of minimal areal extent and quality, resulting in minimal use of the site and vicinity by terrestrial receptors. Groundwater and surface-water contaminants do not appear to pose environmental risks. Soil and sediment contaminants do not appear to have bioaccumulated in vegetation or fish to any significant extent, and potential risks to benthic organisms and terrestrial and piscivorous receptors appear to be low. Therefore, additional ecological studies or remediation based on ecological risks are not necessary, and therefore, are not recommended.

2.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of investigation at SWMU 4 were to identify the existing nature and extent of contamination (after removal of the drums) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

Low levels of metals and organic compounds were detected in each medium sampled at SWMU 4. Inorganics were detected with the greatest frequency in soil and sediment, but detections were scattered. VOCs were detected in a few samples at low concentrations. Although both metals and organics were detected in some of the samples from the immediate vicinity of the locations formerly occupied by Drums A and B, concentrations were not remarkable, and there was no obvious pattern of contamination.

The human health risk assessment performed at SWMU 4 indicates that contaminants are not present at sufficient concentrations to cause adverse noncarcinogenic or carcinogenic health effects to any current potential receptors; however, adverse noncarcinogenic health effects might occur under conditions evaluated for the future resident exposure scenario. The risk for the future resident exposure scenario was estimated at the lower end of EPA's 1E-04 to 1E-06 target risk range for carcinogenic risk, slightly exceeds the FDEP target cancer risk of 1E-06, and only slightly exceeded the 1.0 hazard index for noncarcinogenic risk.

The ecological risk assessment concluded that potential risks to terrestrial receptors at SWMU 4 appear to be low. Soil, surface water, and sediment contaminants do not appear to have bioaccumulated in vegetation or fish to any significant extent. In addition, terrestrial habitat at the site is of minimal areal extent and quality, resulting in minimal use of the site and vicinity by terrestrial receptors. The marsh north of the site provides excellent aquatic habitat, but contaminants do not appear to have migrated there to any significant extent.

Although metal contaminants (i.e., antimony, and beryllium) are present at concentrations that might contribute to the risk for the hypothetical future resident, these metals may not be associated with past site-related activity. Antimony and beryllium appear to be present at concentrations within or slightly above background. Based on the lack of current human health and ecological risk posed by the site, it is recommended that an NFA decision document be prepared for SWMU 4.

3.0 SOLID WASTE MANAGEMENT UNIT 5 (SWMU 5)

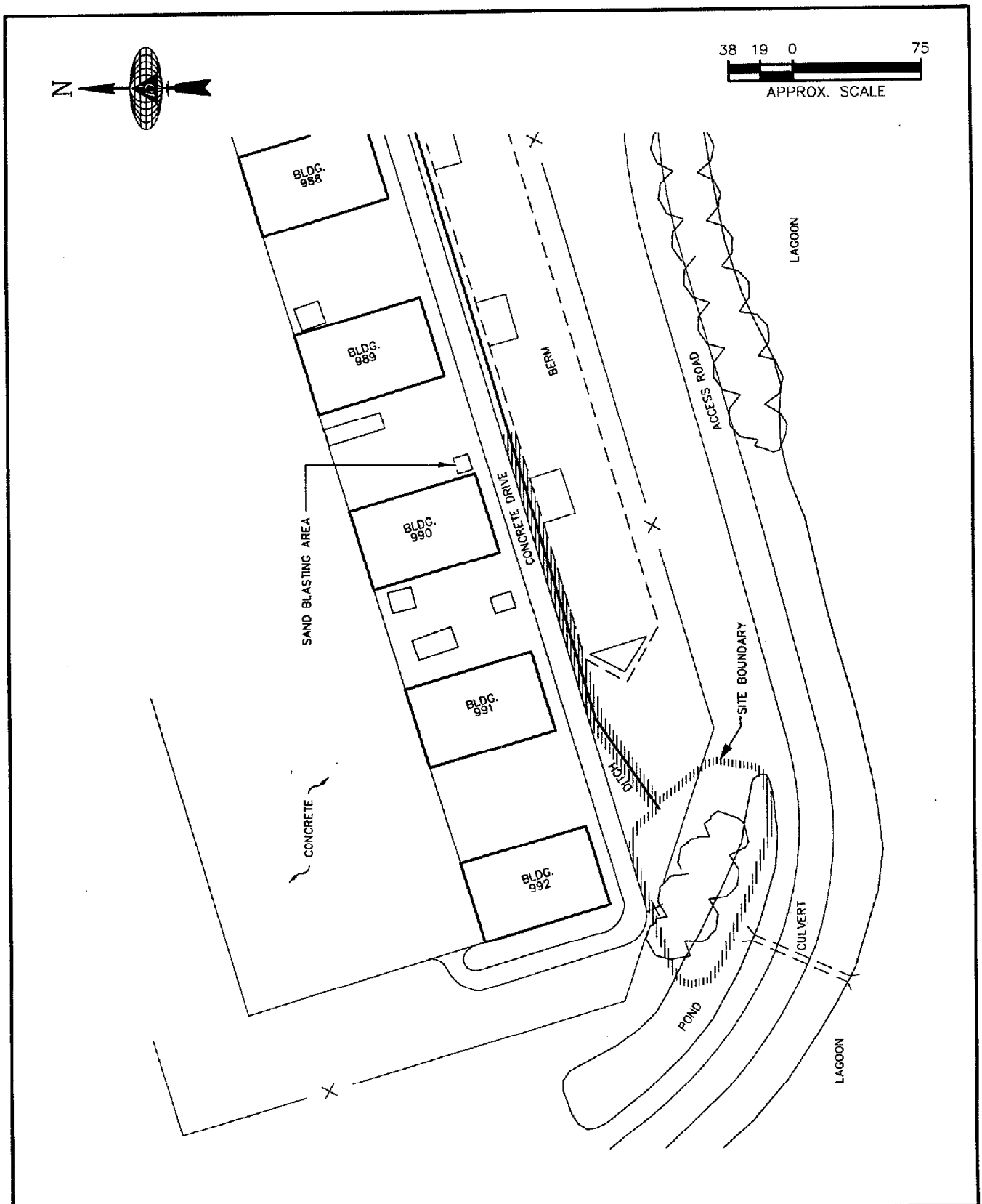
This chapter describes the site-specific evaluation of data for SWMU 5 (Boca Chica AIMD Sand Blasting Building A-990). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 3.8 presents a summary and conclusions with recommendations for SWMU 5.

3.1 UNIT DESCRIPTION

The Sand Blasting Area is located at the western end of the airfield adjacent to Building A-990 (Figure 3-1). The area was used from the early 1970s until 1995 to remove painted surfaces from ground handling and ground support vehicles and equipment, aircraft parts, and other metal objects and pieces of equipment. The Sand Blasting Area measures approximately 65 feet by 90 feet. Sand blasting residue was normally left on the ground or stockpiled for disposal. The former Sand Blasting Area consists of bare rock and concrete and an extensive paved area located north of the site. AIMD buildings are located to the east and west of the site. A concrete access road is located to the south, and six AIMD buildings are situated along this road. A variety of aircraft maintenance operations are conducted in the buildings and in the area to the north. Immediately south of the concrete access road is a concrete ditch that collects stormwater runoff from the AIMD area and transports it westward. The concrete drainage ditch ends in a small grassy area approximately 300 feet west of the site. Surface-water flow beyond this point is nonexistent except after heavy rainfall events, when surface water flows overland to a shallow pond. The pond is connected by a culvert under a paved road to an extensive area of large lagoons south of the road. A large dirt berm is located immediately south of the concrete ditch. The berm is vegetated with grass, weeds, and Australian pines. With the exception of the berm, the topography of the site and surrounding area is flat.

3.2 INVESTIGATION HISTORY

Several investigations have been performed at SWMU 5 since the mid-1980s to identify, confirm, or delineate contamination. The previous investigations are summarized in Section 3.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 3.2.2.



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SCALE: AS SHOWN	
CAD DWG. NO.: 704699031	PROJ. NO.: HK7046

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FIGURE 3-1
SITE LOCATION MAP
SWMU 5
NAVAL AIR STATION
KEY WEST, FLORIDA

3.2.1 Previous Investigations

In June 1984, the Navy collected soil and groundwater samples at SWMU 5. Analyses from these samples indicated the presence of phenol in the soil. Subsequently, the Navy requested Geraghty and Miller to coordinate analysis of two samples of the substance used as blasting material for equipment. Geraghty and Miller collected the samples of one used and one unused material in April 1988. No metals were present above EP Toxicity threshold values.

IT Corporation conducted soil, sediment, surface-water, and groundwater sampling during the RFI/RI at this site in 1993. Characterization of contamination at the site indicated that cyanide exceeded the drinking water standard for groundwater, and that surface water and sediment appeared to be impacted by metals (e.g., lead, arsenic, barium, cadmium, and chromium) (IT Corporation, 1994). The Final RFI/RI report prepared by IT Corporation recommended resampling of the groundwater monitoring well to confirm cyanide levels, performing additional surface-water and sediment sampling to delineate contamination, conducting an IRA to reduce migration of contamination, and performing a baseline human health risk assessment based on post-IRA sampling data. An IRA has not been conducted at this site.

3.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at SWMU 5 and the scope of those field activities performed from August to October 1996. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 3-2 through 3-5 show the location of all soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as those from previous investigations.

3.2.2.1 Investigation Rationale

Additional sampling of all media was conducted at SWMU 5 to provide more information upon which appropriate risk assessments can be based. Sediment and surface-water samples were collected to assess the extent of metal contamination along the concrete-lined ditch and stormwater runoff pond to which the ditch discharges. Existing monitoring wells were resampled and new monitoring wells were installed and sampled to delineate the extent of cyanide in groundwater samples collected during the original RFI/RI and to assess groundwater flow direction.

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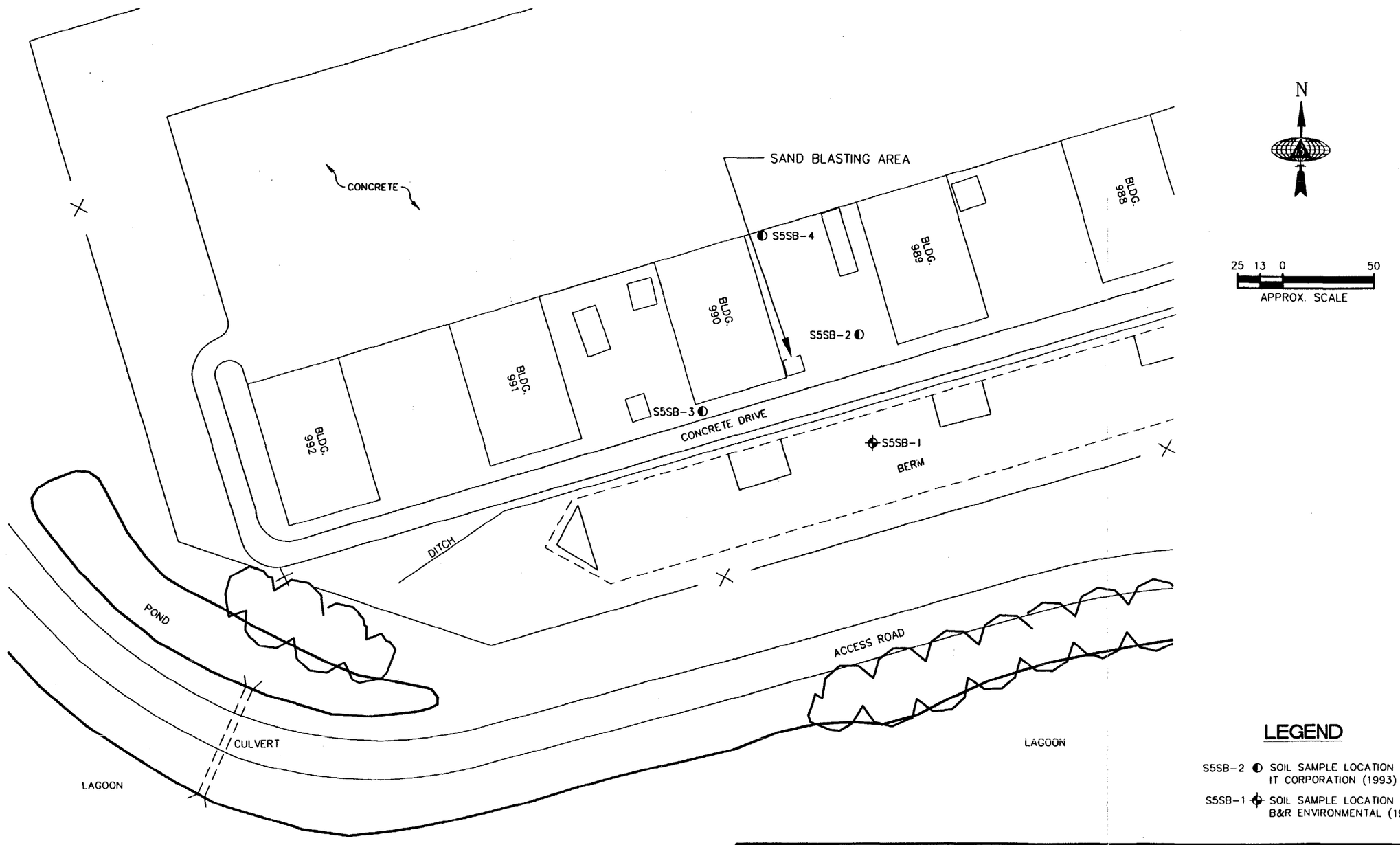

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SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699032	PROJ. NO.: HK7046

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FIGURE 3-2
SOIL SAMPLE LOCATIONS SWMU 5
NAVAL AIR STATION
KEY WEST, FLORIDA

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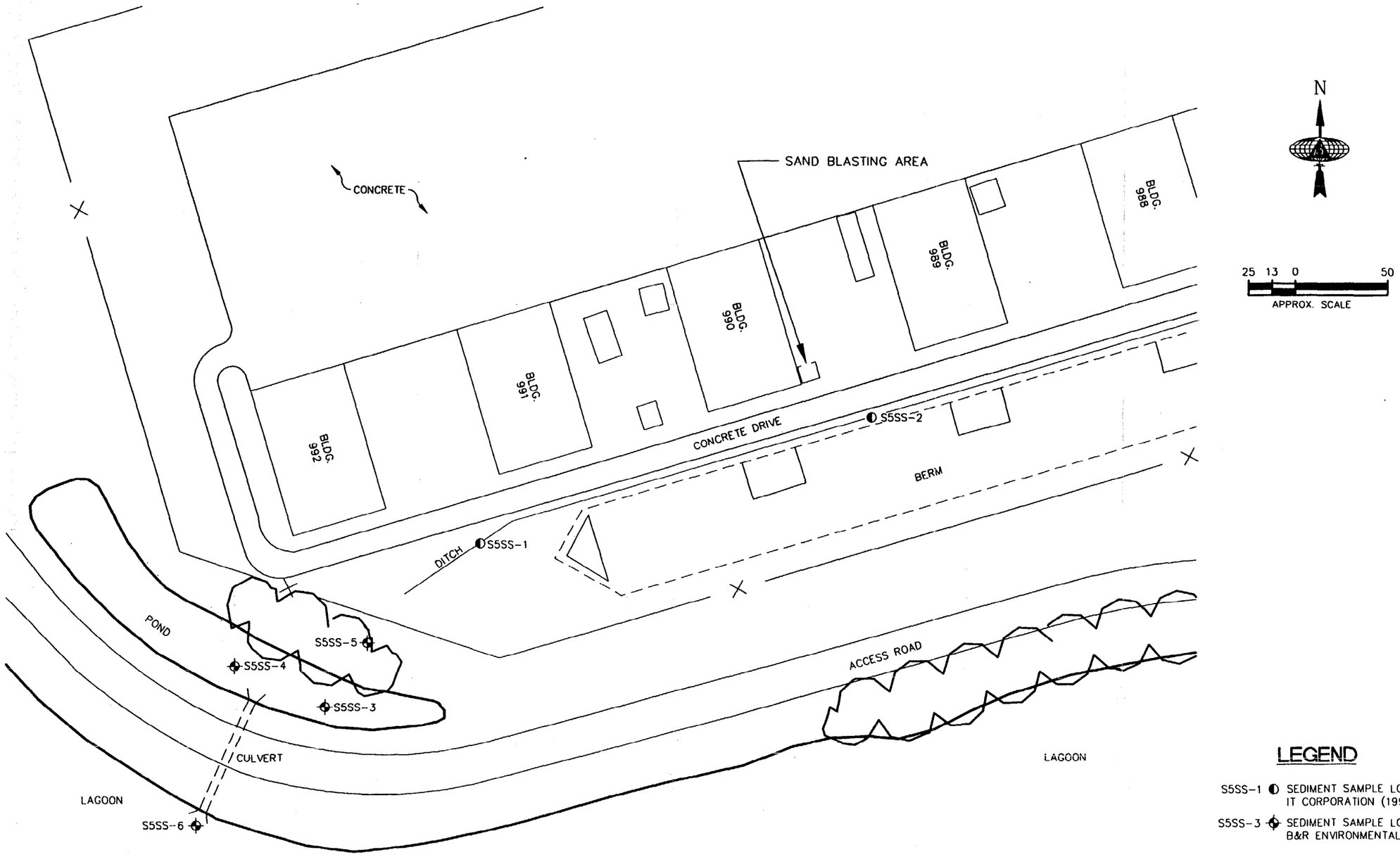

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SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699033	PROJ. NO.: HK7046

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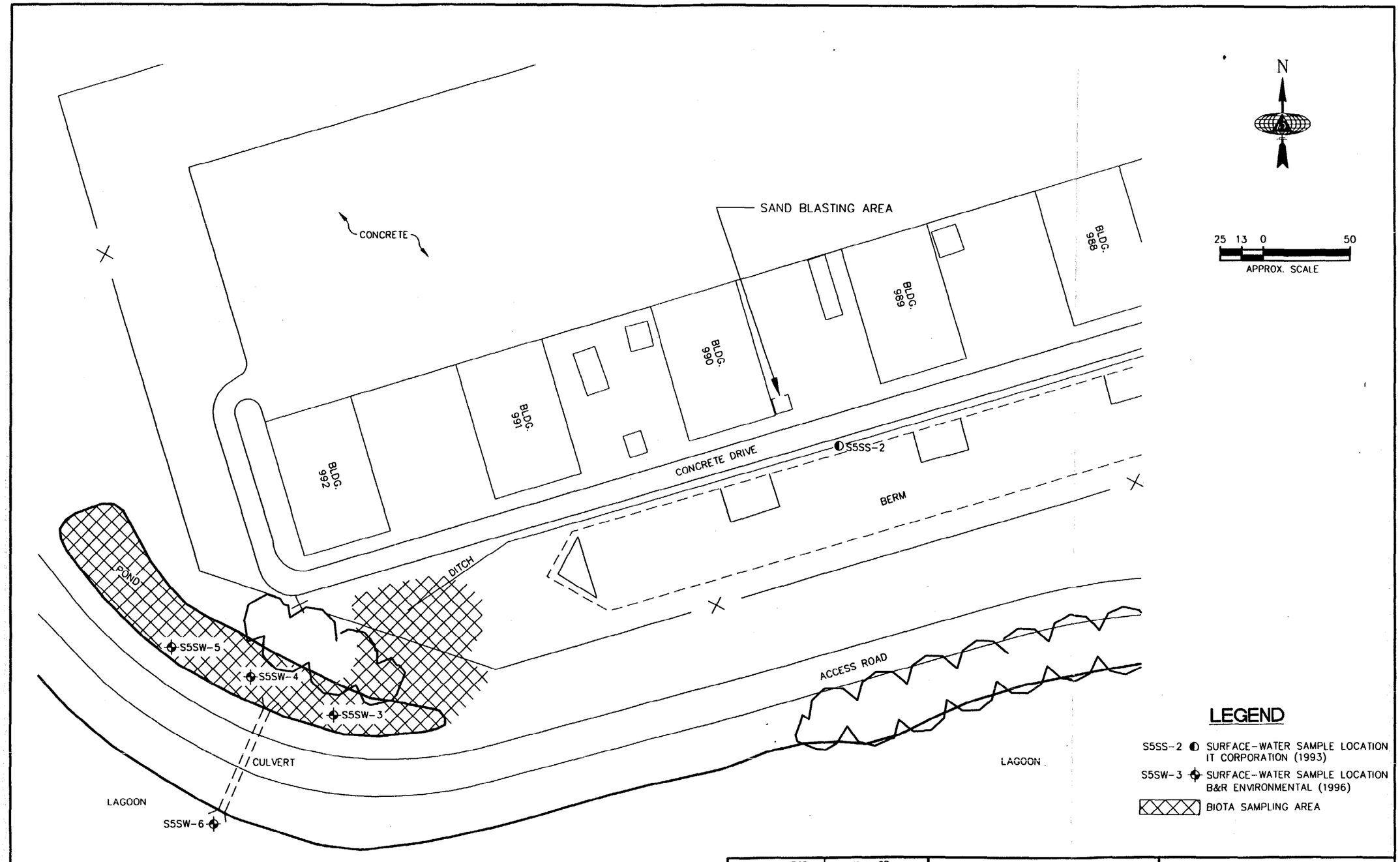
FIGURE 3-3
SEDIMENT SAMPLE LOCATIONS SWMU 5
NAVAL AIR STATION KEY WEST, FLORIDA



SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699034	PROJ. NO.: HK7046

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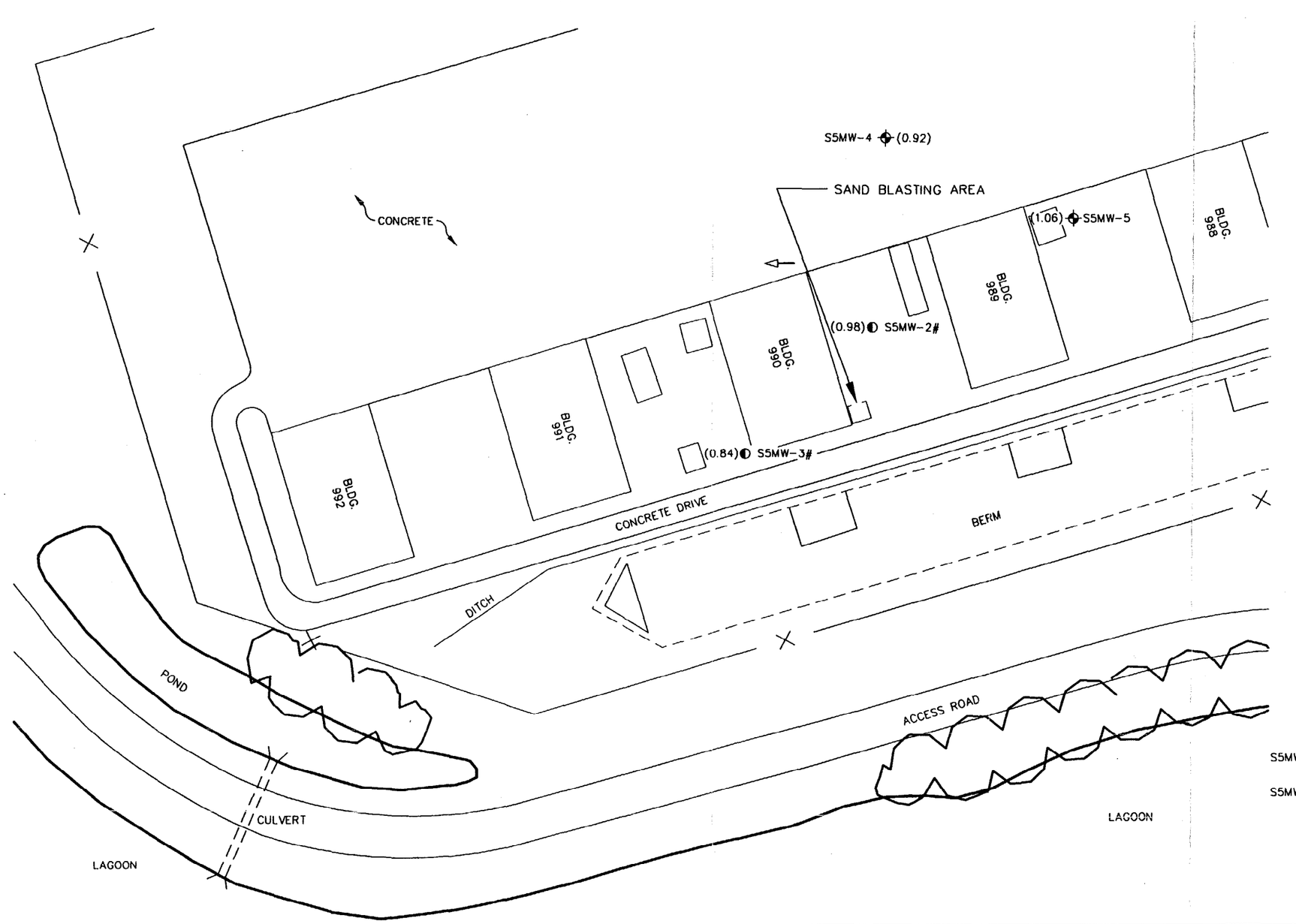
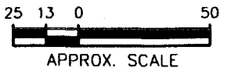
FIGURE 3-4
SURFACE-WATER AND BIOTA SAMPLING LOCATIONS
SWMU 5
NAVAL AIR STATION
KEY WEST, FLORIDA





NOTE: S5MW-4 AND S5MW-5 WERE GROUNDWATER BACKGROUND SAMPLING LOCATIONS.

LEGEND

S5MW-2 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

S5MW-4 ⊕ MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)

ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

→ GROUNDWATER FLOW DIRECTION OBSERVED BY B&R ENVIRONMENTAL (1996)

(0.84) GROUNDWATER ELEVATION (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699035	PROJ. NO.: HK7046

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FIGURE 3-5
GROUNDWATER SAMPLE LOCATIONS SWMU 5
NAVAL AIR STATION KEY WEST, FLORIDA

3.2.2.2 Scope of Current Field Investigation

Supplemental field activities at SWMU 5 included surface soil sampling to further characterize surface soil conditions, surface-water and sediment sampling to further delineate the contaminants detected in earlier activities, and monitoring well installation and groundwater sampling to verify previously detected contamination.

3.2.2.2.1 Surface Soil

Since SWMU 5 drains to a wetlands area and previous work had sufficiently characterized surface soil between the site and the stormwater runoff pond, the Supplemental RFI/RI investigation restricted soil sampling to a single off-site location that required characterization along the boundary of the site for use with previously collected background and contaminant data. The SWMU 5 surface soil sample was analyzed for TAL metals.

3.2.2.2.2 Surface Water and Sediment

Surface-water and sediment samples were collected in the stormwater runoff pond and wetlands beyond where the extent of metal contamination had not been sufficiently delineated. All SWMU 5 sediment and surface-water samples were analyzed for the following parameters:

- Appendix IX VOCs
- Appendix IX semivolatile organic compounds (SVOCs)
- TAL metals
- Cyanide

3.2.2.2.3 Groundwater

Groundwater sampling was conducted to characterize background (hydraulically upgradient) groundwater quality and areas hydraulically downgradient, particularly with respect to SVOCs metals, and cyanide. All SWMU 5 groundwater samples were analyzed for the following parameters:

- Appendix IX VOCs
- Appendix IX SVOCs
- TAL metals
- Cyanide

3.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at NAS Key West is included in Section 1.4 (Base Environmental Setting) of this document. Applicable unit surface features are discussed in Section 3.1, while hydrogeology and soils at SWMU 5 are discussed below.

3.3.1 Hydrogeology

The primary hydrogeologic unit underlying the site is a surficial oolite limestone aquifer. During the Supplemental RFI/RI, B&R Environmental installed two additional monitoring wells (S5MW-4 and S5MW-5) and also sampled the existing wells. The depths to groundwater during this sampling event ranged from 2.79 feet to 2.98 feet. Groundwater elevations varied from 0.98 feet to 1.06 feet above msl. Groundwater flow at the site is generally toward the west (Figure 3-5). Recharge of the aquifer is primarily through direct infiltration of precipitation. Tidal influences would appear to be greatest adjacent to the lagoon south and west of the facility. Monitoring well construction logs for the wells installed in 1996 are represented in Appendix E.

3.3.2 Soils

The lithologic description of soil samples was recorded during the installation of soil borings and monitoring wells in 1993. The lithologic logs were presented in Appendix E of the Final RFI/RI Report (IT Corporation, 1994). Review of the lithologic descriptions reveal the presence of two distinguishable units in the subsurface of the site. The uppermost unit is a light brown, poorly sorted mixture of sand and limestone fill material varying in thickness from 4 to 5 feet. The fill material varies in size from a pebble to a fine-grained material. Natural oolitic limestone was encountered below the fill material and was found to continue to the depths at which monitoring wells were terminated.

3.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from subsurface and surface soil, sediment, surface water, and groundwater in the vicinity of the Sand Blasting Area. The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various state and Federal agencies and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media, in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. The figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix H contains the full data set used in site characterization and assessment. Appendix I contains the analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI.

3.4.1 Subsurface Soil

Data from the IT Corporation 1993 RFI/RI and this Supplemental RFI/RI were considered in the analysis of subsurface soil contamination in at SWMU 5. Chemicals that were detected in subsurface soil samples are listed in Table 3-1. This table includes analytical results from all applicable historical sampling and this Supplemental RFI/RI. Figure 3-6 shows the occurrence of analytes that exceeded screening values and indicated possible subsurface soil contamination. Metals accounted for most of the chemicals detected in the subsurface soil at SWMU 5. In general, metals were detected in samples throughout the site, while semivolatile and volatile detections were limited to a single sample.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of subsurface soil samples.

3.4.1.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the subsurface soil samples. However, acetone and methylene chloride were detected in the subsurface soil sample at S5SB-4 between Buildings A-990 and A-989 within the Sand Blasting Area. This sample was collected by IT Corporation in 1993.

3.4.1.2 Semivolatile Organic Compounds

No SVOCs exceeded the screening criteria in any of the subsurface soil samples. Only one SVOC was detected at SWMU 5 within the Sand Blasting Area. Bis(2-ethylhexyl)phthalate was detected in the subsurface soil at S5SB-4 by IT Corporation in 1993. Several VOCs were also detected in the same sample (see Section 3.4.1.1).

TABLE 3-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT SWMU 5
NAS KEY WEST

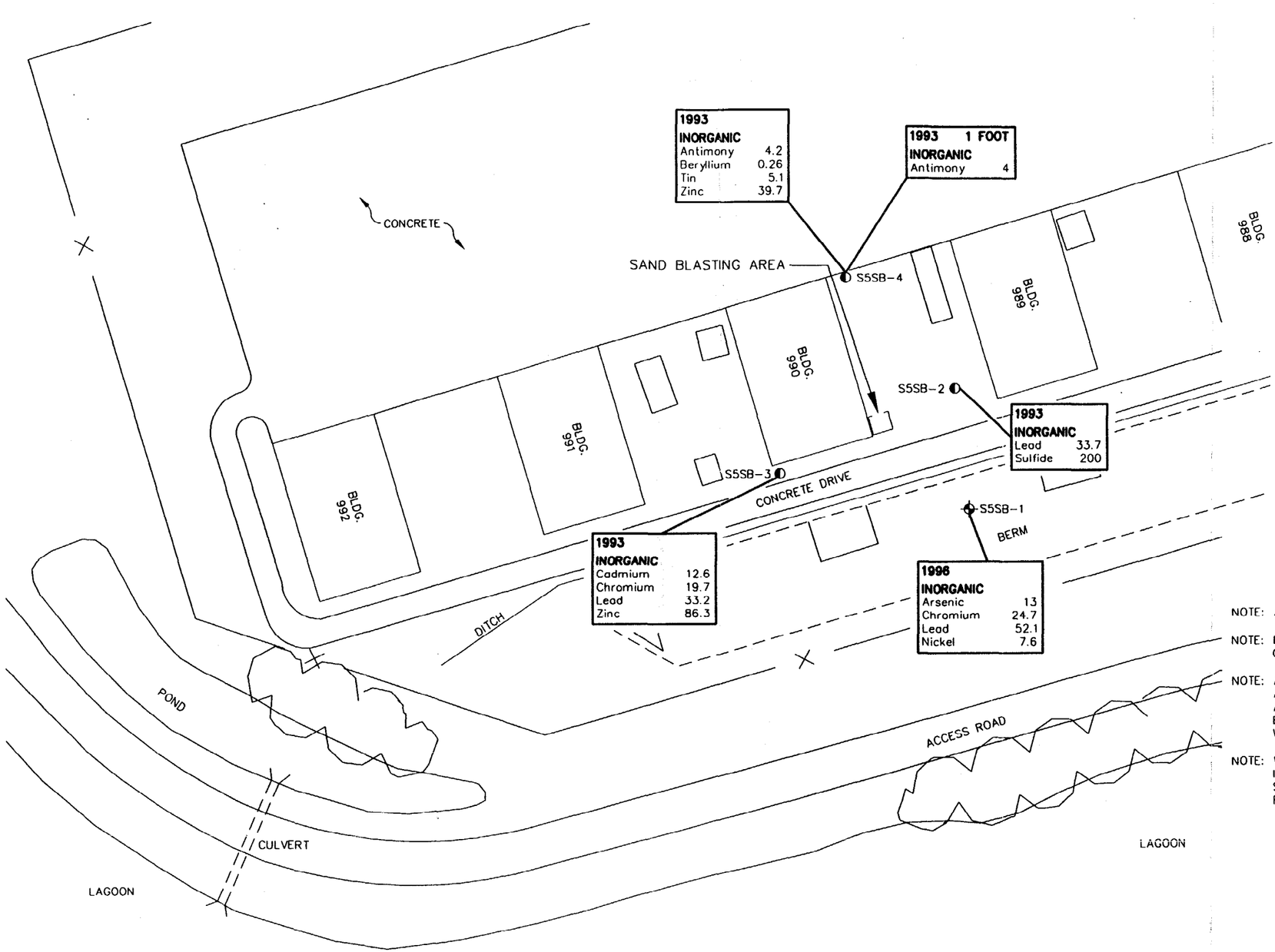
Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
S5SB-4	1	IT 1993	Antimony	4	B_1
S5SB-4	2	IT 1993	Arsenic	0.31	B_1
S5SB-3	2	IT 1993	Arsenic	0.29	B_1
S5SB-3	1	IT 1993	Arsenic	0.29	B_1
S5SB-4	1	IT 1993	Arsenic	0.28	B_1
S5SB-2	1	IT 1993	Arsenic	0.27	B_1
S5SB-2	2	IT 1993	Arsenic	0.26	B_1
S5SB-3	2	IT 1993	Barium	3.7	B_1
S5SB-3	1	IT 1993	Barium	3.4	B_1
S5SB-2	2	IT 1993	Barium	3.2	B_1
S5SB-4	1	IT 1993	Barium	3.2	B_1
S5SB-2	1	IT 1993	Barium	3.2	B_1
S5SB-4	2	IT 1993	Barium	2.9	B_1
S5SB-3	2	IT 1993	Beryllium	0.14	B_1
S5SB-3	1	IT 1993	Beryllium	0.12	B_1
S5SB-3	1	IT 1993	Cadmium	0.95	
S5SB-3	1	IT 1993	Chromium	5.3	
S5SB-3	2	IT 1993	Chromium	4.1	
S5SB-4	1	IT 1993	Chromium	4.1	
S5SB-4	2	IT 1993	Chromium	3.9	
S5SB-2	1	IT 1993	Chromium	3.4	
S5SB-2	2	IT 1993	Chromium	3	
S5SB-3	1	IT 1993	Lead	11.3	
S5SB-2	1	IT 1993	Lead	2.4	
S5SB-3	2	IT 1993	Lead	0.38	B_1
S5SB-4	2	IT 1993	Lead	0.29	B_1
S5SB-4	1	IT 1993	Lead	0.25	B_1
S5SB-4	2	IT 1993	Sulfide	60	
S5SB-3	1	IT 1993	Zinc	12.5	
S5SB-3	2	IT 1993	Zinc	4.6	
S5SB-4	2	IT 1993	Zinc	2.3	
S5SB-4	1	IT 1993	Zinc	2.2	B_1
S5SB-2	2	IT 1993	Zinc	1.6	B_1
S5SB-2	1	IT 1993	Zinc	1.4	B_1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
S5SB-4	2	IT 1993	Bis(2-ethylhexyl)phthalate	56	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)					
S5SB-4	2	IT 1993	Acetone	36	
S5SB-4	2	IT 1993	Methylene chloride	19	B_2

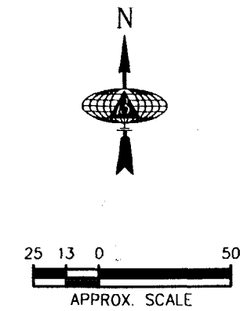
Shading indicates a concentration in excess of the screening values (See Table C.3-1).

1 Depths are in feet and represent top of sampling interval.

2 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

3 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.
B_2 - Analyte was found in the blank as well as the sample.





PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Cadmium	2.5
Chromium	12
Lead	31
Nickel	3.4
Sulfide	98
Tin	3.9
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: NO ORGANIC PARAMETERS WERE DETECTED IN EXCESS OF SCREENING VALUES.

NOTE: ALL THREE IT SAMPLE LOCATIONS WERE SAMPLED AT THE SURFACE, AT A DEPTH OF 1 FOOT, AND AT A DEPTH OF 2 FEET. THE ONLY DETECTION IN EXCESS OF SCREENING VALUES IN THE SUBSURFACE WAS ANTIMONY AT S5SB-4, AS SHOWN.

NOTE: WHEN A DEPTH IS SHOWN IN THE RESULT BOX, IT INDICATES THE TOP OF A SUBSURFACE SAMPLING INTERVAL. DEPTHS ARE NOT SHOWN FOR SURFACE SOIL SAMPLES.

LEGEND

S5SB-2 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)

S5SB-1 ⌖ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699036	PROJ. NO.: HK7046

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FIGURE 3-6
SOIL CHEMICAL CONCENTRATIONS SWMU 5
NAVAL AIR STATION KEY WEST, FLORIDA

0101F082

3.4.1.3 Pesticides

No pesticides were detected in the subsurface soil at SWMU 5.

3.4.1.4 Polychlorinated Biphenyls

No PCBs were detected in the subsurface soil at SWMU 5.

3.4.1.5 Inorganics

Inorganics were detected at all of the subsurface soil sample locations near the Sand Blasting Area. While many of the inorganics were detected in multiple samples, only antimony exceeded its 0.79 mg/kg screening criteria. Antimony was detected at S5SB-4 (4 mg/kg) within the immediate Sand Blasting Area sampled by IT Corporation in 1993. Arsenic, barium, beryllium, cadmium, chromium, lead, sulfide, and zinc were detected in subsurface soil at SWMU 5.

3.4.2 Surface Soil

Data from the IT Corporation 1993 RFI/RI and this Supplemental RFI/RI were considered in the analysis of surface soil contamination in at SWMU 5. Chemicals that were detected in surface soil samples are listed in Table 3-2. This table includes analytical results from all applicable historical sampling events as well as the Supplemental RFI/RI. Figure 3-6 shows the occurrence of analytes that exceeded screening and indicated possible surface soil contamination. Metals accounted for most of the chemicals detected in surface soil at SWMU 5. In general, metals were detected in samples throughout the site, while volatile detections were limited to a single sample.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

TABLE 3-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 5
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
S5SB-1	B&RE 1996	Aluminum	923	
S5SB-4	IT 1993	Antimony	4.2	B_1
S5SB-1	B&RE 1996	Arsenic	13	
S5SB-4	IT 1993	Arsenic	0.9	B_1
S5SB-3	IT 1993	Arsenic	0.39	B_1
S5SB-2	IT 1993	Arsenic	0.34	B_1
S5SB-1	B&RE 1996	Barium	22.3	
S5SB-4	IT 1993	Barium	11.7	B_1
S5SB-3	IT 1993	Barium	6.8	B_1
S5SB-2	IT 1993	Barium	3.7	B_1
S5SB-4	IT 1993	Beryllium	0.26	B_1
S5SB-3	IT 1993	Cadmium	12.6	
S5SB-1	B&RE 1996	Cadmium	2.2	
S5SB-4	IT 1993	Cadmium	1.7	
S5SB-1	B&RE 1996	Chromium	24.7	
S5SB-3	IT 1993	Chromium	19.7	
S5SB-4	IT 1993	Chromium	9	
S5SB-2	IT 1993	Chromium	6.4	
S5SB-1	B&RE 1996	Cobalt	0.7	
S5SB-1	B&RE 1996	Copper	7.2	
S5SB-4	IT 1993	Copper	4.3	
S5SB-3	IT 1993	Copper	2.2	B_1
S5SB-1	B&RE 1996	Iron	1,480	
S5SB-1	B&RE 1996	Lead	52.1	
S5SB-2	IT 1993	Lead	33.7	
S5SB-3	IT 1993	Lead	33.2	
S5SB-4	IT 1993	Lead	13.8	
S5SB-1	B&RE 1996	Manganese	8.9	
S5SB-1	B&RE 1996	Mercury	0.04	
S5SB-1	B&RE 1996	Nickel	7.6	
S5SB-4	IT 1993	Nickel	3	B_1
S5SB-3	IT 1993	Nickel	2.4	B_1
S5SB-2	IT 1993	Sulfide	200	
S5SB-4	IT 1993	Tin	5.1	B_1
S5SB-1	B&RE 1996	Vanadium	3.2	
S5SB-4	IT 1993	Vanadium	2.7	B_1
S5SB-3	IT 1993	Zinc	86.3	
S5SB-4	IT 1993	Zinc	39.7	
S5SB-1	B&RE 1996	Zinc	26.2	
S5SB-2	IT 1993	Zinc	3.1	
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
S5SB-2	IT 1993	2-butanone	9	J
S5SB-2	IT 1993	Acetone	35	
S5SB-2	IT 1993	Cis-1,2-dichloroethene	1	J
S5SB-2	IT 1993	Methylene chloride	20	B_2

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
B_2 - Analyte was found in the blank as well as the sample.

3.4.2.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the surface soil samples. However, 2-butanone, acetone, cis-1,2-dichloroethene, and methylene chloride were detected in the surface soil sample at S5SB-2 (located between Buildings A-990 and A-989 within the Sand Blasting Area) by IT Corporation in 1993. As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Acetone and 2-butanone were selected as ecological COPCs (see Section 3.7.4.1.2) based on a comparison with twice the average background concentration because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels, and were higher than twice the average background concentrations.

3.4.2.2 Semivolatile Organic Compounds

No SVOCs were detected in the surface soil at SWMU 5.

3.4.2.3 Pesticides

No pesticides were detected in the surface soil at SWMU 5.

3.4.2.4 Polychlorinated Biphenyls

No PCBs were detected in the surface soil at SWMU 5.

3.4.2.5 Inorganics

Although inorganics were detected at all of the surface soil sample locations near the Sand Blasting Area, only 14 of the 39 detects exceeded screening values. Antimony exceeded its 0.79 mg/kg screening criteria at S5SB-4 (4.2 mg/kg) within the immediate Sand Blasting Area sampled by IT Corporation in 1993. Several other inorganics were detected in excess of their screening values within the immediate Sand Blasting Area by IT Corporation in 1993. This included beryllium, tin, and zinc, all at S5SB-4 and lead and sulfide at S5SB-2 (sulfide was not tested in any other surface soil sample). Beryllium and tin were not detected elsewhere at the site. Lead also exceeded its 31 mg/kg screening value at the two sampling locations outside the immediate Sand Blasting Area (S5SB-3 and S5SB-1). The maximum concentration (52.1 mg/kg) was located at S5SB-1 on the berm south of the Sand Blasting Area. Zinc

exceeded its screening value at S5SB-3 and, although it was detected in other surface soil samples (S5SB-1 and S5SB-2), its concentration was less than the 30 mg/kg screening value. Arsenic, cadmium, and nickel were detected in several surface soil samples, but exceeded screening values at only one location each: arsenic (13 mg/kg) and nickel (7.6 mg/kg) at S5SB-1 and cadmium (12.6 mg/kg) at S5SB-3. Aluminum, barium, cobalt, copper, iron, manganese, mercury, and vanadium were detected in surface soil at SWMU 5, but did not exceed screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Antimony and iron were identified as COPCs (see Section 3.6.2.2) in the human health risk assessment, but did not exceed the selected nature and extent screening level due to the conservative non-cancer hazard index applied to the EPA RBC during the risk assessment process. Aluminum, tin, and vanadium were selected as ecological COPCs (see Section 3.7.4.1.2) based on a comparison with twice the average background concentration because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels, and were higher than twice the average background concentration.

3.4.3 Sediment

Data from the IT Corporation 1993 RFI/RI and this Supplemental RFI/RI were considered in the analysis of sediment contamination at SWMU 5. Chemicals that were detected in sediment samples are listed in Table 3-3. This table lists analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Sediment samples were taken from the berm south of the Sand Blasting Area and in the southwestern pond and lagoon areas of SWMU 5. Figure 3-7 shows the occurrence of analytes that exceeded screening values and indicated possible sediment contamination.

Screening values were obtained from a variety of sources including FDEP SQAGs, EPA Region IV Screening Values, EPA SQCs for Marine and Freshwater Sediments, ER-L Criteria, ER-M Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples.

TABLE 3-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 5
NAS KEY WEST
PAGE 1 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
S5SS-6	B&RE 1996	Aluminum	3,040	
S5SS-3	B&RE 1996	Aluminum	2,300	
S5SS-5	B&RE 1996	Aluminum	2,000	
S5SS-4	B&RE 1996	Aluminum	1,340	
S5SS-2	IT 1993	Antimony	4	B_1
S5SS-1	IT 1993	Arsenic	8.6	
S5SS-5	B&RE 1996	Arsenic	8	
S5SS-3	B&RE 1996	Arsenic	4.8	
S5SS-6	B&RE 1996	Arsenic	4.7	
S5SS-4	B&RE 1996	Arsenic	4.3	
S5SS-2	IT 1993	Arsenic	4.3	
S5SS-1	IT 1993	Barium	250	
S5SS-2	IT 1993	Barium	140	
S5SS-5	B&RE 1996	Barium	53.5	
S5SS-3	B&RE 1996	Barium	16.1	
S5SS-6	B&RE 1996	Barium	12.8	
S5SS-4	B&RE 1996	Barium	10.6	
S5SS-2	IT 1993	Beryllium	2.6	
S5SS-1	IT 1993	Beryllium	1.8	
S5SS-1	IT 1993	Cadmium	120	
S5SS-5	B&RE 1996	Cadmium	17.9	
S5SS-3	B&RE 1996	Cadmium	11.6	
S5SS-2	IT 1993	Cadmium	2.9	
S5SS-4	B&RE 1996	Cadmium	2.3	
S5SS-1	IT 1993	Chromium	428	
S5SS-5	B&RE 1996	Chromium	316	
S5SS-3	B&RE 1996	Chromium	85	
S5SS-2	IT 1993	Chromium	36.5	
S5SS-4	B&RE 1996	Chromium	19.3	
S5SS-6	B&RE 1996	Chromium	16.5	

Location	Source[1]	Parameter	Result	Qual.[2]
S5SS-1	IT 1993	Cobalt	9.8	
S5SS-2	IT 1993	Cobalt	9.6	
S5SS-5	B&RE 1996	Cobalt	2	
S5SS-3	B&RE 1996	Cobalt	0.59	
S5SS-1	IT 1993	Copper	38.9	
S5SS-3	B&RE 1996	Copper	23.4	
S5SS-5	B&RE 1996	Copper	17	
S5SS-2	IT 1993	Copper	13.9	
S5SS-4	B&RE 1996	Copper	10.9	
S5SS-6	B&RE 1996	Copper	10.5	
S5SS-5	B&RE 1996	Iron	3,245	
S5SS-3	B&RE 1996	Iron	2,390	
S5SS-6	B&RE 1996	Iron	1,710	
S5SS-4	B&RE 1996	Iron	952	
S5SS-1	IT 1993	Lead	966	
S5SS-5	B&RE 1996	Lead	292.5	
S5SS-3	B&RE 1996	Lead	115	
S5SS-2	IT 1993	Lead	61.7	
S5SS-4	B&RE 1996	Lead	31.7	
S5SS-6	B&RE 1996	Lead	30.1	
S5SS-5	B&RE 1996	Manganese	32.1	
S5SS-6	B&RE 1996	Manganese	19.8	
S5SS-3	B&RE 1996	Manganese	14.6	
S5SS-4	B&RE 1996	Manganese	9.2	
S5SS-1	IT 1993	Mercury	0.13	
S5SS-3	B&RE 1996	Mercury	0.07	
S5SS-5	B&RE 1996	Mercury	0.03	
S5SS-1	IT 1993	Nickel	26.6	
S5SS-2	IT 1993	Nickel	20.6	
S5SS-5	B&RE 1996	Nickel	6	
S5SS-3	B&RE 1996	Nickel	5.3	

TABLE 3-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 5
NAS KEY WEST
PAGE 2 OF 2

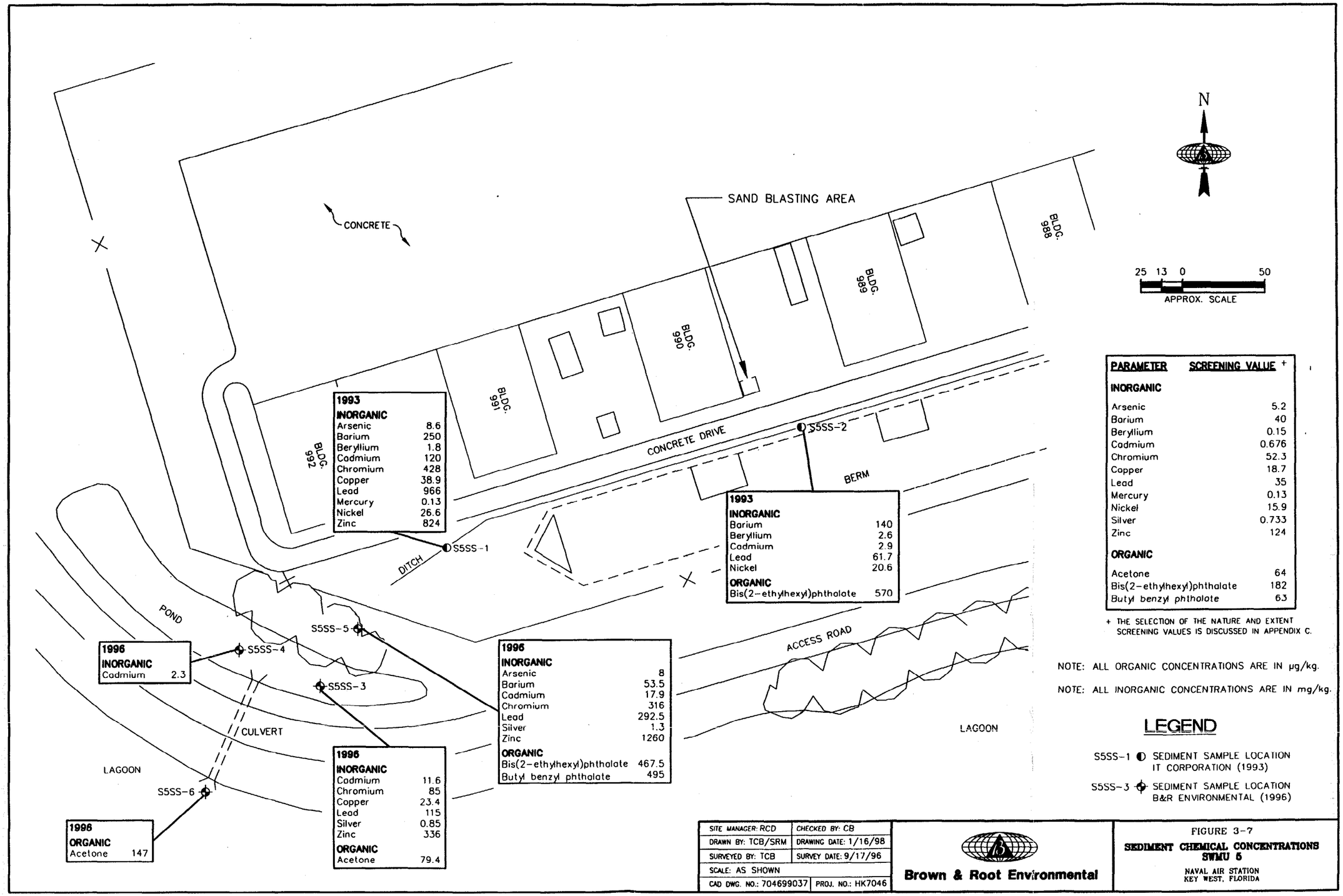
Location	Source(1)	Parameter	Result	Qual.(2)
S5SS-6	B&RE 1996	Nickel	3.5	
S5SS-4	B&RE 1996	Nickel	2.3	
S5SS-5	B&RE 1996	Silver	1.3	
S5SS-3	B&RE 1996	Silver	0.85	
S5SS-2	IT 1993	Sulfide	20	
S5SS-2	IT 1993	Tin	8.1	B_1
S5SS-2	IT 1993	Vanadium	34.2	
S5SS-1	IT 1993	Vanadium	27.1	
S5SS-3	B&RE 1996	Vanadium	9.2	
S5SS-5	B&RE 1996	Vanadium	7.4	
S5SS-6	B&RE 1996	Vanadium	7.1	
S5SS-4	B&RE 1996	Vanadium	6.4	
S5SS-5	B&RE 1996	Zinc	1,260	
S5SS-1	IT 1993	Zinc	824	
S5SS-3	B&RE 1996	Zinc	336	
S5SS-4	B&RE 1996	Zinc	79.7	
S5SS-2	IT 1993	Zinc	58.8	
S5SS-6	B&RE 1996	Zinc	24.6	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
S5SS-2	IT 1993	Bis(2-ethylhexyl)phthalate	570	J
S5SS-5	B&RE 1996	Bis(2-ethylhexyl)phthalate	467.5	J
S5SS-5	B&RE 1996	Butyl benzyl phthalate	495	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
S5SS-6	B&RE 1996	Acetone	147	
S5SS-3	B&RE 1996	Acetone	79.4	
S5SS-2	IT 1993	Acetone	24	
S5SS-2	IT 1993	Cis-1,2-dichloroethene	2	J
S5SS-2	IT 1993	Methylene chloride	12	B_2
S5SS-3	B&RE 1996	Tetrachloroethene	10.2	
S5SS-6	B&RE 1996	Tetrachloroethene	5.6	J
S5SS-5	B&RE 1996	Tetrachloroethene	2.6	J

Location	Source(1)	Parameter	Result	Qual.(2)
S5SS-4	B&RE 1996	Tetrachloroethene	2.5	J

*All sediment samples at SWMU 5 were surface samples.
Shading indicates a concentration in excess of the screening values (see Table C.3-2).

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation 1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
B_2 - Analyte was found in the blank as well as the sample.



PARAMETER	SCREENING VALUE +
INORGANIC	
Arsenic	5.2
Barium	40
Beryllium	0.15
Cadmium	0.676
Chromium	52.3
Copper	18.7
Lead	35
Mercury	0.13
Nickel	15.9
Silver	0.733
Zinc	124
ORGANIC	
Acetone	64
Bis(2-ethylhexyl)phthalate	182
Butyl benzyl phtholate	63

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

LEGEND

S5SS-1 ◐ SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)

S5SS-3 ⌖ SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699037	PROJ. NO.: HK7046

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FIGURE 3-7
SEDIMENT CHEMICAL CONCENTRATIONS SWMU 5
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F092

3.4.3.1 Volatile Organic Compounds

A single VOC, acetone, was detected in excess of the 68.6 μg/L sediment screening criteria at the Sand Blasting Area. It was detected at three sample locations: in the ditch immediately south of the Sand Blasting Area (S5SS-2, 24 μg/kg), in the pond (S5SS-3, 79.4 μg/kg), and in the lagoon (S5SS-6, 147 μg/kg). Only the concentrations in the pond and lagoon exceeded the screening value. Other volatiles, including cis-1,2-dichloroethene, methylene, chloride and tetrachoroethene were also detected at the site, although none were detected in excess of the screening levels. Acetone was detected in both 1993 and 1996. Tetrachloroethene was not detected in 1993 and was detected at low levels in the Supplemental RFI/RI samples (all from the southwestern region of the site). The other detections were geographically isolated and were limited to the 1993 RFI/RI investigation.

3.4.3.2 Semivolatile Organic Compounds

Two SVOCs were detected in the sediment at SWMU 5, and both were in excess of the screening criteria. Bis(2-ethylhexyl)phthalate exceeded its 182 μg/kg screening value in the ditch near the Sand Blasting Area (S5SS-2, 570 μg/kg) and near the pond (S5SS-5, 467.5 μg/kg). Butyl benzyl phthalate was detected in excess of its 63 μg/kg screening value at a single location near the pond (S5SS-5, 495 μg/kg).

3.4.3.3 Pesticides

No pesticides were detected in sediment at SWMU 5.

3.4.3.4 Polychlorinated Biphenyls

No PCBs were detected in sediment at SWMU 5.

3.4.3.5 Inorganics

Metal contamination in sediment appears fairly widespread throughout SWMU 5, although fewer inorganics were detected in the sediment sample collected at the lagoon. Maximum concentrations were commonly detected in samples collected from the concrete ditch immediately south of the Sand Blasting Area and immediately west of the berm. Maximum concentrations that were detected at S5SS-1 (just west of the berm) and that exceeded screening criteria included arsenic (8.6 mg/kg), barium (250 mg/kg), cadmium (120 mg/kg), chromium (428 mg/kg), copper (38.9 mg/kg), lead (966 mg/kg), mercury (0.13 mg/kg), and nickel (26.6 mg/kg). S5SS-2, collected immediately south of the Sand Blasting Area,

contained the maximum concentration in excess of screening criteria for beryllium (2.6 mg/kg). Maximum concentrations of silver (1.3 mg/kg) and zinc (1260 mg/kg) were detected near the pond at S5SS-5. The maximum manganese concentration was also detected at S5SS-5, although it did not approach the 460 mg/kg screening value. The most frequently detected chemicals in sediment at SWMU 5 included arsenic, barium, chromium, copper, lead, nickel, vanadium, and zinc. Each of these inorganics were detected at all six sample locations. Other inorganics detected at SWMU 5 included aluminum, antimony, cobalt, iron, manganese, sulfide, tin, and vanadium. Most of the inorganics detected in sediment were also detected in soil samples at SWMU 5.

3.4.4 Surface Water

Data from the IT Corporation 1993 RFI/RI and this Supplemental RFI/RI were considered in the analysis of surface-water contamination at SWMU 5. Chemicals that were detected in surface-water samples are listed in Table 3-4. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Figure 3-8 shows the occurrence of analytes that exceeded screening values and indicated possible contamination. Inorganics were the dominant class of contaminants detected in these samples.

Screening values were obtained from a variety of sources including SWQSs, EPA Region IV Freshwater and Marine Screening Values, EPA AWQCs for Fresh and Marine Waters, Proposed RCRA ALs, EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples.

3.4.4.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the surface-water samples at SWMU 5. VOCs detected at SWMU 5 included acetone and methylene chloride. Both were detected at a single sample location from the berm south of the Sand Blasting Area (S5SS-2).

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and

TABLE 3-4

CHEMICALS DETECTED IN SURFACE WATER AT SWMU 5
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
S5SS-2	IT 1993	Arsenic	3.5	B_1
S5SS-2	IT 1993	Barium	53.1	B_1
S5SS-2	IT 1993	Cadmium	9.7	
S5SS-2	IT 1993	Chromium	58.2	
S5SS-2	IT 1993	Copper	13.6	B_1
S5SS-2	IT 1993	Lead	68.9	
S5SW-3	B&RE 1996	Lead	5.1	
S5SS-2	IT 1993	Zinc	147	
S5SS-2	IT 1993	Sulfide	1,200	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S5SS-2	IT 1993	Acetone	12	
S5SS-2	IT 1993	Methylene chloride	1	B_2J

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.

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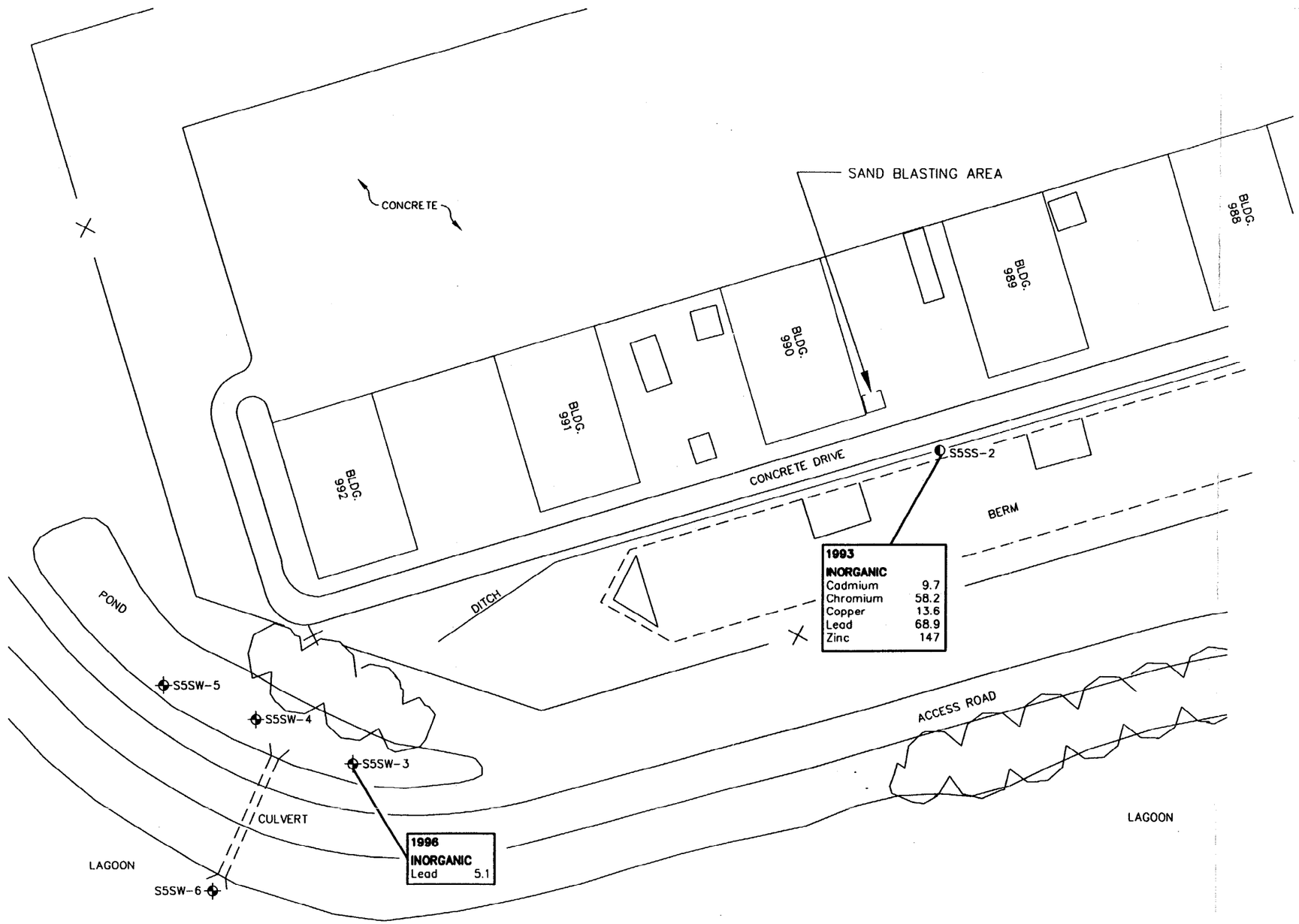

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APPROX. SCALE

PARAMETER	SCREENING VALUE +
INORGANIC	
Cadmium	0.53
Chromium	5.2
Copper	4.5
Lead	1.32
Zinc	19

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

LEGEND

S5SS-2 ◐ SURFACE-WATER SAMPLE LOCATION IT CORPORATION (1993)

S5SW-3 ⊕ SURFACE-WATER SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699038	PROJ. NO.: HK7046

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FIGURE 3-8
SURFACE-WATER CHEMICAL CONCENTRATIONS SWMU 5
NAVAL AIR STATION
KEY WEST, FLORIDA

extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Acetone was identified as a COPC (see Section 3.6.2.2) in the human health risk assessment due to toxicity, since it does not have an RBC. All barium concentrations in surface water at SWMU 5 were less than the Tap Water RBC selected for surface-water screening in this section.

3.4.4.2 Semivolatile Organic Compounds

No SVOCs were detected in surface water at SWMU 5.

3.4.4.3 Pesticides

No pesticides were detected in surface water at SWMU 5.

3.4.4.4 Polychlorinated Biphenyls

No PCBs were detected in surface water at SWMU 5.

3.4.4.5 Inorganics

Inorganics were detected in only two surface-water samples from SWMU 5 and the majority of the detected compounds occurred only at S5SS-2, sampled by IT Corporation in 1993. One chemical, lead, was detected at two locations in excess of its 1.32 µg/L screening criteria. Lead was detected at S5SS-2 (68.9 mg/kg) and in the pond at S5SW-3 (5.1 mg/kg). Lead was the only compound detected at S5SW-3, sampled by B&R Environmental in 1996. All other metal detections occurred only at S5SS-2. Cadmium, chromium, copper, and zinc were detected there at levels in excess of the screening criteria. Arsenic, barium, and sulfide were also detected S5SS-2 at levels below the screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Acetone was identified as a COPC (see Section 3.6.2.2) in the human health risk assessment due to toxicity, since it does not have an RBC. All barium concentrations in surface water at SWMU 5 were less than the RCRA AL selected for surface-water screening in this section.

3.4.5 Groundwater

Data from the IT Corporation 1993 RFI/RI and this Supplemental RFI/RI were considered in the analysis of groundwater contamination at SWMU 5. Chemicals that were detected in groundwater samples are listed in Table 3-5. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Samples were collected from the same two monitoring well locations during both investigations. Figures 3-9 and 3-10 show the occurrence of analytes that exceeded the screening values and indicated possible groundwater contamination. Groundwater contamination beneath the site is predominantly attributable to metals.

Screening values were obtained from a variety of sources including SDWA MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

3.4.5.1 Volatile Organic Compounds

A single VOC, methylene chloride, was detected at a concentration below its screening value at location (S5MW-2) in the IT Corporation 1993 sampling.

3.4.5.2 Semivolatile Organic Compounds

A single SVOC, bis(2-ethyhexyl)phthalate, was detected in excess of its 3 μg/L screening criteria at a single location (S5MW-2, 4 μg/L) in the IT Corporation 1993 sampling. No other SVOCs were detected.

3.4.5.3 Pesticides

No pesticides were detected in groundwater at SWMU 5.

3.4.5.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at SWMU 5.

TABLE 3-5

CHEMICALS DETECTED IN GROUNDWATER AT SWMU 5
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
S5MW-2	IT 1993	Antimony	31.8	B_1
S5MW-2	B&RE 1996	Antimony	26.2	
S5MW-2	IT 1993	Arsenic	3.4	B_1
S5MW-3	IT 1993	Arsenic	2.3	B_1
S5MW-2	IT 1993	Barium	54.7	B_1
S5MW-3	IT 1993	Barium	29.2	B_1
S5MW-3	B&RE 1996	Barium	12.2	
S5MW-2	B&RE 1996	Barium	8.9	
S5MW-2	IT 1993	Beryllium	1.3	B_1
S5MW-3	IT 1993	Cadmium	4.8	
S5MW-3	IT 1993	Chromium	35.6	
S5MW-2	IT 1993	Chromium	32.3	
S5MW-2	B&RE 1996	Chromium	1.7	
S5MW-2	IT 1993	Cyanide	230	
S5MW-2	B&RE 1996	Cyanide	1.5	
S5MW-3	IT 1993	Lead	24.7	
S5MW-2	IT 1993	Lead	9.8	
S5MW-3	B&RE 1996	Manganese	3	
S5MW-2	B&RE 1996	Manganese	2.3	
S5MW-2	B&RE 1996	Mercury	4.7	
S5MW-3	B&RE 1996	Mercury	0.26	
S5MW-3	IT 1993	Mercury	0.19	
S5MW-2	B&RE 1996	Silver	1.9	
S5MW-2	IT 1993	Sulfide	4,000	
S5MW-2	B&RE 1996	Vanadium	2.4	
S5MW-3	B&RE 1996	Vanadium	2.3	
S5MW-2	IT 1993	Zinc	82.4	
S5MW-3	B&RE 1996	Zinc	52.4	
S5MW-3	IT 1993	Zinc	29.3	
S5MW-2	B&RE 1996	Zinc	26.5	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
S5MW-2	IT 1993	Bis(2-ethylhexyl)phthalate	4	J
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S5MW-2	IT 1993	Methylene chloride	2	B_2J

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
B_2 - Analyte was found in the blank as well as the sample.

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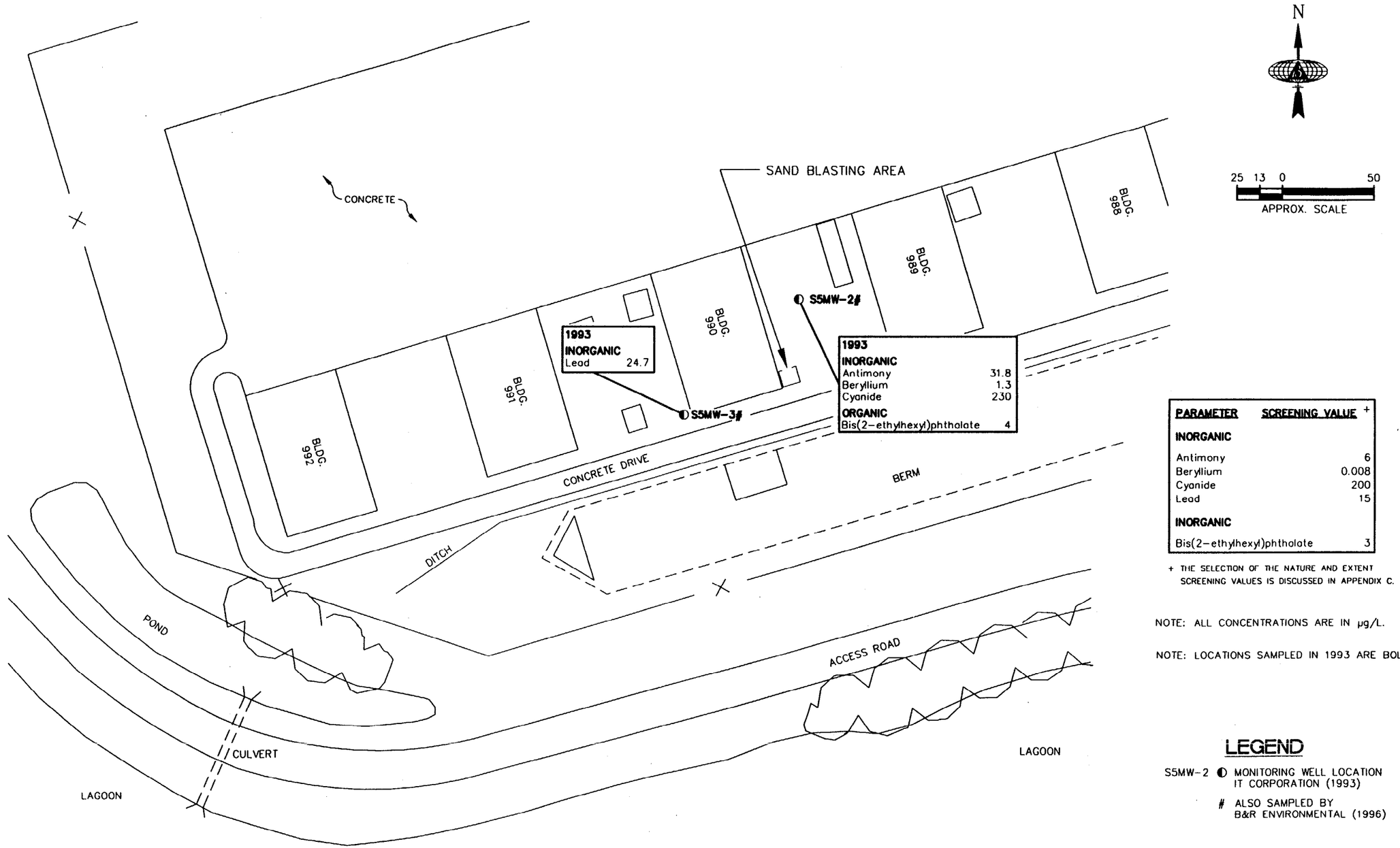

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6
Beryllium	0.008
Cyanide	200
Lead	15
INORGANIC	
Bis(2-ethylhexyl)phtholate	3

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

LEGEND

S5MW-2 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704699039	PROJ. NO.: HK7046

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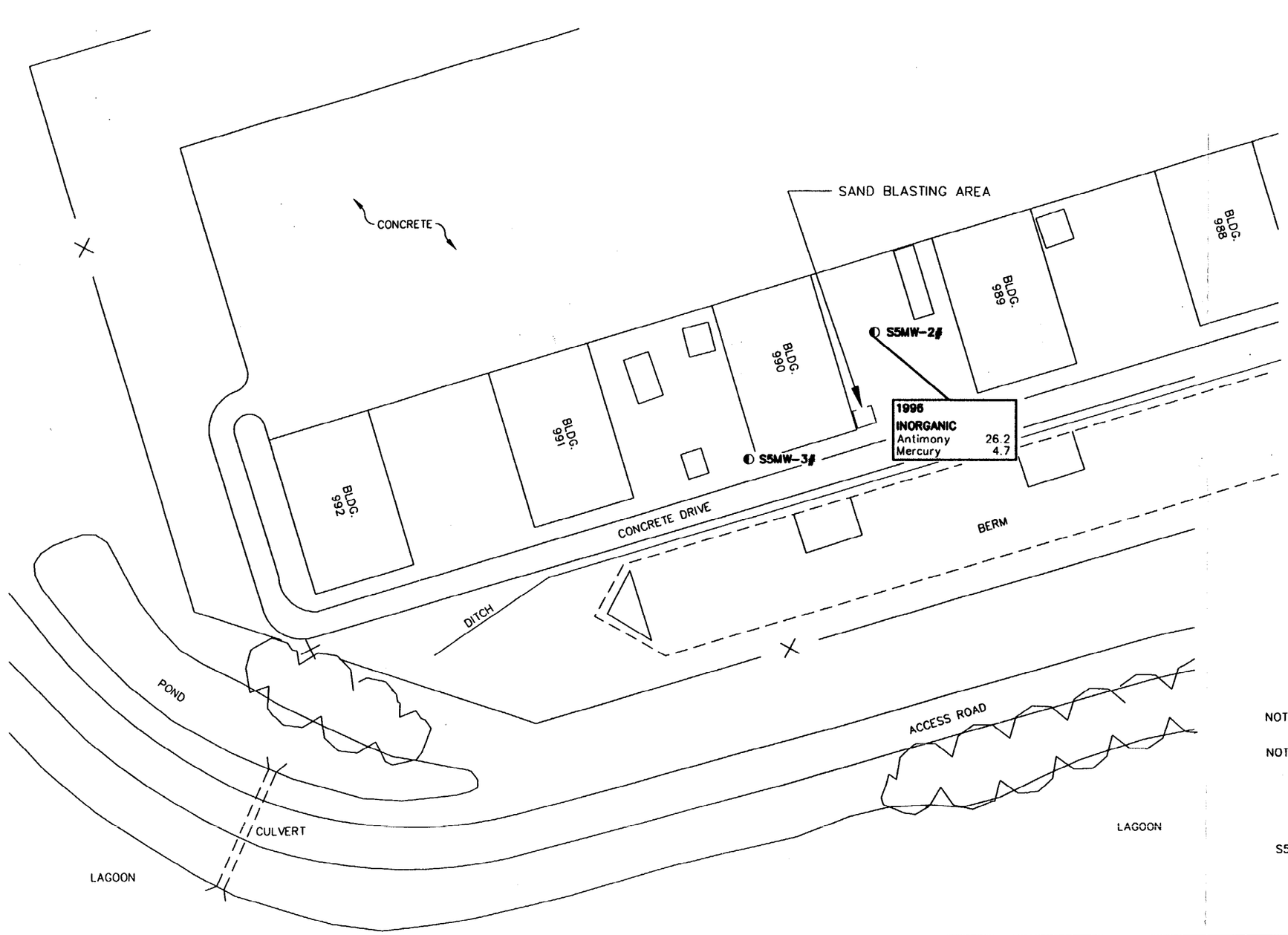
FIGURE 3-9
1993 GROUNDWATER CHEMICAL CONCENTRATIONS
SWMU 6
NAVAL AIR STATION
KEY WEST, FLORIDA



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APPROX. SCALE

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6
Mercury	2

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

LEGEND

S5MW-2 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.:7046990310	PROJ. NO.: HK7046

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FIGURE 3-10
1996 GROUNDWATER CHEMICAL CONCENTRATIONS SWMU 5
NAVAL AIR STATION
KEY WEST, FLORIDA

3.4.5.5 Inorganics

Although several inorganics were detected in the groundwater at SWMU 5, only antimony, beryllium, cyanide, lead, and mercury were detected at levels greater than the screening criteria. Beryllium, cyanide, and lead exceeded the screening values only in 1993 samples. Antimony was detected at S5MW-2 in excess of its 6 μg/L screening value in both investigations, although the 1996 concentration was somewhat reduced from that observed in 1993. Mercury was the only chemical detected in excess of its 2 μg/L screening criteria in 1996 (S5MW-2, 4.7 μg/L) and not detected in 1993. At S5MW-3, mercury slightly increased in concentration between 1993 and 1996, although neither detection approached the screening value. Silver, vanadium, and zinc were all either detected in groundwater for the first time in 1996 or increased in concentration. Other inorganics detected at SWMU 5 at low levels included arsenic, barium, cadmium, chromium, manganese, and sulfide.

3.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at SWMU 5. Section 3.5.1 presents those chemicals detected in excess of the screening values discussed in the nature and extent sections, along with apparent temporal and spatial trends. Section 3.5.2 addresses potential routes of migration, and Section 3.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. Section 3.1.5.1 Appendix C quantifies the physical and chemical properties of the detected contaminants.

3.5.1 Contaminant Summary and Trends

Sand blasting was performed at SWMU 5 to remove painted surfaces from ground handling and ground support vehicles and equipment, aircraft parts, and other metal objects and pieces of equipment. Paints and contaminants resulting from the sand blasting of equipment, parts, and vehicles are potential sources of contamination. Consistent with these activities, inorganics were the most common contaminants detected at SWMU 5. Inorganic contamination appeared to be most widespread in soil and sediment, while the occurrence and distribution of the same parameters in groundwater and surface water were generally more limited and localized.

Of all detected inorganics, antimony, beryllium and silver were the least prevalent and do not appear to be pervasive at SWMU 5. All three were detected in multiple media, but within a given medium, occurrences were isolated.

Arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, and zinc were commonly detected in soil and sediment, although not all detections were in excess of the nature and extent screening values. Generally, inorganic concentrations in sediment were highest in the two samples collected between the berm and the pond. Lower inorganic concentrations were detected in pond sediment and in the sediment sample directly south of the Sand Blasting Area.

The same compounds that were detected in soil and sediment were generally detected in groundwater at SWMU 5, but fewer concentrations were in excess of screening values. With a few exceptions, inorganic concentrations in groundwater decreased between 1993 and 1996, and were reduced below screening values. Manganese, silver, and vanadium were detected below screening values in 1996 but were either not tested for (manganese) or were not detected (silver and vanadium) in 1993. Mercury concentrations increased temporally in both wells at SWMU 5. Although zinc concentrations decreased in groundwater below the Sand Blasting Area, zinc concentrations increased in the southwestern portion of the site. The increased concentration in the southwestern portion of the site remains lower than the 1993 maximum of zinc in groundwater at SWMU 5.

With one exception, surface-water contamination was limited to the region immediately south of the Sand Blasting Area. Cadmium, chromium, copper, lead, and zinc exceeded screening values in the surface-water sample collected from this area in 1993. In the 1996 B&R Environmental samples collected in the pond and along the lagoon further to the southwest, lead was the only compound detected. Its single occurrence was in excess of the screening value but was much lower than the lead concentration detected directly below the Sand Blasting Area in 1993.

VOCs, SVOCs, pesticides, and PCBs were tested in a limited number of samples in each medium at SWMU 5 and did not appear to be pervasive at the site. No pesticides or PCBs were detected in any medium. Several VOCs and SVOCs were detected, but most occurrences were limited to a specific sample or a specific medium, and were below the nature and extent screening values. The organic compounds detected in excess of screening values [bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and acetone] are considered common laboratory or rinsate contaminants. Despite the use of proper sampling protocols and data validation to minimize analytical bias, these compounds remained in both the site and background data sets after data validation. With the exception of sediment, all VOCs and SVOCs were limited to a single sample in each medium.

In sediment, low concentrations of VOCs and SVOCs were detected in several samples, with the exception of tetrachloroethene (detected in all four B&R Environmental samples). The data do not suggest a pattern of consistent contamination associated with known activities at SWMU 5.

3.5.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

The contaminant source at SWMU 5 consists of the former Sand Blasting Area located between Buildings A-989 and A-990. Additional contaminant sources consist of the entire AIMD area on both sides of SWMU 5. Six AIMD buildings are located in the vicinity of the site; these are used for a variety of aircraft maintenance activities. Surface-water runoff from these buildings drains into the same concrete ditch into which surface water from SWMU 5 is directed.

The contaminant release pathways from this area include volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in soil could volatilize from surficial material or become airborne via wind erosion. Contaminated fugitive dust can be generated during ground-disturbing activities, such as construction or excavation. The contaminants could then be dispersed in the surrounding environment and transported to downwind locations where they could repartition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. However, the former Sand Blasting Area is primarily bare rock and concrete, minimizing the airborne contaminant transport pathway.

Precipitation runoff can carry contaminants to nearby surface water, sediments, and surface soils at the western end of the concrete ditch. Infiltrating precipitation can cause the contamination of subsurface soil and groundwater. Sand blasting operations could have deposited contaminants on a small portion of the berm south of the site. Runoff from the berm or from the site would be carried westward via the concrete ditch. Beyond the end of the ditch, surface-water runoff into the pond is possible, as is infiltration into subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. After reaching the water table, contaminants can be carried with the flow of groundwater to downgradient locations. Groundwater in the vicinity of the site is shallow and probably is connected hydrologically to surface water in the pond and lagoon southwest of the site. Contaminants can be deposited in sediment or surface water and can potentially accumulate in the tissues of aquatic organisms.

3.5.3 Contaminant Transport Potential and Persistence

Metals, the predominant class of contaminants detected at SWMU 5, are adsorbed onto soil and sediment, but may exist in dissolved or suspended forms. Many metals are water-insoluble; however, some soluble species of metals have increased mobility. Arsenic and chromium, for example, exhibit mobilities that are strongly influenced by pH and speciation, or in the case of mercury, by the presence of organic compounds such as alkylated mercury compounds. The transport of lead in the environment is strongly influenced by the speciation of the ion. Sorption processes appear to exert a dominant effect on

the distribution of lead in the environment. Generally, it is strongly complexed to organic materials present in both aquatic systems and soil.

Although sorption of inorganics tends to reduce their mobility in the subsurface, strong association with soil and sediment particles may increase the persistence of inorganic contamination at a site. Contaminants that persist in the solid media will also continue to be present in surface water and groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations would remain low.

3.6 BASELINE HUMAN HEALTH RISK ASSESSMENT - SWMU 5

This section presents the baseline human health risk assessment for SWMU 5. It describes a qualitative and quantitative assessment of actual or potential risks for SWMU 5. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and RGOs. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 3.6.8.

3.6.1 Preliminary Risk Evaluation

A PRE was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 3-6 and 3-7 summarize the preliminary risk evaluation for SWMU 5 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. However, the risk ratios calculated for the residential land use scenario are greater than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. Therefore, a baseline human health risk assessment is necessary

TABLE 3-6

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
SWMU 5
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	13	8.6	3.5	0.43	0.43	0.045	3.8	3E-05	2E-05	8E-05	3E-06
Beryllium	0.26	2.6	ND	0.15	0.15	0.016	1.3	2E-06	2E-05	NA	2E-07
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	ND	570	ND	46,000	46,000	4.8	410,000	NA	1E-08	NA	NA
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	20	12	1	85,000	85,000	4.1	760,000	2E-10	1E-10	2E-07	3E-11
Tetrachloroethene	ND	10.2	ND	12,000	12,000	1.1	110,000	NA	9E-10	NA	NA
							Risk Sums by Medium	**3E-05**	**4E-05**	**8E-05**	**4E-06**
							Risk Sums by Use Scenario	**1E-04**			**4E-06**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 3-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
SWMU 5
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	923	3,040	ND	78,000	78,000	37,000	1,000,000	1E-01	4E-01	NA	9E-03
Antimony	4.2	4	ND	31	31	15	820	1E+00	1E+00	NA	5E-02
Arsenic	13	8.6	3.5	23	23	11	610	6E+00	4E+00	3E+00	2E-01
Barium	22.3	250	53.1	5,500	5,500	2,600	140,000	4E-02	5E-01	2E-01	2E-03
Beryllium	0.26	2.6	ND	390	390	180	1,000	7E-03	7E-02	NA	3E-03
Cadmium	12.6	120	9.7	39	39	18	1,000	3E+00	3E+01	5E+00	1E-01
Chromium VI	24.7	428	58.2	390	390	180	10,000	6E-01	1E+01	3E+00	2E-02
Cobalt	0.7	9.8	ND	4,700	4,700	2,200	120,000	1E-03	2E-02	NA	6E-05
Copper	7.2	38.9	13.6	3,100	3,100	1,500	82,000	2E-02	1E-01	9E-02	9E-04
Cyanide	ND	ND	ND	1,600	1,600	730	41,000	NA	NA	NA	NA
Iron	1,480	3,245	ND	23,000	23,000	11,000	610,000	6E-01	1E+00	NA	2E-02
Manganese	8.9	32.1	ND	390	390	180	10,000	2E-01	8E-01	NA	9E-03
Mercury	0.04	0.13	ND	23	23	11	610	2E-02	6E-02	NA	7E-04
Nickel	7.6	26.6	ND	1,600	1,600	730	41,000	5E-02	2E-01	NA	2E-03
Selenium	ND	ND	ND	390	390	180	10,000	NA	NA	NA	NA
Silver	ND	1.3	ND	390	390	180	10,000	NA	3E-02	NA	NA
Thallium	ND	ND	ND	6.3	6	2.9	160	NA	NA	NA	NA
Tin	5.1	ND	ND	47,000	47,000	22,000	1,000,000	1E-03	NA	NA	5E-05
Vanadium	3.2	34.2	ND	550	550	2,600	14,000	6E-02	6E-01	NA	2E-03
Zinc	86.3	1,260	147	23,000	23,000	11,000	610,000	4E-02	5E-01	1E-01	1E-03
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	ND	570	ND	1,600,000	1,600,000	730	41,000,000	NA	4E-03	NA	NA
Butyl benzyl phthalate	ND	495	ND	16,000,000	16,000,000	7300	410,000,000	NA	3E-04	NA	NA
VOLATILE ORGANIC COMPOUNDS											
2-butanone	9	ND	ND	47,000,000	47,000,000	1900	1,000,000,000	2E-06	NA	NA	9E-08
Cis-1,2-dichloroethene	1	2	ND	780,000	780,000	61	20,000,000	1E-05	3E-05	NA	5E-07
Acetone	35	147	12	7,800,000	7,800,000	3700	200,000,000	4E-05	2E-04	3E-02	2E-06
Methylene chloride	20	12	1	4,700,000	4,700,000	260	120,000,000	4E-05	3E-05	4E-02	2E-06
Tetrachloroethene	ND	10.2	ND	780,000	780,000	370	20,000,000	NA	1E-04	NA	NA
							Hazard Sums by Medium	**1E+01**	**5E+01**	**1E+01**	**5E-01**
							Hazard Sums by Use Scenario	**8E+01**			**5E-01**

* All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

for SWMU 5. The primary contributor to carcinogenic risk in soil, sediment, and surface water is arsenic. The primary contributors to noncarcinogenic risk are antimony, arsenic, and cadmium in soil; antimony, arsenic, cadmium, chromium VI, and iron in sediment; and arsenic, cadmium, and chromium VI in surface water.

3.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

3.6.2.1 Soils

Metals and four VOCs (2-butanone, acetone, cis-1,2-DCE, and methylene chloride) were detected in one or more of the surface soil samples collected at SWMU 5. Acetone, methylene chloride, and bis(2-ethylhexyl)phthalate and several metals were detected in subsurface soil samples collected at SWMU 5. The occurrence and distribution of chemicals in surface and subsurface soils are presented in Tables 3-8 through 3-11. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in SWMU 5 soils are also presented in these tables.

The following chemicals were selected as COPCs at SWMU 5 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
Antimony	None Selected	None Selected	None Selected
Arsenic			
Beryllium			
Cadmium			

Metals selected as COPCs in surface soil at SWMU 5 were detected at the following frequencies: antimony (1/4), arsenic (4/4), beryllium (1/4), and cadmium (3/4). The maximum and representative concentrations for these COPCs exceed RBCs developed for the residential land use scenario. Organic chemicals in surface soils were detected at concentrations less than residential RBC values. Therefore, no organic COPCs were selected from surface soils. Inorganic chemicals in subsurface soils were detected at levels below RBCs developed for the industrial land use scenario. Likewise, organic

TABLE 3-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT SWMU 5 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	14/14	120 - 4,250	1,887	1/1	923 - 923	923	923	7,800	923	N	A
Antimony	2/15	0.26 - 0.48	0.39	1/4	4.2 - 4.2	4.20	1.95	3.1	4.2	Y	C
Arsenic	6/15	0.63 - 2.7	1.29	4/4	0.34 - 13	3.66	3.66	0.43	13	Y	C
Barium	15/15	4.4 - 17.7	10.51	4/4	3.7 - 22.3	11.13	11.13	550	22.3	N	A
Beryllium	2/15	0.13 - 0.15	0.05	1/4	0.26 - 0.26	0.26	0.10	0.15	0.26	Y	C
Cadmium	4/15	0.11 - 0.45	0.15	3/4	1.7 - 12.6	5.50	4.20	3.9	12.6	Y	C
Chromium**	15/15	1.9 - 15.5	6.02	4/4	6.4 - 24.7	14.95	14.95	39	24.7	N	A
Cobalt	7/15	0.22 - 0.51	0.29	1/4	0.7 - 0.7	0.70	1.01	470	0.7	N	A
Copper	14/15	1.3 - 15.6	5.43	3/4	2.2 - 7.2	4.57	3.56	310	7.2	N	A
Iron	14/14	98.1 - 2,260	1,167	1/1	1,480 - 1,480	1,480	1,480	2,300	1,480	N	A
Lead	14/15	0.65 - 48.3	15.66	4/4	13.8 - 52.1	33.20	33.20	400	52.1	N	A
Manganese	14/14	2.6 - 33.7	17.65	1/1	8.9 - 8.9	8.90	8.90	180	8.9	N	A
Mercury	5/15	0.03 - 0.08	0.03	1/4	0.04 - 0.04	0.04	0.02	2.3	0.04	N	A
Nickel	11/15	0.63 - 4.1	1.67	3/4	2.4 - 7.6	4.33	3.53	160	7.6	N	A
Vanadium	15/15	0.8 - 8.8	3.97	2/4	2.7 - 3.2	2.95	1.75	55	3.2	N	A
Sulfide	1/1	49 - 49	49	1/1	200 - 200	200	200	–	200	N	D
Tin	2/5	0.78 - 2.1	1.94	1/3	5.1 - 5.1	5.1	2.82	4,700	5.1	N	A
Zinc	12/15	0.63 - 89.1	15.22	4/4	3.1 - 86.3	38.83	38.83	2,300	86.3	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

D - Not COPC (nut./mineral)

**As chromium VI

TABLE 3-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT SWMU 5 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
VOLATILE ORGANIC COMPOUNDS											
2-butanone	0/12	Not detected	–	1/1	9 - 9	9	9	4,700,000	9	N	A
Acetone	1/12	1 - 1	3.67	1/1	35 - 35	35	35	780,000	35	N	A
Cis-1,2-dichloroethene	0/3	Not detected	–	1/3	1 - 1	1	0.70	70,000	1	N	A
Methylene chloride	6/12	0.11 - 14	2.80	1/3	20 - 20	20	12.33	85,000	20	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

TABLE 3-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SUBSURFACE SOILS AT SWMU 5 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Antimony	2/15	0.26 - 0.48	0.39	1/6	4 - 4	4.0	2.15	82	3.02	N	A
Arsenic	6/15	0.63 - 2.7	1.29	6/6	0.26 - 0.31	0.28	0.28	3.8	0.299	N	A
Barium	15/15	4.4 - 17.7	10.51	6/6	2.9 - 3.7	3.27	3.27	14,000	3.5	N	A
Beryllium	2/15	0.13 - 0.15	0.05	2/6	0.12 - 0.14	0.13	0.08	1.3	0.13	N	A
Cadmium	4/15	0.11 - 0.45	0.15	1/6	0.95 - 0.95	0.95	0.41	100	0.698	N	A
Chromium**	15/15	1.9 - 15.5	6.02	6/6	3 - 5.3	3.97	3.97	1,000	4.75	N	A
Lead	14/15	0.65 - 48.3	15.66	5/6	0.25 - 11.3	2.92	2.46	400	11.3	N	A
Sulfide	1/1	49 - 49	49.00	1/1	60 - 60	60	60.00	–	60	N	D
Zinc	12/15	0.63 - 89.1	15.22	6/6	1.4 - 12.5	4.1	4.10	61,000	12.5	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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 industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
D - Not COPC (nut./mineral)
**As chromium VI

TABLE 3-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SUBSURFACE SOILS AT SWMU 5 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	1/11	330 - 330	470.55	1/1	56 - 56	56	56	410,000	56	N	A
VOLATILE ORGANIC COMPOUNDS											
Acetone	1/12	1 - 1	3.67	1/1	36 - 36	36	36	20,000,000	36	N	A
Methylene chloride	6/12	0.11 - 14	2.80	1/6	19 - 19	19	10.58	760,000	14.5	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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 industrial exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

chemicals detected in subsurface soils were detected at levels less than industrial RBC values. Therefore, no COPCs were selected from subsurface soils.

3.6.2.2 Sediment and Surface Water

Several VOCs, phthalates, and metals were detected in one or more of the sediment samples collected at SWMU 5. Acetone, methylene chloride, and metals were detected in surface-water samples collected at SWMU 5. The occurrence and distribution of chemicals in sediment and surface water are presented in Tables 3-12 through 3-15. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in SWMU 5 sediment and surface water are also presented in these tables. The following chemicals were selected as COPCs for SWMU 5 sediment and surface water:

SEDIMENT		SURFACE WATER	
Inorganics	Organics	Inorganics	Organics
Antimony	None	Lead*	None
Arsenic	Selected	Barium**	Selected
Beryllium		Zinc**	
Cadmium			
Chromium			
Iron			
Lead*			

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No WQSs (for consumption of water and organisms) were listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Metals selected as COPCs for sediment at SWMU 5 were detected in 80 percent or more of the samples with the exception of antimony (1/6) and beryllium (2/6). Maximum and representative concentrations of these metals exceeded RBCs for residential soil exposure. Organic chemical concentrations were detected at concentrations less than residential soil RBCs. Soil RBCs are used because RBCs protective of human health for sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health.

TABLE 3-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SEDIMENT AT SWMU 5 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	12/12	97.7 - 3,350	1,332	4/4	1,340 - 3,040	2,170	2,170	7,800	3,040	N	A
Antimony	0/13	Not detected	–	1/6	4 - 4	4.0	1.46	3.1	4	Y	C
Arsenic	8/12	1.5 - 7	2.63	6/6	4.3 - 8.6	5.78	5.78	0.43	8.02	Y	C
Barium	13/13	5 - 15.2	9.27	6/6	10.6 - 250	80.49	80.49	550	250	N	A
Beryllium	1/13	0.12 - 0.12	0.06	2/6	1.8 - 2.6	2.2	0.76	0.15	2.6	Y	C
Cadmium	3/13	0.06 - 0.9	0.22	5/6	2.3 - 120	30.94	25.88	3.9	120	Y	C
Chromium**	8/13	2.1 - 11.7	5.01	6/6	16.5 - 428	150.22	150.22	39	428	Y	C
Cobalt	2/13	0.12 - 0.56	0.47	4/6	0.59 - 9.8	5.48	3.77	470	9.8	N	A
Copper	13/13	0.76 - 34.6	8.88	6/6	10.5 - 38.9	19.09	19.09	310	35	N	A
Iron	12/12	109 - 3,640	1,199	4/4	952 - 3,245	2,074	2,074	2,300	3,250	Y	C
Lead	12/13	5.5 - 56.5	17.97	6/6	30.1 - 966	249.50	249.50	400	966	Y	C
Manganese	12/12	4 - 38.6	15.39	4/4	9.2 - 32.1	18.91	18.91	180	32.1	N	A
Mercury	4/13	0.04 - 0.07	0.05	3/6	0.03 - 0.13	0.05	0.05	2.3	0.13	N	A
Nickel	10/13	0.7 - 5.5	2.15	6/6	2.3 - 26.6	10.72	10.72	160	26.6	N	A
Silver	1/13	0.5 - 0.5	0.27	2/6	0.85 - 1.3	1.08	0.58	39	1.3	N	A
Sulfide	1/1	340 - 340	340	1/1	20 - 20	20.00	20.00	–	20	N	D
Tin	1/2	0.99 - 0.99	2.85	1/2	8.1 - 8.1	8.1	5.3	4,700	8.1	N	A
Vanadium	13/13	1.6 - 11.7	5.08	6/6	6.4 - 34.2	15.23	15.23	55	34.2	N	A
Zinc	8/13	3.5 - 140	25.74	6/6	24.6 - 1,260	430.52	430.52	2,300	1,260	N	A

Notes:
Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Sediment RBCs are adapted using residential soil RBC.
An RBC for lead based on cancer risk or hazard index is not available. The 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
D - Not COPC (nut./mineral)
**As chromium VI

TABLE 3-13

OCCURRENCE, DISTRIBUTION. AND SELECTION OF CHEMCIALS OF POTENTIAL CONCERN ORGANICS IN SEDIMENT AT SWMU 5 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	1/6	4,500 - 4,500	1,992	2/5	467.5 - 570	518.75	532.70	46,000	570	N	A
Butylbenzylphthalate	0/6	Not detected	–	1/5	495 - 495	495	614.20	1,600,000	495	N	A
VOLATILE ORGANIC COMPOUNDS											
Acetone	3/6	4 - 120	30.90	3/5	24 - 147	83.47	54.45	780,000	147	N	A
Cis-1,2-dichloroethene	0/2	Not detected	–	1/2	2 - 2	2	1.38	78,000	2	N	A
Methylene chloride	2/6	5 - 20	7.50	1/6	12 - 12	12	8.83	85,000	12	N	A
Tetrachloroethene	1/6	2 - 2	4.33	4/6	2.5 - 10.2	5.21	4.02	12,000	10	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
Sediment RBCs are adapted using residential soil RBC.
Applicable RBCs originate from EPA Region 3 RBCs for residential exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

TABLE 3-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE WATER AT SWMU 5 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Arsenic	3/13	2.6 - 5.2	3.97	1/5	3.5 - 3.5	3.5	2.30	0.018	3.08	N	G
Barium	11/13	4.7 - 16.3	6.93	1/5	53.1 - 53.1	53.1	13.67	–	53.1	Y	H
Cadmium	0/13	Not detected	–	1/5	9.7 - 9.7	9.7	2.10	16	9.7	N	A
Chromium**	1/13	16.4 - 16.4	2.62	1/5	58.2 - 58.2	58.2	12.44	170	58.2	N	A
Copper	1/13	2 - 2	2.26	1/5	13.6 - 13.6	13.6	4.32	1,300	13.6	N	A
Lead	0/12	Not detected	–	2/5	5.1 - 68.9	37	15.80	50	68.9	Y	C
Sulfide	1/1	4,000 - 4,000	4,000	1/1	1,200 - 1,200	1,200	1,200	–	1,200	N	D
Zinc	5/13	1.4 - 39.6	7.19	1/5	147 - 147	147	30.20	–	147	Y	H

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg)

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

D - Not COPC (nut./mineral)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

H - COPC (lacks an RBC, but has a quantitative toxicity)

**As chromium VI

TABLE 3-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE WATER AT SWMU 5 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
VOLATILE ORGANIC COMPOUNDS											
Acetone	2/9	4 - 12	4.33	1/5	12 - 12	12	13.77	–	12	Y	H
Methylene chloride	3/9	1 - 1	1.5	1/5	1 - 1	1	2.19	4.7	1	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Surface water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)
H - COPC (lacks an RBC, but has a quantitative toxicity)

No sediment RBC for lead based on a cancer risk or hazard index is available. Therefore, the OSWER residential soil guidance of 400 mg/kg was used to represent the sediment RBC. Consequently, lead will be evaluated qualitatively in the uncertainty section.

Of the metals selected as COPCs for surface water, only lead was detected at a maximum concentration that exceeded an applicable WQSs. WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure that provides the basis for developing an applicable WQS. Thus, the use of WQS as RBCs to select surface-water COPCs is conservative regarding protection of human health.

As with sediment, lead does not have a listed quantitative toxicity value; therefore, it will be evaluated qualitatively in the uncertainty section. Barium, zinc, and acetone were also selected as COPCs for surface water at SWMU 5. These chemicals do not have listed WQS values, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

3.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at SWMU 5 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

3.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at SWMU 5 are presented in Section 3.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

3.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under an RME and a CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if a hazard index (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in three parts:

- Carcinogenic risks
- Noncarcinogenic risks
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

3.6.5.1 Carcinogenic Risks

Table 3-16 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents is 2E-04, which is greater than both the EPA "target risk range" of 1E-04 to 1E-06 and the FDEP target cancer risk of 1E-06. Dermal contact with surface soil for the future resident has an incremental cancer risk of 1E-04. The dermal exposure route contributes the most to the cumulative carcinogenic risk for the future resident. This exposure route is also associated with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPCs contributing to this cancer risk are arsenic (surface soil and sediment) and beryllium (sediment). Arsenic is a major contributor to risk and was elevated above background concentrations in surface soil and sediment. Beryllium was the other major contributor to the risk with elevated levels in sediment. The estimated carcinogenic risks for trespasser adults (9E-06), trespasser adolescents (8E-06), maintenance workers (3E-06), and occupational workers (3E-05) are within the EPA target risk range. The principal COPCs contributing to these cancer risks were arsenic (surface soil and sediment) and beryllium (sediment). Chemical-specific risks for COPCs are presented in Section 3.6.8.

Table 3-17 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents (2E-05) and occupational workers (3E-06) are within the EPA "target risk

TABLE 3-16

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
SWMU 5*
NAS KEY WEST
PAGE 1 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	3E-05	5E-07	7E-07	4E-07	NA	4E-06
Dermal Contact	1E-04	5E-06	4E-06	3E-06	NA	3E-05
Inhalation of Fugitive Dust	3E-12	2E-14	1E-14	2E-14	NA	4E-13
Subtotal	1E-04	5E-06	5E-06	3E-06	NA	3E-05
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	1E-05	6E-07	7E-07	NA	NA	NA
Dermal Contact	2E-05	3E-06	3E-06	NA	NA	NA
Subtotal	3E-05	3E-06	3E-06	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E-04	9E-06	8E-06	3E-06	**	3E-05
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	9E-01	6E-03	1E-02	4E-03	NA	3E-02
Dermal Contact	9E-01	4E-02	6E-02	2E-02	NA	2E-01
Inhalation of Fugitive Dust	1E-08	4E-11	5E-11	4E-11	NA	9E-10
Subtotal	2E+00	5E-02	8E-02	2E-02	NA	2E-01
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	9E-01	2E-02	5E-02	NA	NA	NA
Dermal Contact	4E-01	6E-02	9E-02	NA	NA	NA
Subtotal	1E+00	8E-02	1E-01	NA	NA	NA

TABLE 3-16

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
SWMU 5*
NAS KEY WEST
PAGE 2 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
Surface Water						
Incidental Ingestion	3E-03	2E-04	4E-04	NA	NA	NA
Dermal Contact	2E-03	9E-05	1E-04	NA	NA	NA
Subtotal	5E-03	3E-04	5E-04	NA	NA	NA
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	3E+00	1E-01	2E-01	2E-02	**	2E-01

* = Chemical-Specific Risks are presented in Section 3.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
NA = Not Applicable; pathway is not applicable for the respective media.

TABLE 3-17

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
SWMU 5*
NAS KEY WEST
PAGE 1 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	1E-05	5E-08	3E-08	6E-08	NA	1E-06
Dermal Contact	7E-06	2E-07	8E-08	2E-07	NA	2E-06
Inhalation of Fugitive Dust	8E-13	3E-15	1E-15	8E-15	NA	2E-13
Subtotal	2E-05	2E-07	1E-07	3E-07	NA	3E-06
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	2E-06	5E-08	3E-08	NA	NA	NA
Dermal Contact	6E-07	1E-07	5E-08	NA	NA	NA
Subtotal	2E-06	2E-07	8E-08	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E-05	4E-07	2E-07	3E-07	**	3E-06
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	9E-01	2E-03	3E-03	2E-03	NA	3E-02
Dermal Contact	2E-01	4E-03	1E-03	4E-03	NA	3E-02
Inhalation of Fugitive Dust	1E-08	2E-11	3E-11	4E-11	NA	9E-10
Subtotal	1E+00	6E-03	5E-03	6E-03	NA	7E-02
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	5E-01	6E-03	1E-02	NA	NA	NA
Dermal Contact	4E-02	6E-03	9E-03	NA	NA	NA
Subtotal	5E-01	1E-02	2E-02	NA	NA	NA

TABLE 3-17

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
SWMU 5*
NAS KEY WEST
PAGE 2 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
Surface Water						
Incidental Ingestion	2E-03	8E-05	2E-04	NA	NA	NA
Dermal Contact	1E-03	4E-05	7E-05	NA	NA	NA
Subtotal	3E-03	1E-04	3E-04	NA	NA	NA
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E+00	2E-02	3E-02	6E-03	**	7E-02

* = Chemical-Specific Risks are presented in Section 3.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
NA = Not Applicable; pathway is not applicable for the respective media.

range" of 1E-04 to 1E-06 and exceed the FDEP target cancer risk of 1E-06. The dermal contact with surface soil contributes the most to the cumulative carcinogenic risk for the future resident and the occupational worker. The estimated carcinogenic risks for all other receptors are below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 3.6.8.

3.6.5.2 Noncarcinogenic Risks

Table 3-16 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The cumulative hazard index (HI) for the hypothetical future resident (3) exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The principal COPCs contributing to the noncarcinogenic risk are arsenic in surface soils and sediment, cadmium in sediment, and chromium in sediment. The target organs for these chemicals are as follows: arsenic (skin), cadmium (kidney), and chromium (kidney and skin). Arsenic is the primary noncarcinogenic risk driver for the future resident (via ingestion) at SWMU 5. The HI for arsenic (via exposure to surface soil and sediment) is greater than 1.0. The HIs for cadmium and chromium (via exposure to sediment) are less than 1.0. The HIs for all other receptors at SWMU 5 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 3.6.8.

Table 3-17 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The HI based on the same target organ for the future residential receptor (exposure to surface soil and sediment) would not be above 1.0. The HIs for all other receptors at SWMU 5 are less than or equal to 1.0. Chemical-specific risks for COPCs are presented in Section 3.6.8.

3.6.5.3 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the SWMU 5 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 3-18 and 3-19 for inorganics and organics, respectively. The results of this preliminary comparison for SWMU 5 are presented in this section.

The maximum values of antimony, cyanide, lead, and mercury exceeded both their respective MCL and RBC values. Both detections of antimony exceeded MCLs and RBCs. Cyanide was detected in 2 out of 3 samples with a single detection of 230 µg/L exceeding both MCLs and RBCs. Lead was detected in 2 out of 4 samples with a single detection of 24.7 µg/L exceeding both MCLs and RBCs. Mercury was detected in 3 out of 4 samples with a single detection of 4.7 µg/L exceeding both MCLs and RBCs. Arsenic, beryllium, cadmium, and chromium concentrations exceeded tap water RBCs; however, this is not uncommon for unfiltered groundwater. Only two organic chemicals, bis(2-ethylhexyl)phthalate and methylene chloride, were detected in groundwater, each in one sample. These chemicals are considered common laboratory contaminants. The concentrations of these organic constituents did not exceed either MCLs or RBCs.

3.6.6 Uncertainties for SWMU 5

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of SWMU 5 risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and HI (via surface soils and sediment) for the future residential receptors and occupational workers. The uncertainty associated with the dermal exposure route may overestimate the risk at SWMU 5.

- Arsenic is a major contributor to the cumulative carcinogenic risks in surface soil, but arsenic was detected at levels in SWMU 5 that slightly exceed background levels. The inclusion of arsenic as site-related surface soil COPC could overestimate the quantitative risk at SWMU 5 for the future residential receptor. Furthermore, the carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Since arsenic is a major contributor to the risk, risks may be overstated.

TABLE 3-18

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs INORGANICS IN GROUNDWATER AT SWMU 5 (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	–	2/4	26.2 - 31.8	29	18.75	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	2/4	2.3 - 3.4	2.9	3.45	50	N	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	4/4	8.9 - 54.7	26.23	26.23	2,000	N	260	N
Beryllium	0/13	Not detected	–	1/4	1.3 - 1.3	1.3	0.50	4	N	0.016	Y
Cadmium	0/13	Not detected	–	1/4	4.8 - 4.8	4.8	1.93	1,300**	N	1.8	Y
Chromium	3/13	0.71 - 13	2.51	3/4	1.7 - 35.6	23.2	17.64	100	N	18	Y
Cyanide	2/8	2.4 - 5.525	1.47	2/3	1.5 - 230	115.7	77.38	200	Y	73	Y
Lead	1/12	2.5 - 2.5	1.39	2/4	9.8 - 24.7	17.2	9.36	15***	Y	15	Y
Manganese	7/10	2.2 - 10.3	3.78	2/2	2.3 - 3	2.63	2.63	–	NA	84	N
Mercury	4/13	0.13 - 0.24	0.10	3/4	0.19 - 4.7	1.7	1.32	2	Y	1.1	Y
Silver	1/13	3.3 - 3.3	1.37	1/4	1.9 - 1.9	1.9	1.96	–	NA	18	N
Sulfide	3/3	10,000 - 52,000	28,000	1/1	4,000 - 4,000	4,000	4,000	–	NA	–	NA
Vanadium	4/13	3.4 - 3.9	2.62	2/4	2.3 - 2.4	2.3	3.66	–	NA	26	N
Zinc	3/13	3.425 - 15.3	2.82	4/4	26.5 - 82.4	47.64	47.64	–	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 3-19

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs
ORGANICS IN GROUNDWATER AT SWMU 5 (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				
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	0/7	Not detected	–	1/3	4 - 4	4	7.17	6	N	4.8	N
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	2/4	1 - 1	1.75	1/2	2 - 2	2	4.75	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

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at SWMU 5 (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

- Lead was determined to be a COPC in sediment and surface water at SWMU 5. Exposure to lead in sediment and surface water is not estimated under the IEUBK Lead Model for the baseline human health risk assessment at SWMU 5. This probably underestimates the risks to potential receptors exposed to lead in sediment and surface water, especially to residential children (surface water and sediment). Exposure to lead in surface water and sediment by residential children is lower than exposure to lead in surface soil at SWMU 5. It is generally desirable to avoid contact with lead for all potential receptors, especially for young children.

3.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for SWMU 5.

3.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment (based on RME), a subset of chemicals, called COCs, was selected for the evaluation of RGOs. At SWMU 5, COCs were included in the RGO evaluation only if the COC's contribution to risk exceeds a cancer risk level of 1E-06 or a hazard quotient of 0.1. The COCs selected at SWMU 5 are as follows:

- Surface Soils
  - Arsenic
  - Beryllium

Arsenic was selected as a COC in soil because its contribution to the cancer risk level is greater than 1E-06 and because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential

receptor). Beryllium was selected as a COC in soil because its contribution to the cancer risk was greater than 1E-06 (future residential receptor).

- Sediment
  - Arsenic
  - Beryllium
  - Chromium

Arsenic was selected as a COC in sediment because its contribution to the cancer risk level is greater than 1E-06 and because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor). Beryllium was selected as a COC in sediment because its contribution to the cancer risk was greater than 1E-06 (future residential receptor). Chromium was selected as a COC in sediment because its contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor).

3.6.7.2 Remedial Goal Options

RGOs based on generic FDEP and RCRA TBCs for COCs in surface soils are listed in Table 3-20 for residential exposure scenarios. RGOs are not listed for sediment because generic levels for sediment exposure have not been established. The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 3-21 (surface soil - future resident) and Table 3-22 (sediment - future resident). These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

3.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 3-23 and 3-24. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic effects used to estimate risks for each COPC in each medium

TABLE 3-20

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE SOIL AT SWMU 5 NAS KEY WEST

COC	RCRA Subpart S Action Levels (mg/kg)	FDEP Residential Soil Cleanup Goals (mg/kg)
INORGANICS		
Arsenic	80	0.8
Beryllium	0.2	0.2

TABLE 3-21

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE SOIL AT SWMU 5 NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	0.09	0.88	8.8	0.93	9.3	28
Beryllium	0.13	1.33	13	–	–	–

TABLE 3-22

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SEDIMENT AT SWMU 5 NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	9.6	96	962	101	1008	3024
Beryllium	0.46	4.6	46	–	–	–
Chromium	–	–	–	130	1305	3915

TABLE 3-23

RME--CHEMICAL SPECIFIC RISKS AT SWMU 5
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.2	NA	NA	NA	NA	1.3E-01	6.4E-03	NA	1.4E-01
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13	3.1E-05	1.2E-04	2.0E-12	1.5E-04	5.5E-01	8.5E-01	NA	1.4E+00
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.26	1.8E-06	2.1E-07	5.2E-14	2.0E-06	6.6E-04	3.2E-05	NA	7.0E-04
Cadmium	1.00E-03	2.00E-04	-	-	-	-	12.6	NA	NA	5.3E-13	5.3E-13	1.6E-01	7.7E-02	1.2E-08	2.4E-01
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.2E-05	1.2E-04	2.5E-12	1.5E-04	8.5E-01	9.3E-01	1.2E-08	1.8E+00
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4	NA	NA	NA	NA	3.7E-02	1.8E-03	NA	3.8E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	8.02	5.4E-06	2.1E-05	NA	2.6E-05	9.8E-02	1.5E-01	NA	2.5E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	2.6	5.0E-06	6.0E-07	NA	5.6E-06	1.9E-03	9.1E-05	NA	2.0E-03
Cadmium	1.00E-03	2.00E-04	-	-	-	-	120	NA	NA	NA	NA	4.4E-01	2.1E-01	NA	6.5E-01
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	428	NA	NA	NA	NA	3.1E-01	1.5E-02	NA	3.3E-01
Iron	3.00E-01	6.00E-02	-	-	-	-	3,250	NA	NA	NA	NA	4.0E-02	1.9E-03	NA	4.1E-02
Lead	-	-	-	-	-	-	966	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.0E-05	2.1E-05	NA	3.2E-05	9.3E-01	3.8E-01	NA	1.3E+00
SURFACE WATER															
Inorganics															
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	53.1	NA	NA	NA	NA	1.8E-03	1.2E-03	NA	3.0E-03
Lead	-	-	-	-	-	-	68.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	147	NA	NA	NA	NA	1.2E-03	7.8E-04	NA	1.9E-03
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	12	NA	NA	NA	NA	2.8E-04	NA	NA	2.8E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2E-03	2.0E-03	NA	5.2E-03
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.3E-05	1.4E-04	2.5E-12	1.8E-04	1.8E+00	1.3E+00	1.2E-08	3.1E+00

TABLE 3-24

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 5
NAS KEY WEST
PAGE 6 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.2	NA	NA	NA	NA	5.1E-03	2.4E-04	NA	5.4E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13	1.2E-06	1.8E-06	1.2E-13	3.0E-06	2.1E-02	3.1E-02	NA	5.2E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	0.26	7.0E-08	3.2E-09	3.2E-15	7.4E-08	2.5E-05	1.2E-06	NA	2.7E-05
Cadmium	1.00E-03	2.00E-04	-	-	-	-	12.6	NA	NA	3.3E-14	3.3E-14	6.2E-03	2.8E-03	9.1E-10	9.0E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.3E-06	1.8E-06	1.6E-13	3.0E-06	3.3E-02	3.4E-02	9.1E-10	6.7E-02
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	8.02	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	8.40E+00	2.6	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	-	-	-	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	428	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	3,250	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	966	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	53.1	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	68.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	147	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	12	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.3E-06	1.8E-06	1.6E-13	3.0E-06	3.3E-02	3.4E-02	9.1E-10	6.7E-02

1 Units are (mg/kg)/day.

2 Units are [(mg/kg)/day]-1.

3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.

4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

- Representative concentrations for each COPC in each applicable medium
- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use
- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways.

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents) receptors. COPCs in SWMU 5 media were not present at sufficient concentrations to cause adverse noncarcinogenic health effects to any current potential receptors and the future excavation worker. The cancer risks estimated for the current potential receptors were below or within the 1E-04 to 1E-06 target risk range that is often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation. These risks exceeded the FDEP target cancer risk of 1E-06.

COPCs at SWMU 5 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Additionally, cancer risks for this receptor were estimated at levels exceeding 1E-04. Arsenic and beryllium are the main contributors to the carcinogenic risk and arsenic is the main contributor to the noncarcinogenic risk. Arsenic and beryllium are present at concentrations in surface soil that exceed background levels. Arsenic and chromium are present at concentrations in sediment that exceed background levels.

3.7 ECOLOGICAL RISK ASSESSMENT

This section presents the results of the ecological risk assessment performed at SWMU 5 and consists of a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

3.7.1 Problem Formulation

This section presents the problem formulation, which includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

3.7.1.1 Habitat Types and Ecological Receptors

Section 3.1 (See Figure 3-11) describes the physical setting at SWMU 5. The Sand Blasting Area consists of buildings and concrete surfaces, and thus provides no terrestrial or aquatic habitat. A concrete drainage ditch at the site directs surface-water runoff (after major rainfall events) to a small area of terrestrial vegetation and a shallow pond approximately 400 feet southwest of the site. The pond is connected with a large lagoon to the south by a culvert under a paved road. The large lagoon is part of an extensive area of lagoons and wetlands in the southern portion of Boca Chica Key. Thus, the water quality of this small pond is influenced by the water quality of the larger lagoon, which has an outlet to the Atlantic Ocean.

The pond is approximately 150 feet in length and varies in width from 10 to 40 feet. Water depth is approximately 10 to 18 inches during the summer rainy season. The pond is almost totally dry during years with especially dry winters. Salinity in the pond ranged from 26.4 to 33.2 ppt in August and September 1996 (Appendix C, Table C.1-3), which would classify the pond as mixo-euhaline (Reid, 1961). Conductivity was highly correlated with salinity, with the highest conductivity values associated with the highest salinity values. DO concentrations ranged between 2.41 and 4.50 mg/L and averaged 3.3 mg/L. The shallow water and lack of shade result in high water temperatures in the pond during hot summer days. Water temperatures in the pond ranged from 28.5°C (83.3°F) to 38.6°C (101.5°F) and exceeded 35°C (95°F) on 3 of 8 site visits. Based on the FDEP standards and the EPA (1986) "Gold Book," the highest temperatures and low DO levels are indicative of a very stressful environment for aquatic organisms. Water temperatures in excess of 35°C are known to reduce survival in juveniles and adults of most fish species. In spite of these harsh conditions, the small pond supports a surprisingly diverseassemblage of small fishes, including sheepshead minnow, sailfin molly, and at least two species of killifish (*Fundulus* spp.). This suggests that fish are able to move between the small pond and the adjacent lagoon in response to changing water quality conditions.

Approximately 0.2 acres of upland terrestrial habitat exists at the downstream end of the concrete ditch. Vegetation here consists of broom sedge (*Andropogon virginicus*), saltgrass (*Distichlis spicata*) saltwort (*Batis maritima*), sea oxeye daisy (*Borrichia frutescens*), seashore dropseed (*Sporobolus virginicus*), wax myrtle (*Myrica cerifera*), Brazilian pepper and various other grasses and weeds. An earthen berm is located immediately south of the concrete ditch. Vegetation on the berm consists of Australian pine, Brazilian pepper, and various weeds. The shallow pond is located approximately 80 feet slightly down-slope from the end of the concrete ditch. Buttonwood and black mangrove occur along the edges of the pond and the large lagoon to which the pond is connected. There are no freshwater resources at the site.

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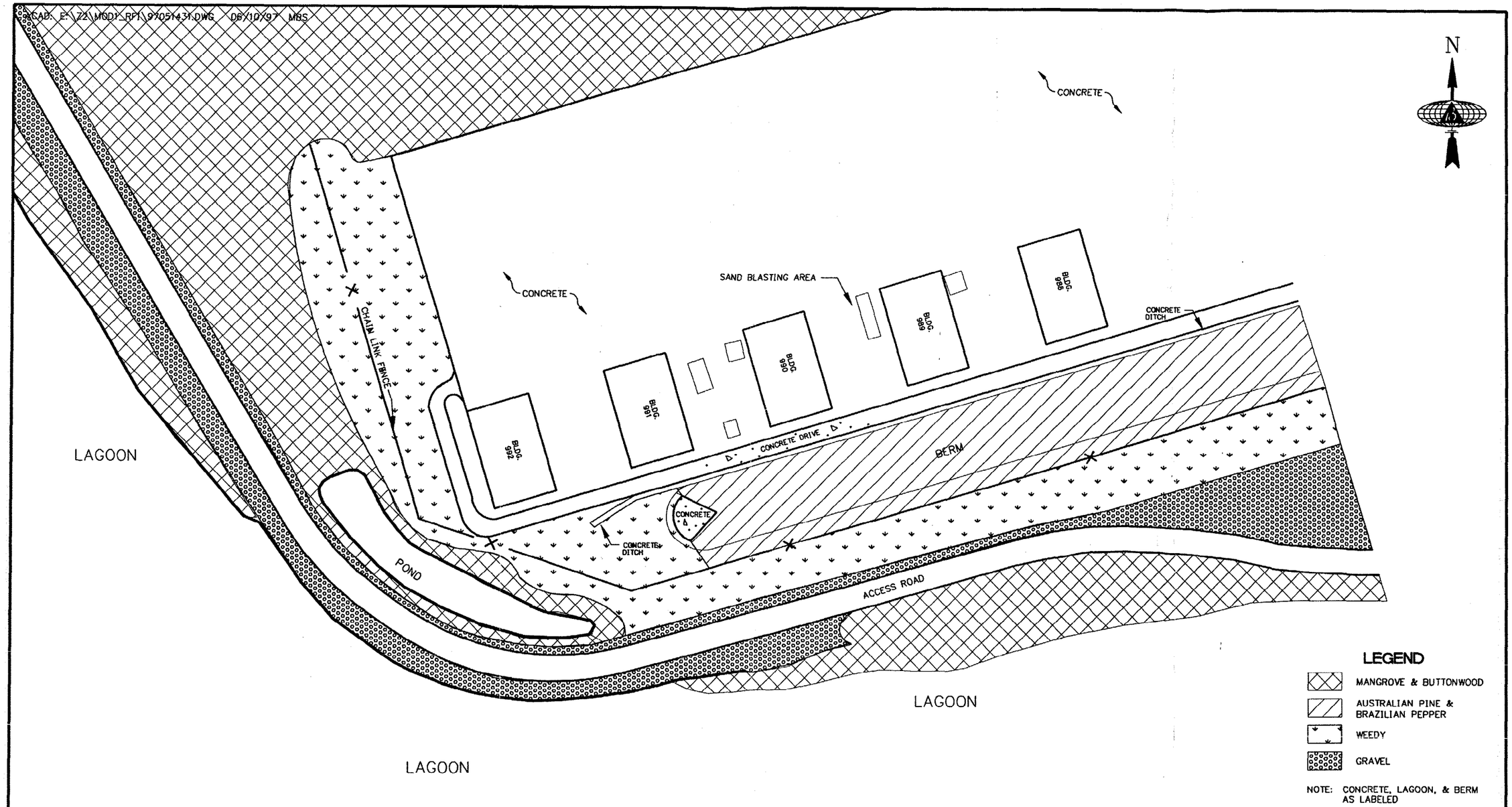

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BROWN & ROOT ENVIRONMENTAL

FIGURE 3-11
HABITATS AT SWMU 5

NAVAL AIR STATION
BOCA CHICA KEY, FLORIDA

0101F127

Due to the small areal extent of the upland area at the end of the concrete ditch, and the close proximity of active AIMD operations in the adjacent buildings, use of the area by terrestrial receptors is probably minimal. However, occasional use by birds and small mammals is possible. The shallow pond provides habitat for minnow-sized fish and wading birds, while the large lagoon provides habitat for a variety of fish and wildlife.

Ecological receptors listed as threatened, endangered, or of special concern that utilize (or could potentially utilize) the small pond consist of the red rat snake and wading birds such as the white ibis, little blue heron, snowy egret, and tricolored heron (all state-listed as SSC). A tricolored heron was often seen foraging in the pond during B&R Environmental sampling activities of August to October 1996. During the same period, little blue herons, tricolored herons, and ospreys were observed foraging in the large lagoon south of the pond. An active bald eagle nest is located approximately 1,200 feet southeast of the culvert that connects the pond to the lagoon. One or two bald eagles were occasionally seen foraging over the lagoon during sampling activities of August to October 1996. No signs of the lower keys marsh rabbit have been observed at the site, but marsh rabbits have been observed approximately 500 feet northwest of the pond (Schuetz, 1997).

Minnows were collected for tissue analysis from the small pond down slope of the concrete ditch. Additionally, foliage of sea oxeye daisy and seashore dropseed, two species known to be consumed by the Lower Keys marsh rabbit, was collected for tissue analysis from the area between the pond and the concrete ditch.

3.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways is presented in Section 3.5.2.

3.7.1.3 Exposure Routes

Terrestrial animals at SWMU 5 can be exposed to soil contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation. Aerial deposition could have been a significant exposure route during sand blasting activities. However, as mentioned in Section 3.5.2, aerial deposition is presently minimal. Terrestrial receptors can also come into contact with contaminants in surface water by using it for drinking, although this exposure route generally represents a negligible portion of total exposure for most receptors. In addition, the high salt content in the pond and lagoon downstream from the site precludes the use of the

water for drinking. Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue.

Volatile constituents could be present in some site soils, and soil-bound contaminant airborne suspension could occur at SWMU 5. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors. The only terrestrial habitat (other than paved areas) in the vicinity of the site consists of the berm south of the concrete ditch, an area of approximately 0.2 acres at the downstream end of the ditch, and the shoreline of the pond and lagoon beyond the end of the ditch. Thus, the above discussion applies only to terrestrial receptors that utilize these small areas.

Aquatic and terrestrial organisms utilizing the pond and lagoon southwest of SWMU 5 can be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semi-aquatic organisms can also be exposed to constituents in contaminated groundwater that flows into surface water.

3.7.1.4 Selection of Ecological Chemicals of Potential Concern

Calcium, magnesium, potassium, and sodium were excluded as ecological COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water and groundwater. Otherwise, analytes selected for evaluation consisted of all analytes detected during current and previous sampling of surface water, sediment, and surface soil at SWMU 5. Groundwater analytes selected for evaluation consisted of analytes detected during current sampling of the two monitoring wells nearest to the lagoon. Inorganic contaminants in groundwater, surface water, sediment, and surface soil whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

3.7.1.5 Assessment and Measurement Endpoints

A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3.1.1.5 of Appendix C.

3.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 3-12 shows the conceptual model for SWMU 5. The figure shows complete exposure routes for the infiltration, wind erosion, and volatile emission pathways. However, infiltration is possible only in the small area beyond the western end of the concrete ditch, and possibly along the edge of the berm south of the site. Additionally, since most of the site is bare rock and concrete, and bare soil is almost totally absent, the wind erosion and volatile emission pathways are possible only to a small extent.

3.7.2 Ecological Effects Characterization

Ecologically-based thresholds (e.g., concentrations of contaminants in various media protective of ecological receptors) were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at SWMU 5. Brief descriptions of each COPC are included in Appendix B Part 3. Groundwater contaminant concentrations were compared to surface-water thresholds for saltwater. Terrestrial plant thresholds were obtained to assess potential risks to plants from soil contaminants. Contaminant intake doses for the Lower Keys marsh rabbit, cotton rat, kestrel, and great blue heron were modeled, and estimated doses were compared to TRVs (doses above which potential risks might be present). Example doses and TRVs are provided in Appendix B, Part 4. The raccoon was not selected as a representative mammalian carnivore in the foodchain modeling because COPCs either did not include contaminants that biomagnify in the foodchain, or were detected infrequently and at low concentrations. Groundwater, surface-water, sediment, terrestrial plant, and surface soil thresholds, as well as TRVs used in foodchain modeling, are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Minnow-sized fish were collected from the shallow pond west of the site and analyzed for pesticides, PCBs, and metals. Fifteen of 25 fish samples collected from the pond were also analyzed for SVOCs. Concentrations of analytes detected in the fish were compared to concentrations in fish collected at

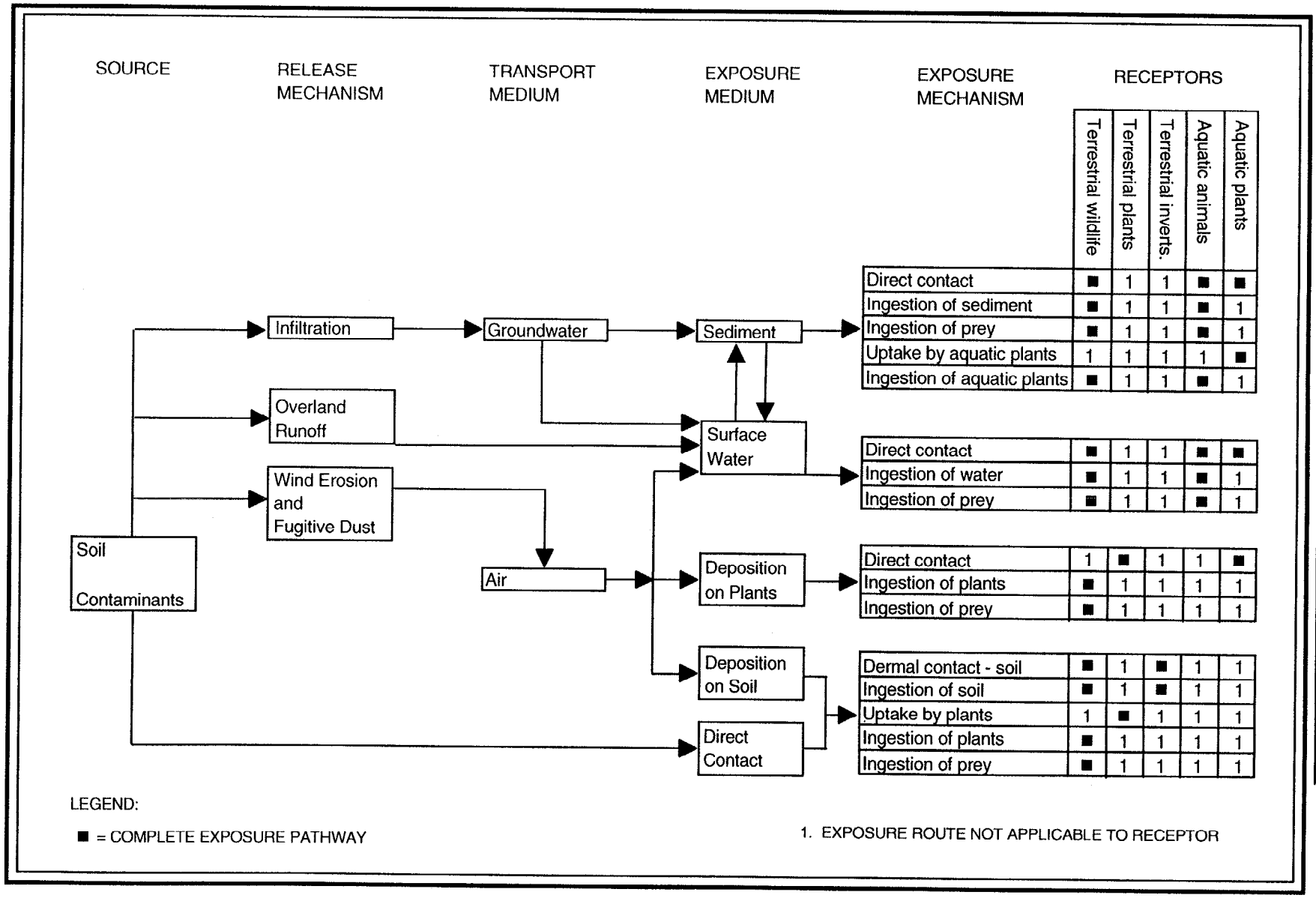

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Figure 3-12. Conceptual Site Model - SWMU 5, NAS Key West, Boca Chica Key, Florida

background sites, and to threshold concentrations considered to be protective of fish and piscivorous receptors (Appendix C, Table C.3-26). Maximum and mean concentrations of analytes detected in fish samples were also used to estimate doses to the great blue heron.

Foliage of sea oxeye daisy and seashore dropseed (major food sources of the Lower Keys marsh rabbit) was collected from the area between the ditch terminus and the pond. Concentrations of metals, pesticides, and PCBs in the vegetation were compared to concentrations in vegetation collected at background sites, and maximum and mean concentrations in the vegetation samples were also used to estimate doses to the Lower Keys marsh rabbit.

3.7.3 Exposure Assessment

This section presents the ecological exposure assessment for SWMU 5 and includes a discussion of exposure point contaminant concentrations and dose calculations.

3.7.3.1 Exposure Point Contaminant Concentrations

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil were used as representative exposure point concentrations for screening against threshold values. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.

3.7.3.2 Dose Calculations

The potential risks to ecological receptors resulting from exposure to SWMU 5-related contaminants were also evaluated by estimating the total contaminant dose that representative organisms inhabiting the site might receive for each contaminant and comparing those doses to TRVs, which are doses above which adverse effects might occur. The Lower Keys marsh rabbit, cotton rat, and kestrel were selected as representative terrestrial receptors, and the great blue heron was selected as the representative piscivorous receptor for foodchain modeling at SWMU 5. Section 3.3.2.1.2 of Appendix C provides a detailed description of dose calculations and exposure parameters used for the foodchain modeling.

3.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at SWMU 5.

3.7.4.1 Results

The results of the ecological risk characterization at SWMU 5 are presented in this section, which includes a discussion of the results from the Phase I and Phase II ecological screening assessments, foodchain modeling for selected terrestrial and piscivorous receptors, and tissue analyses.

3.7.4.1.1 Phase I

The Phase I ecological screening risk assessment conducted by IT Corporation (1994) identified 2,4-dichlorophenol as a final COC in groundwater, but concluded that it presented a minimal risk due to the lack of a groundwater pathway. Cadmium, chromium, lead, vanadium, and zinc were identified as COCs in sediment, and soil COCs consisted of barium, cadmium, chromium, tin, and zinc. No COCs were listed for surface water, but cadmium, chromium, lead, and zinc were considered to be capable of bioaccumulating sufficiently to pose risks to piscivores. Based on soil contaminants, the Phase I assessment also concluded that terrestrial receptors could be at risk from cadmium and zinc through consumption of forage. The overall conclusion was that SWMU 5 appeared to pose a low to moderate ecological risk, and the collection of surface-water and sediment samples from the pond was recommended (IT Corporation, 1994).

3.7.4.1.2 Phase II - Ecological Screening Assessment

Analytes detected in groundwater samples from the two wells nearest the lagoon were limited to inorganics. Mercury was the only analyte that exceeded twice its average background concentration and its toxicity threshold, and was thus retained as a COPC in groundwater (Table 3-25).

Maximum surface-water concentrations of copper, chromium, zinc, cadmium, and lead exceeded ecological screening thresholds and exceeded twice their respective average background concentrations and were, therefore, retained as COPCs (cadmium and lead were not detected in background) (Table 3-26). No organic compounds in surface water exceeded ecological thresholds. Several inorganics were retained as COPCs in SWMU 5 sediments (Table 3-27). Barium was retained as a COPC since its maximum detected concentration exceeded twice its average background concentration and the only available threshold value. Arsenic, copper, mercury, nickel, and silver were all retained as COPCs since their maximum concentrations exceeded twice their respective average background values and the most conservative thresholds available, but they did not exceed less conservative thresholds. Maximum concentrations of cadmium, chromium, lead, and zinc exceeded twice their average background

TABLE 3-25

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER (µg/L) - SWMU 5
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	1/2	ND	26.2	4,300	0.01	Eliminated - does not exceed threshold
Barium	2/2	10.2	8.9 - 12.2	10,000	0.00	Eliminated - does not exceed 2 X background
Chromium	1/2	2.51	1.7	50	0.03	Eliminated - does not exceed 2 X background
Cyanide	1/2	1.47	1.5	1	1.45	Eliminated - does not exceed 2 X background
Manganese	2/2	3.78	2.3 - 3	10	0.30	Eliminated - does not exceed 2 X background
Mercury	2/2	0.1	0.26 - 4.7	0.025	189.00	Retained - exceeds 2 X background and HQ > 1
Silver	1/2	1.37	1.9	0.05	37.0	Eliminated - does not exceed 2 X background
Vanadium	2/2	2.62	2.3 - 2.4	10,000	0.00	Eliminated - does not exceed 2 X background
Zinc	2/2	2.82	26.5 - 52.4	86	0.61	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 3-26

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L) - SWMU 5
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						
Arsenic	1/5	3.97	3.5	50	0.07	Eliminated - does not exceed 2 X background
Barium	1/5	6.93	53.1	10,000	0.005	Eliminated - does not exceed threshold
Cadmium	1/5	ND	9.7	9.3	1.04	Retained - HQ > 1
Chromium	1/5	2.62	58.2	50	1.16	Retained - exceeds 2 X background and HQ > 1
Copper	1/5	2.26	13.6	2.4	5.7	Retained - exceeds 2 X background and HQ > 1
Lead	2/5	ND	5.1 - 68.9	5.6	12.3	Retained - HQ > 1
Zinc	1/5	7.19	147	86	1.7	Retained - exceeds 2 X background and HQ > 1
VOLATILE ORGANIC COMPOUNDS						
Acetone	1/5	4.33	12	9,000,000	1.3E-06	Eliminated - does not exceed threshold
Methylene chloride	1/5	1.50	1	2,560	0.0004	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 3-27

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - SWMU 5
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	4/4	1,331.89	1,340 - 3,040	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Antimony	1/6	ND	4	12	0.3	Eliminated - does not exceed threshold
Arsenic	6/6	2.63	4.3 - 8.6	7.24/70	1.2/0.1	Retained - exceeds 2 X background and HQ > 1
Barium	6/6	9.27	10.6 - 250	40	6.2	Retained - exceeds 2 X background and HQ > 1
Beryllium	2/6	0.06	1.8 - 2.6	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	5/6	0.22	2.3 - 120	0.676/9.6	177.5/12.5	Retained - exceeds 2 X background and HQ > 1
Chromium	6/6	5.01	16.5 - 428	52.3/160	8.2/2.7	Retained - exceeds 2 X background and HQ > 1
Cobalt	4/6	0.47	0.59 - 9.8	50	0.2	Eliminated - does not exceed threshold
Copper	6/6	8.88	10.5 - 38.9	18.7/270	2.1/0.1	Retained - exceeds 2 X background and HQ > 1
Lead	6/6	17.97	30.1 - 966	30.2/218	32.0/4.4	Retained - exceeds 2 X background and HQ > 1
Manganese	4/4	15.39	9.2 - 32.1	460	0.07	Eliminated - does not exceed threshold
Mercury	3/6	0.05	0.03 - 0.13	0.13/0.71	1.0/0.2	Retained - exceeds 2 X background and HQ > 1
Nickel	6/6	2.15	2.3 - 26.6	15.9/42.8	1.7/0.6	Retained - exceeds 2 X background and HQ > 1
Silver	2/6	0.27	0.85 - 1.3	0.733/3.7	1.8/0.4	Retained - exceeds 2 X background and HQ > 1
Tin	1/2	2.85	8.1	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	6/6	5.08	6.4 - 34.2	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Zinc	6/6	25.74	24.6 - 1,260	124/410	10.2/3.1	Retained - exceeds 2 X background and HQ > 1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Bis(2-ethylhexyl)phthalate	2/5	1,992.17	467.5 - 570	182/2,647	3.1/0.22	Retained - HQ > 1
Butyl benzyl phthalate	1/5	ND	495	11,000	0.04	Eliminated - does not exceed threshold

TABLE 3-27

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - SWMU 5
NAS KEY WEST
PAGE 2 OF 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
Acetone	3/5	30.9	24 - 147	64	2.3	Retained - HQ > 1
Cis-1,2-dichloroethene	1/2	ND	2	23	0.0.9	Eliminated - does not exceed threshold
Methylene chloride	1/6	7.5	12	427	0.03	Eliminated - does not exceed threshold
Tetrachloroethene	4/6	4.33	2.5 - 10.2	530	0.02	Eliminated - does not exceed threshold

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

concentrations and both the most and less conservative thresholds used in this ERA. Aluminum, beryllium, tin, and vanadium were conservatively retained as sediment COPCs because their maximum values exceeded twice their average background values and no suitable thresholds were available. Bis(2-ethylhexyl)phthalate and acetone were the only organic compounds that were identified as sediment COPCs.

Inorganic surface soil COPCs with maximum concentrations in excess of threshold values and twice their respective average background values consisted of chromium and tin (Table 3-28). Antimony and beryllium were conservatively retained as COPCs in surface soils since their maximum concentrations exceeded twice their average background concentrations, but no suitable thresholds were available. No organics detected in surface soils exceeded thresholds, but 2-butanone and acetone were conservatively retained as COPCs due to the absence of suitable surface soil thresholds.

The inorganics arsenic, cadmium, chromium, lead, and zinc were retained as plant COPCs since their maximum soil concentrations exceeded two times average background concentrations and terrestrial plant thresholds (Table 3-29). The organics 2-butanone, acetone, cis-1,2-dichloroethene, and methylene chloride were conservatively retained as terrestrial plant COPCs since thresholds were not available.

3.7.4.1.3 Tissue Analysis

Minnows (sheepshead minnows, killifish, and sailfin mollies) were collected from the small pond southwest of the site, and were composited by species into samples of approximately 30 grams each. Analytes detected in fish consisted of aluminum, barium, chromium, lead, manganese, zinc, several organochlorine pesticides, and phenol (Table 3-30).

Sea oxeye daisy and seashore dropseed foliage was collected from the area between the ditch terminus and the pond. Analytes detected in foliage consisted of aluminum, arsenic, barium, cadmium, copper, lead, mercury, zinc, and seven pesticides or pesticide daughter products (Table 3-31).

3.7.4.1.4 Foodchain Modeling

Aluminum and arsenic were the primary contributors of potential risks to the Lower Keys marsh rabbit under the maximum and mean contaminant concentration scenarios (Tables 3-32, 3-33). Total HI values for maximum and mean scenarios were 5.16 and 3.34, respectively, and incidental ingestion of soil comprised the majority of potential risks for both scenarios. Aluminum and arsenic were the primary

TABLE- 3-28

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - SWMU 5
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 (mg/kg)						
Aluminum	1/1	1,887.29	923	600	1.5	Eliminated - does not exceed 2 X background
Antimony	1/4	0.39	4.20	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Arsenic	4/4	1.29	0.34 - 13	60	0.2	Eliminated - does not exceed threshold
Barium	4/4	10.51	3.7 - 22.3	440	0.05	Eliminated - does not exceed threshold
Beryllium	1/4	0.05	0.26	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	3/4	0.15	1.7 - 12.6	20	0.6	Eliminated - does not exceed threshold
Chromium	4/4	6.02	6.4 - 24.7	0.4	61.8	Retained - exceeds 2 X background and HQ > 1
Cobalt	1/4	0.29	0.7	200	0.004	Eliminated - does not exceed threshold
Copper	3/4	5.43	2.2 - 7.2	50	0.1	Eliminated - does not exceed 2 X background
Lead	4/4	15.66	13.8 - 52.1	500	0.1	Eliminated - does not exceed threshold
Manganese	1/1	17.65	8.9	100	0.09	Eliminated - does not exceed 2 X background
Mercury	1/4	0.03	0.04	0.1	0.4	Eliminated - does not exceed 2 X background
Nickel	3/4	1.67	2.4 - 7.6	200	0.04	Eliminated - does not exceed threshold
Tin	1/3	1.94	5.1	0.89	5.7	Retained - exceeds 2 X background and HQ > 1
Vanadium	2/4	3.97	2.7 - 3.2	20	0.2	Eliminated - does not exceed 2 X background
Zinc	4/4	15.22	3.1 - 86.3	200	0.4	Eliminated - does not exceed threshold
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
2-butanone	1/1	ND	9	NA	-	Retained - no suitable threshold available
Acetone	1/1	3.67	35	NA	-	Retained - no suitable threshold available
Cis-1,2-dichloroethene	1/3	ND	1	300	0.003	Eliminated - does not exceed threshold
Methylene chloride	1/3	2.8	20	300	0.07	Eliminated - does not exceed threshold

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

TABLE 3-29

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - SWMU 5
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 (mg/kg)						
Aluminum	1/1	1,887.29	923	50	18.5	Eliminated - does not exceed 2 X background
Antimony	1/4	0.39	4.2	5	0.8	Eliminated - does not exceed threshold
Arsenic	4/4	1.29	0.34 - 13	10	1.3	Retained - exceeds 2 X background and HQ > 1
Barium	4/4	10.51	3.7 - 22.3	500	0.04	Eliminated - does not exceed threshold
Beryllium	1/4	0.05	0.26	10	0.03	Eliminated - does not exceed threshold
Cadmium	3/4	0.15	1.7 - 12.6	3	4.2	Retained - exceeds 2 X background and HQ > 1
Chromium	4/4	6.02	6.4 - 24.7	1	24.7	Retained - exceeds 2 X background and HQ > 1
Cobalt	1/4	0.29	0.7	20	0.4	Eliminated - does not exceed threshold
Copper	3/4	5.43	2.2 - 7.2	100	0.07	Eliminated - does not exceed 2 X background
Lead	4/4	15.66	13.8 - 52.1	50	1.04	Retained - exceeds 2 X background and HQ > 1
Manganese	1/1	17.65	8.9	500	0.02	Eliminated - does not exceed 2 X background
Mercury	1/4	0.03	0.04	0.3	0.13	Eliminated - does not exceed 2 X background
Nickel	3/4	1.67	2.4 - 7.6	30	0.25	Eliminated - does not exceed threshold
Tin	1/3	1.94	5.1	50	0.1	Eliminated - does not exceed threshold
Vanadium	2/4	3.97	2.7 - 3.2	2	1.6	Eliminated - does not exceed 2 X background
Zinc	4/4	15.22	3.1 - 86.3	50	1.7	Retained - exceeds 2 X background and HQ > 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
2-butanone	1/1	ND	9	NA	-	Retained - no suitable threshold available
Acetone	1/1	3.67	35	NA	-	Retained - no suitable threshold available
Cis-1,2-dichloroethene	1/3	ND	1	NA	-	Retained - no suitable threshold available
Methylene chloride	1/3	2.8	20	NA	-	Retained - no suitable threshold available

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

TABLE 3-30

SUMMARY STATISTICS FOR ANALYTES DETECTED IN MINNOWS FROM SWMU 5 AND BACKGROUND SITES NAS KEY WEST

	SWMU 5			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum	3/25	27.60-318.00	19.84	6/24	10.40-37.70	8.84
Barium	21/25	2.00-7.30	2.91	39/58	0.67-9.90	2.43
Chromium	7/25	0.86-1.90	0.63	2/58	1.00-3.10	0.41
Lead	22/25	0.56-4.80	2.46	41/58	0.14-11.90	1.50
Manganese	11/25	0.67-4.40	1.44	1/24	16.20	1.38
Zinc	25/25	36.50-86.50	60.23	58/58	13.60-84.20	41.38
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	23/25	0.10-24.00	2.08	48/58	0.25-16.60	3.95
4,4'-DDE	25/25	1.20-3.80	2.21	57/58	3.80-106.00	28.75
4,4'-DDT	25/25	1.60-21.00	5.52	4/58	0.63-2.50	1.02
Aldrin	11/25	0.29-5.10	1.25	5/58	0.28-2.00	0.70
alpha-BHC	1/25	0.47	0.93	0/58		
beta-BHC	11/25	0.10-4.20	1.22	5/58	1.30-6.00	0.95
delta-BHC	4/25	0.16-0.55	0.86	13/58	0.08-1.00	0.58
gamma-BHC (lindane)	9/25	0.10-2.80	0.94	0/58		
Chlorobenzilate	23/25	22.00-330.00	45.86	3/56	73.0-190.0	483.2
Dieldrin	23/25	0.38-4.20	1.41	11/58	0.34-4.90	1.13
Endosulfan I	23/25	0.28-3.30	0.98	6/58	0.66-2.60	0.73
Endosulfan II	22/25	0.26-4.00	1.17	1/58	1.90	1.02
Endosulfan sulfate	19/25	0.58-22.00	3.98	3/58	1.60-9.80	1.30
Endrin	12/25	0.46-1.40	1.40	2/58	1.00-1.10	0.98
Endrin aldehyde	25/25	2.20-16.00	7.60	3/58	3.40-5.40	1.15
Heptachlor	21/25	0.23-8.10	1.39	0/58		
Heptachlor epoxide	9/25	0.23-0.75	0.75	8/58	1.00-10.00	1.01
Isodrin	14/25	0.31-2.00	1.30	0/58		
Methoxychlor	5/25	0.74-8.10	7.87	1/58	1.90	3.73
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Phenol	1/15	620.00	499.00	4/34	1,400.00-10,000.00	1,163.53

1 One-half the detection limit used for all non-detected values.

TABLE 3-31

SUMMARY STATISTICS FOR ANALYTES DETECTED IN VEGETATION FROM SWMU 5 AND BACKGROUND SITES, NAS KEY WEST

	SWMU 5			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum	1/4	49.90	18.59	0/6		
Arsenic	2/4	1.00-1.10	0.76	0/6		
Barium	2/4	4.30-11.80	4.30	1/6	3.50	0.69
Cadmium	2/4	0.42-1.60	0.53	0/6		
Copper	1/4	2.20	1.09	0/6		
Lead	2/4	0.45-1.10	0.47	0/6		
Mercury	3/4	0.01-0.02	0.01	6/6	0.01-0.02	0.01
Zinc	4/4	4.70-57.60	26.60	2/6	12.80-55.50	12.42
PESTICIDE/PCBs (µg/kg)						
beta-BHC	1/4	0.84	0.85	3/6	0.23-0.80	0.72
delta-BHC	1/4	0.78	0.83	1/6	0.21	0.74
gamma-BHC (lindane)	2/4	0.75-0.99	0.86	2/6	0.05-0.21	0.61
Chlorobenzilate	1/4	9.20	8.68	0/6		
Endrin aldehyde	3/4	0.19-0.99	0.77	6/6	0.26-1.20	0.75
Heptachlor	2/4	0.24-0.32	0.56	1/6	0.29	0.76
Heptachlor epoxide	2/4	0.71-0.90	0.83	0/6		

1 One-half the detection limit used for all non-detected values.

TABLE 3-32

MAJOR CONTRIBUTORS TO RISK FOR THE LOWER KEYS MARSH RABBIT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	3.59	69.5
Arsenic	0.97	18.8
Barium	0.16	3.2
Cadmium	0.15	2.9
Antimony	0.14	2.7
All others	0.15	2.9
Total receptor HI	5.16	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	2.74	53.1
Food	2.42	46.9

TABLE 3-33

MAJOR CONTRIBUTORS TO RISK FOR THE LOWER KEYS MARSH RABBIT MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	2.58	77.4
Arsenic	0.49	14.8
Antimony	0.07	1.9
Barium	0.06	1.9
Cadmium	0.05	1.5
All others	0.09	2.5
Total receptor HI	3.34	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	2.27	67.9
Food	1.07	32.1

contributors of potential risks to the cotton rat at SWMU 5 for both the maximum and mean contaminant concentration scenarios (Tables 3-34, 3-35). Total HI values for the maximum and mean concentration scenarios were 3.71 and 2.11, respectively, and ingestion of food was the primary contaminant exposure pathway. Zinc and arsenic were the primary contributors of potential risks to the kestrel for both the maximum and mean contaminant concentration exposure scenarios (Tables 3-36, 3-37). HI values for the maximum and mean exposure scenarios were 0.39 and 0.19, respectively. Since ingestion of soil and water were not considered in the model for the kestrel, ingestion of contaminated food accounted for 100% of contaminant exposure for this raptor. For the great blue heron, barium, 4,4'-DDD, 4,4'-DDT, zinc and aluminum were the primary contributors to potential risks using maximum contaminant concentrations in fish (Tables 3-38, 3-39). Barium, zinc, 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD accounted for the majority of risk to the great blue heron using mean contaminant concentrations in fish. HI values for the maximum and mean contaminant concentration scenarios were 6.50 and 2.19, respectively.

3.7.4.2 Discussion

Mercury was the only analyte that was retained as a COPC in groundwater. Concentrations of mercury in both groundwater samples collected from the two monitoring wells nearest to the lagoon (S5MW-2 and S5MW-3) exceeded the surface-water ecological threshold. However, mercury was not detected in any of four surface-water samples collected from the pond and lagoon in 1996, nor in the surface-water sample collected from the ditch in 1993. Mercury was detected in three of six sediment samples, but the only concentration comparable to the sediment ecological threshold was in the sample collected from the end of the concrete ditch (S5SS-1). Mercury was detected in only one of four soil samples, at a concentration near the average background level. Thus, migration of mercury from groundwater to surface water and sediment does not appear to be occurring, and mercury in groundwater does not appear to be due to site-related soil contamination.

All analytes detected in surface water at SWMU 5 were in a single sample (S5SS-2) collected from the concrete ditch by IT Corporation in 1993 (See Figure 3-8 and Table 3-4), with the exception of lead in one sample in 1996. The concrete ditch is normally dry except after rain events. B&R Environmental collected four surface-water samples during the current investigation; three were collected from the small pond and one was collected from the lagoon near the culvert through which the pond drains. Lead was detected in one of these four 1996 samples. No other analytes were detected in any surface-water sample collected during the 1996 sampling. The single lead value (5.1 mg/L) was less than the ecological threshold of 5.6 mg/L. Thus, the surface-water analyses show no evidence of contamination in the two surface-water bodies nearest to the site.

TABLE 3-34

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	2.53	68.2
Arsenic	0.75	20.1
Barium	0.16	4.2
Cadmium	0.13	3.4
Antimony	0.06	1.7
All others	0.08	2.4
Total receptor HI	3.71	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	1.21	32.6
Food	2.50	67.4

TABLE 3-35

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	1.49	70.9
Arsenic	0.44	20.8
Barium	0.06	2.8
Cadmium	0.04	2.0
Antimony	0.03	1.4
All others	0.05	2.2
Total receptor HI	2.11	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	1.0	47.5
Food	1.11	52.5

TABLE 3-36

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Zinc	0.22	56.1
Arsenic	0.15	37.5
Antimony	0.00	2.4
Mercury	0.00	1.6
Chromium	0.00	1.0
All others	0.02	1.5
Total receptor HI	0.39	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	0.39	100.0

TABLE 3-37

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Zinc	0.10	52.7
Arsenic	0.08	40.6
Antimony	0.00	2.3
Mercury	0.00	1.6
Chromium	0.00	1.2
All others	0.01	1.6
Total receptor HI	0.19	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	0.19	100.0

TABLE 3-38

MAJOR CONTRIBUTORS TO RISK FOR THE GREAT BLUE HERON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Barium	2.08	32.0
4,4'-DDD	1.23	19.0
4,4'-DDT	1.08	16.6
Zinc	0.86	13.2
Aluminum	0.42	6.4
All others	1.13	12.8
Total receptor HI	6.50	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	6.50	100.0

TABLE 3-39

MAJOR CONTRIBUTORS TO RISK FOR THE GREAT BLUE HERON MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 5 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Barium	0.83	37.8
Zinc	0.60	27.3
4,4'-DDT	0.28	13.0
4,4'-DDE	0.11	5.2
4,4'-DDD	0.11	4.9
All others	0.26	22.2
Total receptor HI	2.19	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	2.19	100.0

Several metals and two organic compounds were retained as COPCs in SWMU 5 sediments (Table 3-27). The HQs for most of the COPCs were low, and maximum concentrations of several COPCs did not exceed less conservative thresholds HQs for the two organic COPCs (bis(2-ethylhexyl)phthalate and acetone) were indicative of low potential risk. Phthalates are commonly detected in soils and sediments, and the concentrations in these samples were considerably less than the average background value for bis(2-ethylhexyl)phthalate. In addition, the maximum value of this compound did not exceed a less conservative threshold. Acetone is a common laboratory contaminant, and its hazard quotient (HQ=3.1) was indicative of relatively low potential risk.

Table 3-3 and Figure 3-7 indicate that (as was the case with surface water) most of the highest sediment values were recorded in samples collected in 1993 from the ditch between the Sand Blasting Area and the pond. IT Corporation collected one sediment sample in the concrete ditch near the site and one sample from the terminus of the concrete ditch. However, no soil or sediment was present in the concrete ditch during 1996 sampling. B&R Environmental collected four sediment samples during the current investigation: two samples from the pond, one from the lagoon near the culvert that drains the pond, and one from the edge of the mangroves north of the pond.

Based on high frequencies of detection and elevated concentrations, cadmium, chromium, lead, vanadium, and zinc appear to be of the most concern. These were the same five analytes chosen by IT Corporation (1994) as final sediment COCs. However, the locations of individual sample concentrations warrant discussion. Cadmium was detected in five of six samples and exceeded the less conservative of two thresholds in three samples, one of which was collected from the pond. The maximum concentration of cadmium in sediment (120 mg/kg) was in a sample from collected from the end of the concrete ditch in 1993; the next highest sample was 17.9 mg/kg (Table 3-3). Two samples exceeded the less conservative of two sediment thresholds for chromium and lead; the maximum concentration for each of these metals was observed in the 1993 sample from the end of the concrete ditch. Concentrations of zinc exceeded the less conservative of two thresholds in two samples; the maximum value was from near the pond and the next highest was from the end of the concrete ditch. There was no threshold available for vanadium, which was highest in the two concrete ditch samples (S5SS-2: 34.2 mg/kg and S5SS-1: 27.1 mg/kg). However, vanadium is not usually highly toxic in the environment (Mailman, 1980). Sediment concentrations of vanadium in the other site samples were ranged from 6.4 to 7.4 mg/kg; these are only slightly higher than the average background value (5.08 mg/kg). In summary, sediment concentrations suggest low potential risks, except for cadmium, chromium, lead, and zinc. However, these four metals were highest in the sample collected from the concrete ditch (where no aquatic habitat exists and surrounding terrestrial habitat is minimal), while values in most samples collected from the pond indicate low potential risks. In addition, the lowest sediment concentrations of these four metals were from the

sample collected in the lagoon (S5SS-6) at the outlet of the culvert that drains the pond. This suggests that migration of these metals from the pond into the lagoon has not occurred to any significant extent.

Six analytes were identified as COPCs in surface soil. Chromium and tin were retained as COPCs because their maximum values exceeded threshold values and twice their average background concentrations, while no thresholds were available for antimony, beryllium, 2-butanone, and acetone. The maximum chromium value was measured in a sample collected from the edge of the berm immediately south of the site. Base personnel have stated that the former sand blasting activities occasionally deposited visible residue on the edge of the berm. Other analytes identified as COPCs were measured in samples collected in 1993 from (or near) the area where sand blasting occurred. Currently, soil is virtually absent from the former Sand Blasting Area, and habitat on the portion of the berm near the site minimal in extent, reducing the possibility of exposure for terrestrial receptors.

For the screening of maximum surface soil contaminant concentrations against terrestrial plant thresholds, HQs exceeded 1.0 for arsenic, cadmium, chromium, lead, and zinc. Arsenic, chromium, and lead concentrations were highest in the 1996 sample collected from the berm near the site, but HQs of COPCs were relatively low except for chromium (HQ=24.7). However, chromium was not detected in any of the four vegetation samples collected from the area between the ditch and the pond. The authors who derived the plant thresholds for metals in soil consider the thresholds to be very conservative (Will and Suter, 1995b). The scarcity of terrestrial plant thresholds for organic compounds precluded a detailed assessment of potential risks to terrestrial plants from organics in surface soil. However, plants do not translocate organics to the extent that they translocate inorganics.

Concentrations of most metals in fish collected from the pond southwest of the Sand Blasting Area were similar to those in fish collected from background locations and less than concentrations considered to be hazardous to piscivorous receptors. Concentrations of aluminum exceeded the range of background values in two minnow samples, but this metal was detected in only 3 of 25 SWMU 5 samples. Aluminum is common in the environment, and thus, its presence in a few fish is unremarkable. Chromium concentrations in five minnow samples exceeded the 1.0 mg/kg value identified as indicative of contamination (Eisler, 1986a), but chromium was not detected in 18 of 25 minnow samples (detection limit $\approx$ 0.2 to 0.7 mg/kg). In addition, chromium concentrations were within the range of background minnow values. Concentrations of lead in 16 of 18 sheepshead minnow samples exceeded a 2.0 mg/kg piscivorous mammal protection criterion presented by Maddock and Taylor (1980), and lead values in all other minnow species from this site were less than 2.0 mg/kg. As discussed in Chapter 7 of Appendix F, lead in 9 of 11 sheepshead minnows from background sites exceeded 2.0 mg/kg, and only 2 of 47 background minnow samples of other species exceeded 2.0 mg/kg lead. Thus, sheepshead minnows

appear to accumulate lead to a greater extent than the other species collected during this study. Lead was detected in 17 of 18 sheepshead minnows from the pond at SWMU 5 (range = 1.9 to 4.8 mg/kg; mean = 3.07 mg/kg). These values are similar to those from background sites, where lead was detected in 11 of 11 sheepshead minnows (range = 0.33 to 11.9 mg/kg; mean = 5.76 mg/kg).

Most pesticides and pesticide daughter products were detected more frequently in minnows collected from the pond than in background minnows, but the values were generally similar to those in background samples and less than concentrations considered to be hazardous to piscivorous receptors. 4,4'-DDT and endrin aldehyde tended to be higher in SWMU 5 minnows than in background minnows, but detected values were well below values identified in Table C.3-26 of Appendix C as hazardous to piscivorous wildlife. Chlorobenzilate was detected in most minnow samples, with a maximum detected value of 330 μg/kg, but the next highest value for this organochlorine pesticide was 56 μg/kg. Endosulfan sulfate, isodrin, and methoxychlor were detected more frequently and at higher concentrations in minnows from SWMU 5 than in background minnows. Protective thresholds for these contaminants were not available. In general, a low level of risk is associated with whole body tissue residues of organochlorine contaminants of less than 100 μg/kg in marine and estuarine organisms (Gibson and Dillon, 1989). All organochlorine pesticide values in SWMU 5 fish tissue samples (except for the single chlorobenzilate value discussed above) were well below 100 μg/kg. Phenol was the only semivolatile compound detected in minnows from the pond, and was detected in only 1 of 15 samples. Although a fish and wildlife tissue criterion for this compound was not available, its frequency of detection and concentration was less than in background minnows.

Eight metals and seven pesticides or daughter products were detected in the four vegetation samples collected from the upland area between the ditch terminus and the pond. Concentrations of mercury, BHC (alpha, beta, and gamma isomers), endrin aldehyde, and heptachlor were similar to those in background vegetation samples. The average zinc concentration was higher in SWMU 5 vegetation samples than in background samples, but the range of values was similar. Barium was detected in two samples at 4.3 and 11.8 mg/kg. These values exceeded the single detected barium concentration in background vegetation (3.5 mg/kg). Arsenic, cadmium, copper, lead, chlorobenzilate, and heptachlor epoxide were detected in only one or two of four SWMU 5 vegetation samples but were not detected in background vegetation. However, concentrations of these six analytes were only slightly above the detection limits of the background samples. Detection limits in the six background vegetation samples were as follows: arsenic: 0.94 mg/kg; cadmium: 0.61 mg/kg; copper: 1.1 to 2.3 mg/kg; lead: 0.32 mg/kg; chlorobenzilate: 17 mg/kg; and heptachlor epoxide: 1.7 mg/kg (Appendix F). Aluminum was detected in one SWMU 5 sample, at 49.9 mg/kg, and was not detected in background vegetation (detection limit: 1.6 to 9.2 mg/kg). Aluminum is one of the most abundant metals in the earth's crust and is ubiquitous in the environment (Goyer, 1986).

Thus, the detection of aluminum in one of four plant samples is not surprising. Overall, concentrations of analytes in vegetation were similar to those in background vegetation samples or were only slightly above the detection limits of the background samples, except for barium and aluminum.

Results of the foodchain modeling indicate a relatively low risk to the Lower Keys marsh rabbit and cotton rat, and negligible risk to the kestrel. Aluminum and arsenic were the primary contributors to potential risks for the marsh rabbit and cotton rat. However, aluminum was detected in only one of four vegetation samples, and arsenic was detected in two of four vegetation samples. In addition, the concentration of aluminum in soil at SWMU 5 was approximately one-half of the average background concentration of this common metal. Arsenic exceeded its average background value in only 1 of 4 SWMU 5 soil samples. The estimated potential risks to terrestrial receptor species, while relatively low, are further mitigated by the conservative assumptions used in the foodchain model. The model assumed an absorption fraction of 80 percent (i.e., 80 percent of the ingested contaminant was absorbed) for the dose calculations describing the intake of vegetation, prey, and soil. Actual absorption fractions range widely but are often considerably less than 80 percent (Hrudey et al., 1996). In addition, the model assumed that these species forage on the site 100 percent of the time. However, terrestrial habitat is extremely limited at SWMU 5; not even the smallest mammals would forage solely on habitat available at the site. No signs of the marsh rabbit have been found on SWMU 5, and better terrestrial habitats are located on the west and northwest of the site. Migration of contaminants from SWMU 5 to these areas is precluded by topography and drainage.

For the great blue heron, barium, 4,4'-DDD, 4,4'-DDT, zinc, and aluminum were the primary contributors to potential risks using maximum contaminant concentrations in minnows collected from the pond, while barium, zinc, 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD accounted for the majority of risk using mean contaminant concentrations in minnows. Concentrations of barium, zinc, 4,4'-DDE, and 4,4'-DDD in minnows from the pond were similar to concentrations in minnows from background sites. Aluminum was detected in only 3 of 25 samples collected from the pond, and its HI was only 0.42 under the maximum concentration scenario, even though the maximum concentration was quite high (318 mg/kg). Concentrations of 4,4'-DDT were greater in minnows from the pond than in background minnows, but all concentrations were well below the 200 mg/kg value considered to be protective of sensitive wildlife species. All individual HIs under the mean contaminant scenario were less than 1.0. The total HI under the mean concentration scenario was 1.43 for metals, and 0.5 for DDT and metabolites. The estimated potential risks to the heron, while relatively low, are further mitigated by the same conservative assumptions discussed above in the foodchain model (e.g., absorption fraction of 80 percent, and use of the site for 100 percent of foraging). In addition, the small pond (approximately 150 feet x 10 to 40 feet wide) would not be expected

to provide full-time foraging habitat for even the smallest-ranging piscivores, and the pond is dry during some years.

3.7.4.3 Ecological Risk Summary

The Phase I ecological screening risk assessment conducted by IT Corporation (1994) concluded that groundwater contamination did not pose an environmental risk. Cadmium, chromium, lead, vanadium, and zinc were identified as COCs in sediment, and soil COCs consisted of barium, cadmium, chromium, tin, and zinc. Cadmium, chromium, lead, and zinc were considered to be capable of bioaccumulating sufficiently to pose risks to piscivores. The overall conclusion was that SWMU 5 appeared to pose a low to moderate ecological risk, and the collection of surface-water and sediment samples from the pond was recommended (IT Corporation, 1994).

In this Phase II assessment, several metals and organic compounds were detected in groundwater, surface-water, sediment, and soil samples collected from the site and vicinity. Most COPCs were metals, and hazard quotients for all media were generally indicative of low ecological risk. Mercury was the only COPC in groundwater, but there is no evidence that migration of mercury from groundwater to surface water and sediment is occurring. No surface-water COPCs were identified in samples collected from the pond and lagoon southwest of the site, where aquatic habitat exists. Most sediment COPCs resulted from samples collected in 1993 from the concrete ditch east (upslope) of the pond, where aquatic habitat does not exist. No soil or sediment were present in the concrete ditch during 1996 sampling. Cadmium, chromium, lead, and zinc were detected in sediment at concentrations that are suggestive of moderate potential risk. However, concentrations of these four metals in most samples collected from the pond indicate low potential risks, and the lowest concentrations of these metals were from the sample collected in the lagoon beyond the pond. This suggests that migration of these metals from the pond into the lagoon has not occurred to any significant extent. In addition, cadmium and vanadium were not detected in minnows from the pond, and concentrations of chromium, lead, and zinc in minnows were similar to those in background samples. Although minnows do not inhabit sediments, their diet would expose them to sediment contaminants. Tissue concentrations of these metals in minnows collected from the pond indicate low potential risks from bioaccumulation.

Hazard quotients for soil and plant COPCs indicated relatively low risk to terrestrial receptors, except for chromium. However, chromium was not detected in vegetation samples collected from the upland area between the ditch and the pond. Concentrations of chromium and its frequency of detection in sediment and soil suggest the potential for ecological risks, but chromium was not detected in vegetation, and was infrequently detected in minnows. Overall, most concentrations of COPCs in non-biological media indicate

low potential risks to aquatic and terrestrial biota, and risks from most of the elevated concentrations are mitigated by several factors.

Concentrations of analytes detected in minnows and vegetation from the vicinity of SWMU 5 were generally similar to background values. Several organochlorine pesticides and daughter products were detected more frequently in minnows and vegetation from SWMU 5 than in background samples, but concentrations tended to be low. Organochlorine pesticides have a long history of use at NAS Key West. These compounds remain in soil and sediment for extremely long periods, and are known to accumulate in tissue. Therefore, their presence at the relatively low concentrations measured in SWMU 5 samples is unremarkable.

Results of the foodchain modeling indicate low risks to the Lower Keys marsh rabbit and cotton rat (representative terrestrial herbivorous receptors), great blue heron (representative piscivorous receptor) and negligible risk to the kestrel (representative terrestrial carnivorous receptor). The slightly elevated risks to the rabbit, rat, and heron are mitigated by the conservative assumptions used in the foodchain model.

In summary, the Phase I and the Phase II ecological risk assessments appear to be sufficient to characterize potential ecological risks at SWMU 5. Terrestrial habitat at the site is of minimal extent and quality, resulting in minimal use of the site and vicinity by terrestrial receptors. Groundwater and surface-water contaminants do not appear to pose environmental risks. Soil and sediment contaminants do not appear to have bioaccumulated in vegetation or fish to any significant extent, and potential risks to terrestrial and piscivorous receptors, and to benthic organisms appear to be low. Therefore, additional ecological studies or remediation based on ecological risks are not necessary, and therefore, are not recommended.

3.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of investigation at SWMU 5 were to identify the existing nature and extent of contamination (after interim remedial action) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment. Although metals were the most frequent soil and sediment contaminants at SWMU 5, they were detected at low concentrations. The occurrence and distribution of metals in groundwater and surface water was more limited and localized. While some of the metals (e.g., cadmium and chromium) detected at the site are commonly associated with sand blasting and depainting activities, others, like arsenic (one of the largest contributors to the human health risk at SWMU 5) are not normally associated with previous industrial

activities at SWMU 5. Several VOCs and SVOCs were detected at SWMU 5, but most occurrences were isolated in a specific sample or specific medium. The data do not suggest a pattern of consistent VOC or SVOC contamination associated with known activities at SWMU 5.

The human health risks associated with applicable current receptor scenarios at SWMU 5 are within the EPA target risk range of 1.0E-04 to 1.0E-06 for cancer-causing chemicals, exceed the FDEP target risk of 1E-06, and are below the 1.0 hazard index for noncarcinogenic risk. However, contaminants are present at concentrations indicating that adverse carcinogenic and noncarcinogenic health effects might occur for the hypothetical future residential exposure scenario.

The ecological risk assessment concluded that potential risks to terrestrial receptors at SWMU 5 appear to be low. Soil, water, and sediment contaminants do not appear to have bioaccumulated in vegetation or fish to any significant extent. In addition, terrestrial habitat at the site is of minimal areal extent and quality, resulting in minimal use of the site and vicinity by terrestrial receptors. Potential risks to terrestrial and piscivorious receptors and to benthic organisms appear to be low.

Although no ecological risks are posed by the site, potential risks posed by metal contaminants (i.e., arsenic, beryllium, and cadmium chromium) to hypothetical future residents, trespassers and occupational workers warrants the preparation of a corrective measure study. Remedial actions studied in the CMS should include no further action (NFA), and future interim remedial action to excavate contaminated soil in the vicinity of the Sand Blasting Area for off-site treatment and disposal.

4.0 SOLID WASTE MANAGEMENT UNIT 7 (SWMU 7)

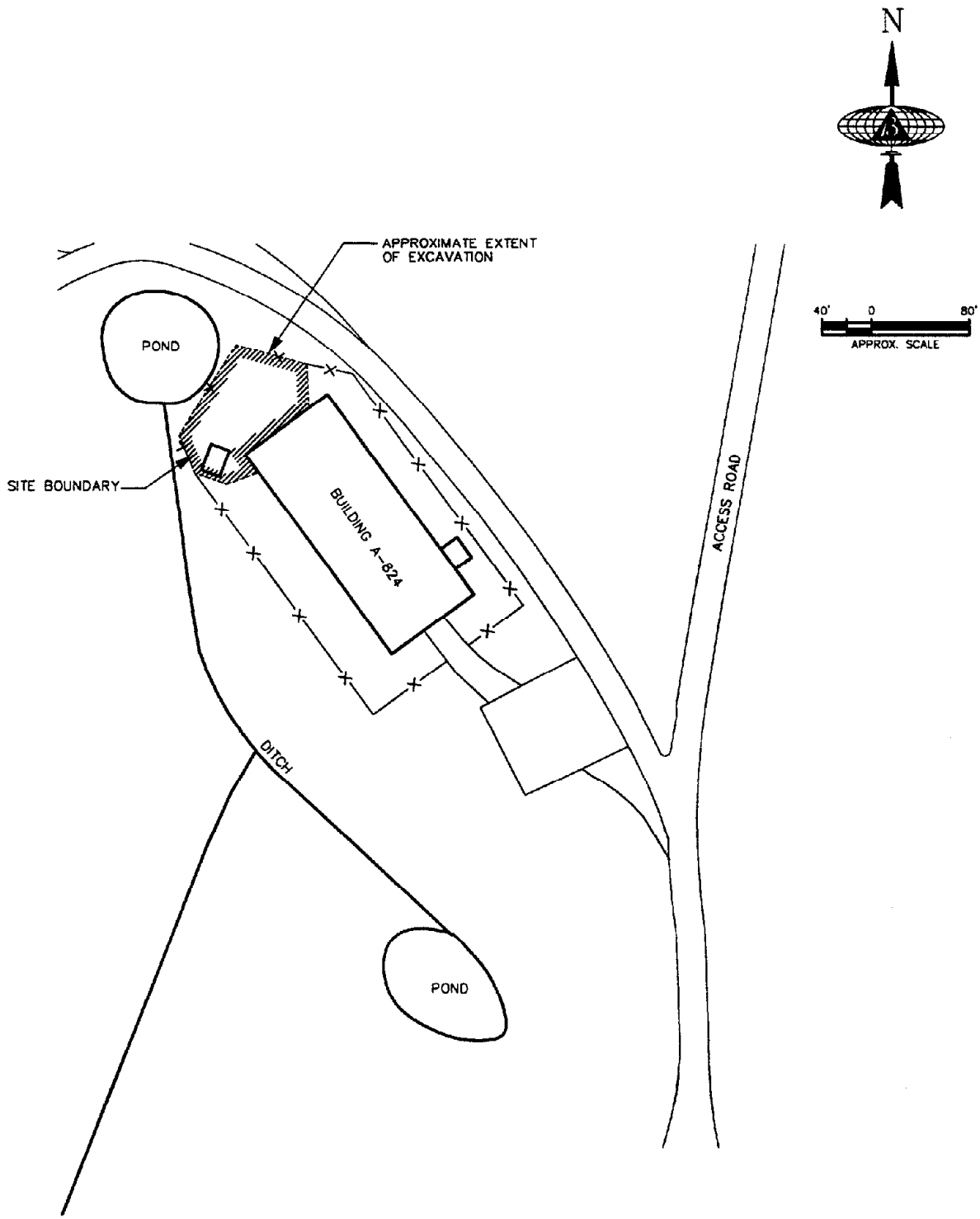
This chapter describes the site-specific evaluation of data for SWMU 7 (Boca Chica Building A-824). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 4.8 presents a summary and conclusions with recommendations for SWMU 7.

4.1 UNIT DESCRIPTION

Building A-824, located north of US 1 on Boca Chica Key (Figure 4-1), is a former temporary hazardous waste storage area. Approximately 30 feet northwest of the building is a small pond. The dimensions of this surface-water body are approximately 30 feet by 30 feet and the pond is 3 to 4 feet deep. A ditch, approximately 18 inches deep, which was cut through the oolitic limestone, extends from the pond to the southwest and ends abruptly at the edge of a road to the southwest of the site. The sediment in the ditch is 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 including Boca Chica channel, Key West Harbor, and 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, small electrical transformers, and temporary staging of 55-gallon drums of hazardous waste. Although no reported releases of contaminants were recorded, a potential roadside diesel fuel spill was identified by IT Corporation (IT Corporation, 1994). 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. Subsequently, a cleanup of possible hazardous material 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.

4.2 INVESTIGATION HISTORY

Several investigations have been performed at SWMU 7 since the mid-1980s to identify, confirm, or delineate contamination. The previous investigations are summarized in Section 4.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 4.2.2.



SITE MANAGER: RCD	CHECKED BY: KW	Brown & Root Environmental	FIGURE 4-1 **SITE LOCATION MAP SWMU 7** NAVAL AIR STATION KEY WEST, FLORIDA
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		

4.2.1 Previous Investigations

In 1991, Blasland, Bouck, and Lee (BB&L) collected samples from sandbags stacked near the building, from soils around the building and rinse samples from the floor of the building. This data was apparently evaluated by IT Corporation prior to the 1993 RFI/RI but was not available for inclusion in the Supplemental RFI/RI data set. 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 soils around the building. In addition, samples of sediments in the ditch to the 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 extent of contamination, receptor identification of potential ecological risks, an IRA to remove petroleum contaminated soils, and a baseline human health risk assessment based on post-IRA sampling data.

In August 1995, BEI conducted delineation sampling at SWMU 7 to define PCB-contaminated soil. An IRA was then conducted to remove the contaminated soil at the north end of the building and prevent further migration of PCBs into other media. The remedial goal was to remove all soils with PCB contamination above 1 ppm. 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.

4.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at SWMU 7 and the scope of those field activities performed from August to October 1996. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 4-2 through 4-5 show the location of all soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as those from previous investigations.

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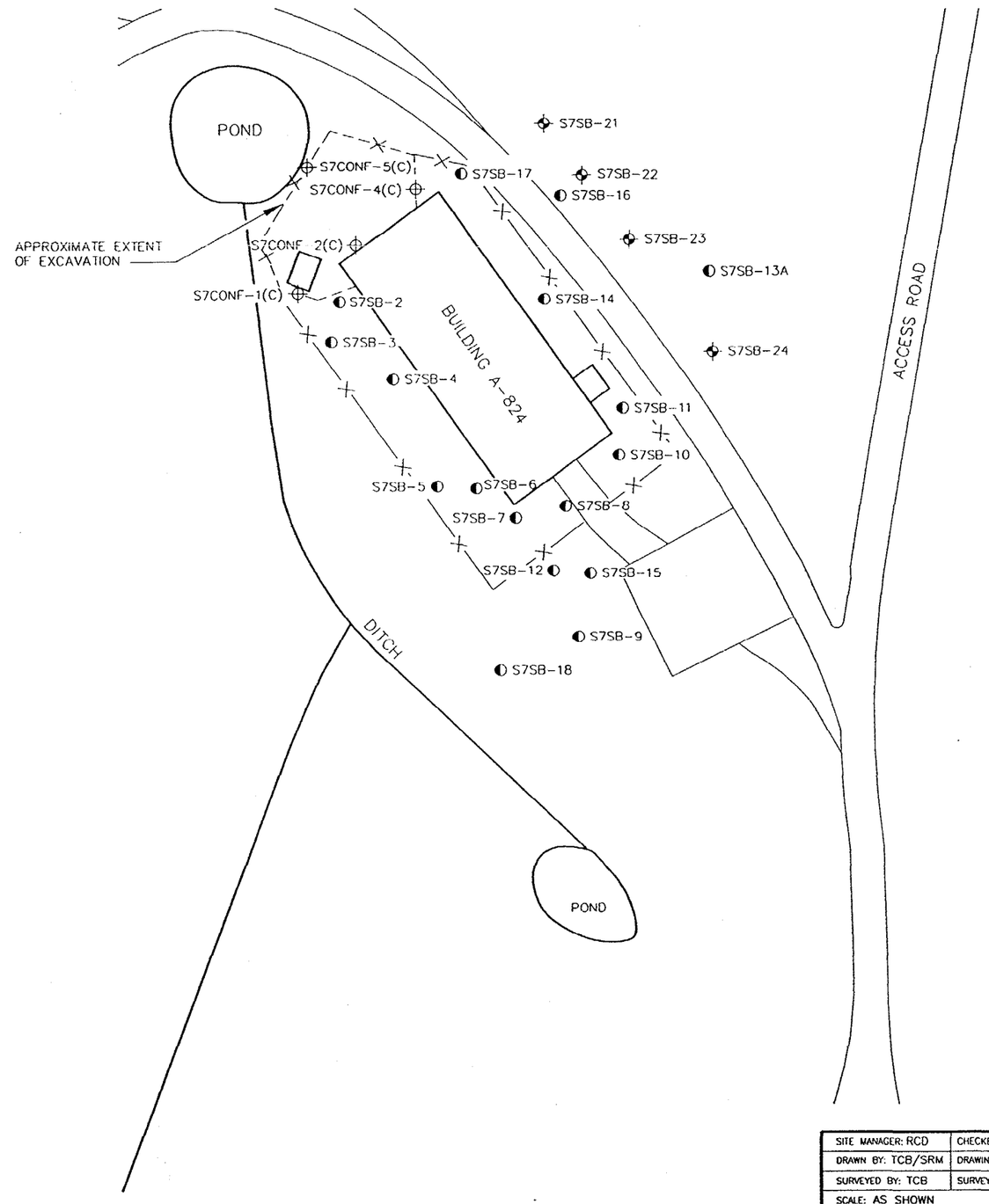

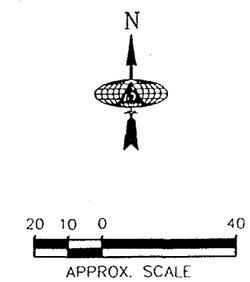

NOTE: THE BEI SAMPLES (S7CONF-1, 2, 4, AND 5) ARE EACH A COMPOSITE OF THREE SAMPLES TAKEN IN THE PROXIMITY OF THE SITES SHOWN.

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)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682442	PROJ. NO.: HK7046

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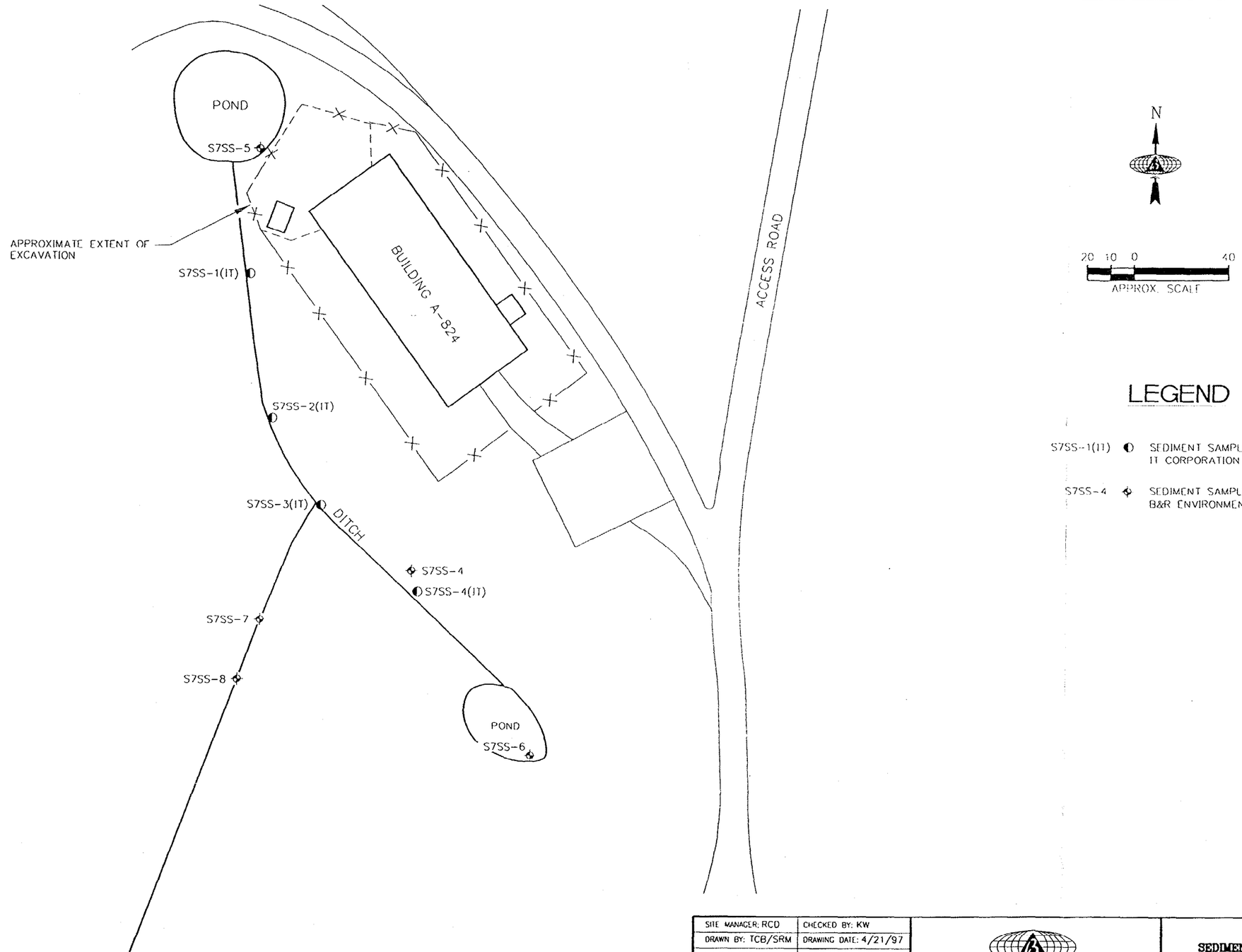
FIGURE 4-2
SOIL SAMPLE LOCATIONS SWMU 7
NAVAL AIR STATION KEY WEST, FLORIDA

0101FB132



LEGEND

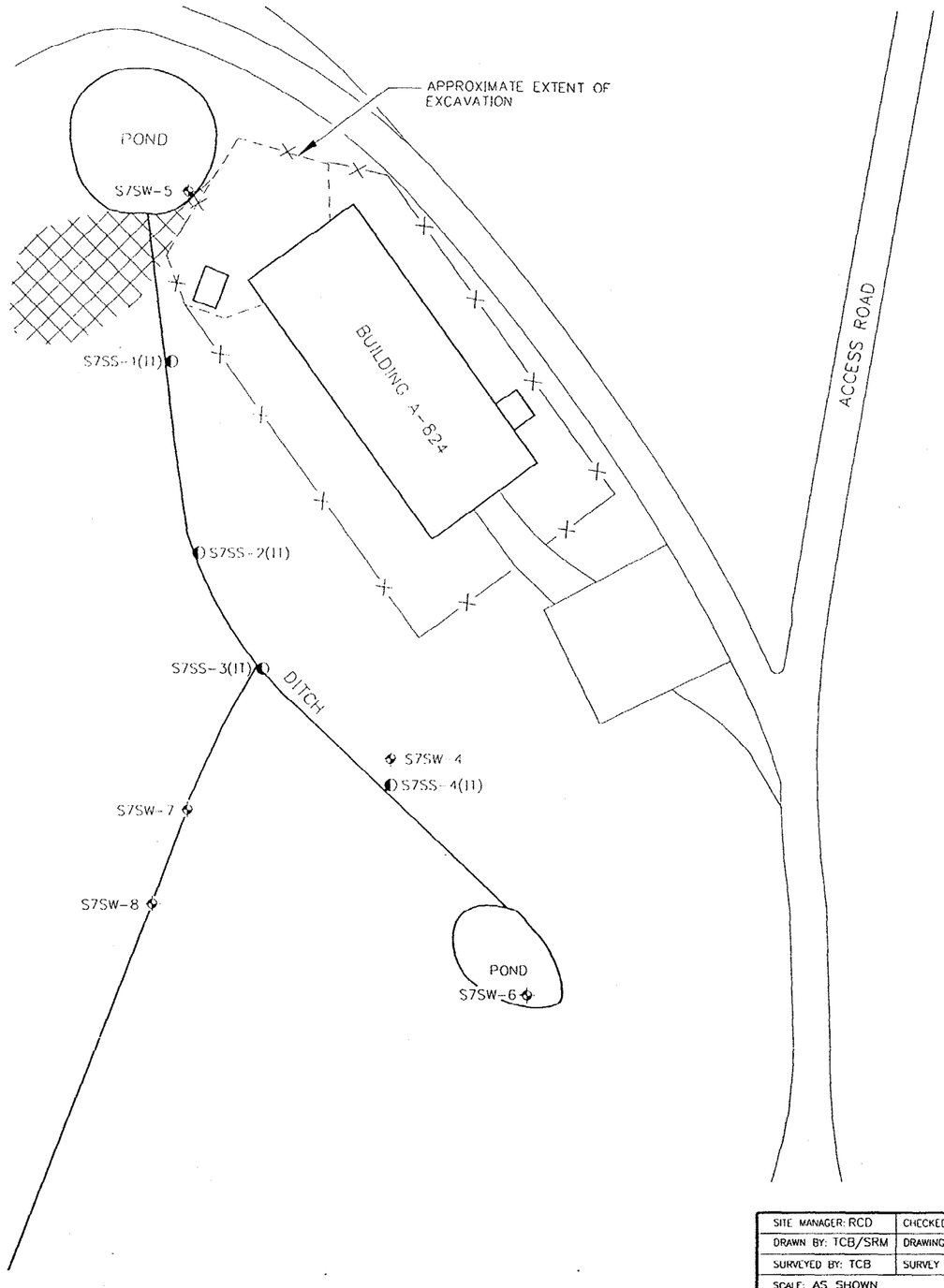
S7SS-1(IT) SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)

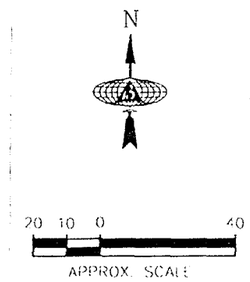
S7SS-4 SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682443	PROJ. NO.: HK7046

Brown & Root Environmental

FIGURE 4-3
SEDIMENT SAMPLE LOCATIONS SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA





LEGEND

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

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

BIOTA SAMPLING AREA

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682444	PROJ. NO.: HK7046

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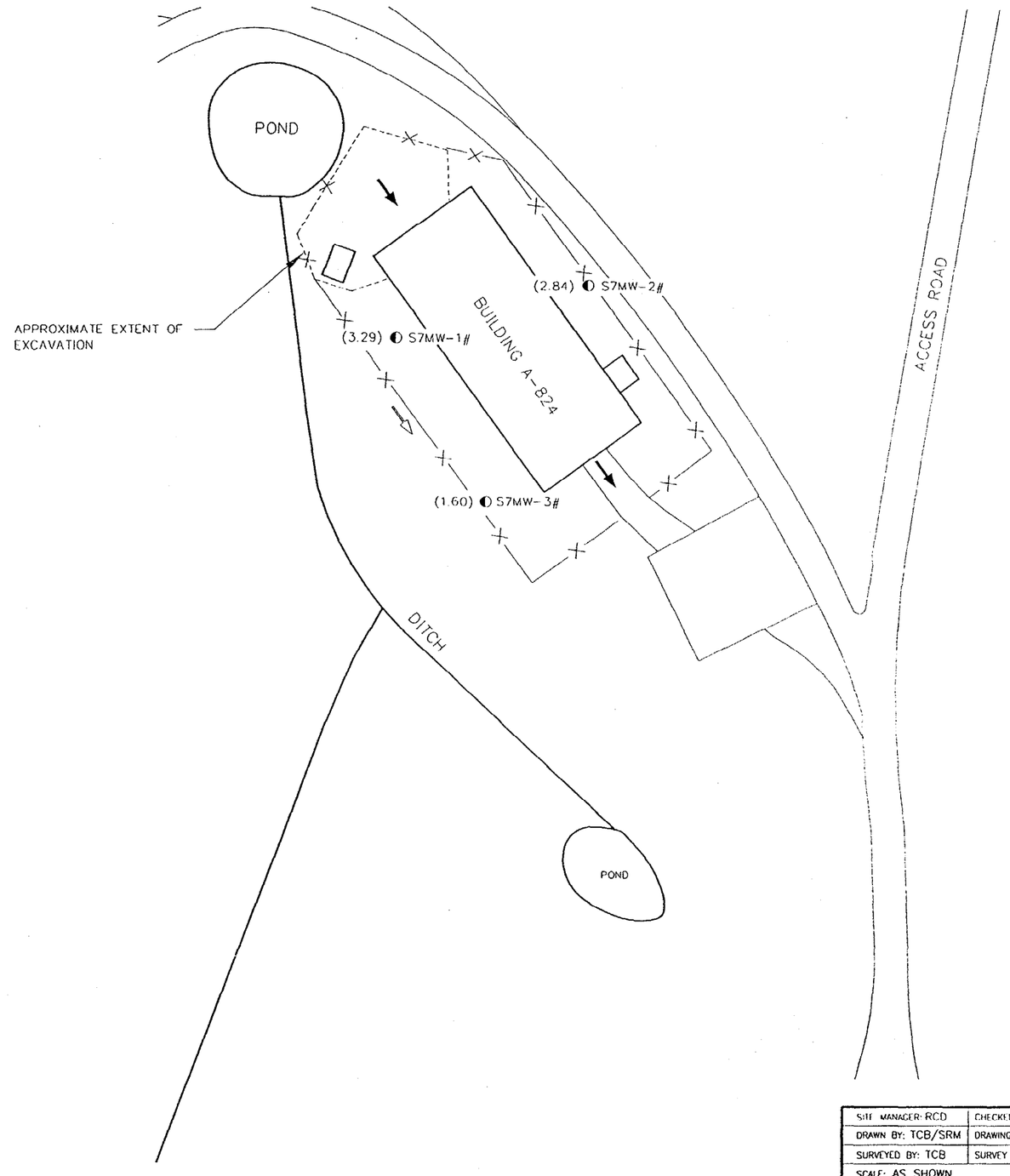
FIGURE 4-4
SURFACE-WATER AND BIOTA SAMPLE LOCATIONS SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA



N

20 10 0 40

APPROX. SCALE

NOTE: S7MW-2 WAS A GROUNDWATER BACKGROUND SAMPLING LOCATION.

LEGEND

S7MW-1 MONITORING WELL LOCATION IT CORPORATION (1993)

\# ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

GROUNDWATER FLOW DIRECTION OBSERVED BY IT CORPORATION (1993)

GROUNDWATER FLOW DIRECTION OBSERVED BY B&R ENVIRONMENTAL (1996)

(1.60) GROUNDWATER ELEVATION (1996)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682445	PROJ. NO.: HK7046

Brown & Root Environmental

FIGURE 4-5
GROUNDWATER SAMPLE LOCATIONS SWMU 7
NAVAL AIR STATION KEY WEST, FLORIDA

4.2.2.1 Investigation Rationale

Additional sampling of all media was conducted at SWMU 7 to provide more information upon which appropriate risk assessments can be based. Surface soil samples were taken to further delineate the hydrocarbon soil contamination found outside the SWMU 7 boundaries, which was assumed to be unrelated to the unit, and to determine its origin. Samples of sediment and surface water were collected to determine if contamination was present in the small pond north of Building A-824 and in the adjoining ditch. The previous RFI/RI sampling did not address these areas. Resampling of existing monitoring wells was performed to verify the presence of contaminants in groundwater detected during the RFI/RI sampling conducted in 1993.

4.2.2.2 Scope of Current Field Investigation

Supplemental field activities at SWMU 7 included surface soil sampling to delineate the extent of hydrocarbon contamination, surface-water and sediment sampling to further delineate the contaminants detected in earlier activities, and groundwater sampling to evaluate previously detected contamination.

4.2.2.2.1 Surface Soil

Previous soil sampling at SWMU 7 has sufficiently characterized surface soil between the site and the stormwater runoff pond and a portion of the adjoining ditch to the west of Building A-824. The supplemental investigation restricted soil sampling to off-site locations east of Building A-824 beyond the paved roadway.

This area required characterization to determine the extent and origin of the hydrocarbon contamination. The SWMU 7 surface soil samples were analyzed for the following parameters:

- Appendix IX VOCs
- Appendix IX SVOCs
- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

4.2.2.2.2 Surface Water and Sediment

Surface-water and sediment samples were collected in the stormwater runoff pond to the north of Building A-824 and in the ditch to the west and south of Building A-824. Analyses were performed to determine if elevated levels of SVOCs, pesticides, PCBs, and metals were present in the stormwater pond and ditch. With the exception of a single sample taken in the main ditch, all surface water and sediment samples were collected from the two ponds or the southwestern branch of the ditch; these areas were not characterized in previous investigations. All SWMU 7 sediment and surface-water samples were analyzed for the following parameters:

- Appendix IX SVOCs
- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

4.2.2.2.3 Groundwater

Groundwater sampling was conducted to assess the presence of pesticides, herbicides, metals, and cyanide in groundwater at SWMU 7 for comparison with the RFI/RI sampling conducted in 1993. All SWMU 7 groundwater samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

4.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at NAS Key West is included in Section 1.4 (Base Environmental Setting) of this document. Applicable unit surface features are discussed in Section 4.1, while hydrogeology and soils at SWMU 7 are discussed below.

4.3.1 Hydrogeology

The site consists of compacted fill material to a depth of approximately 2 to 3 feet bls followed by oolitic limestone (IT Corporation, 1994). 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 msl.

The Supplemental RFI/RI indicated that groundwater flow direction is toward the southeast at a gradient of approximately 0.018 foot/foot. In 1993, IT Corporation observed that groundwater appeared to flow toward the north and then towards the south. Water level measurements indicate that the groundwater flow underlying the site may significantly be influenced by tidal fluctuations. The direction of groundwater flow is indicated on Figure 4-5.

4.3.2 Soils

The soils beneath the site consist of fill material superimposed on oolitic limestone. Dense limestone was encountered between 1 and 3 feet BLS. The fill material runs along the perimeter of the building extending beyond the road to the east and south of the site. Organic rich sediments are present at the water table southwest of the site.

4.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from subsurface and surface soil, sediment, surface water, and groundwater in the vicinity of Building A-824. The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various state and Federal agencies and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed by media in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix H contains the entire data set used for site characterization and assessment. Appendix I contains the analytical results for samples obtained during the August and October 1996 Supplemental RFI/RI.

4.4.1 Subsurface Soil

Data from two sampling efforts including the 1993 IT Corporation RFI/RI and the 1995 BEI Delineation Study were considered in the analysis of subsurface soil contamination at SWMU 7. Chemicals that were detected in subsurface soil samples are listed in Table 4-1. This table includes analytical results from all applicable historical sampling. All subsurface samples were collected from a depth of 1 foot. Figure 4-6 shows the occurrence of analytes that exceeded screening values and indicated possible subsurface soil 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 SVOCs and VOCs were limited to S7SB-16, east of Building A-824, and S7SB-10, at the southeast corner of the building.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening levels is described in Appendix C Section 3.1.4.1 and Table C.3-1 contains all values considered, as well as those values actually selected for the nature and extent screening of subsurface soil samples.

4.4.1.1 Volatile Organic Compounds

Two VOCs were detected in excess of the screening criteria in subsurface soil from a single location, S7SB-16, to the 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.

4.4.1.2 Semivolatile Organic Compounds

Five SVOCs exceeded their screening criteria at a single sample location at SWMU 7, 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

TABLE 4-1

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

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
S7SB-10	1	IT 1993	Antimony	3.8	B_1
S7SB-16	1	IT 1993	Arsenic	3.9	
S7SB-2	1	IT 1993	Arsenic	0.91	B_1
S7SB-17	1	IT 1993	Arsenic	0.41	B_1
S7SB-15	1	IT 1993	Arsenic	0.34	B_1
S7SB-4	1	IT 1993	Arsenic	0.33	B_1
S7SB-8	1	IT 1993	Arsenic	0.31	B_1
S7SB-10	1	IT 1993	Arsenic	0.3	B_1
S7SB-16	1	IT 1993	Barium	5.8	B_1
S7SB-10	1	IT 1993	Barium	5.7	B_1
S7SB-17	1	IT 1993	Barium	5	B_1
S7SB-6	1	IT 1993	Barium	4.9	B_1
S7SB-15	1	IT 1993	Barium	4.5	B_1
S7SB-8	1	IT 1993	Barium	4.5	B_1
S7SB-2	1	IT 1993	Barium	4.4	B_1
S7SB-4	1	IT 1993	Barium	3.8	B_1
S7SB-17	1	IT 1993	Beryllium	0.15	B_1
S7SB-8	1	IT 1993	Beryllium	0.13	B_1
S7SB-4	1	IT 1993	Beryllium	0.13	B_1
S7SB-6	1	IT 1993	Beryllium	0.12	B_1
S7SB-10	1	IT 1993	Chromium	4.2	
S7SB-8	1	IT 1993	Chromium	4.2	
S7SB-16	1	IT 1993	Chromium	4	
S7SB-4	1	IT 1993	Chromium	3.5	
S7SB-17	1	IT 1993	Chromium	3.3	
S7SB-15	1	IT 1993	Chromium	3.3	
S7SB-2	1	IT 1993	Chromium	3	
S7SB-6	1	IT 1993	Chromium	2.8	
S7SB-16	1	IT 1993	Lead	1.6	
S7SB-4	1	IT 1993	Lead	0.37	B_1
S7SB-17	1	IT 1993	Lead	0.34	B_1
S7SB-2	1	IT 1993	Lead	0.29	B_1
S7SB-15	1	IT 1993	Lead	0.28	B_1
S7SB-8	1	IT 1993	Mercury	0.04	
S7SB-4	1	IT 1993	Mercury	0.03	
S7SB-10	1	IT 1993	Mercury	0.03	
S7SB-6	1	IT 1993	Mercury	0.02	
S7SB-16	1	IT 1993	Sulfide	1,600	
S7SB-10	1	IT 1993	Sulfide	74	
S7SB-15	1	IT 1993	Zinc	2.6	
S7SB-16	1	IT 1993	Zinc	2.5	
S7SB-8	1	IT 1993	Zinc	2.2	
S7SB-4	1	IT 1993	Zinc	1.8	B_1
S7SB-2	1	IT 1993	Zinc	1.7	B_1
S7SB-17	1	IT 1993	Zinc	1.7	B_1
S7SB-10	1	IT 1993	Zinc	1.6	B_1
S7SB-6	1	IT 1993	Zinc	1.5	B_1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
S7SB-16	1	IT 1993	2-methylnaphthalene	19,000	
S7SB-16	1	IT 1993	Acenaphthene	660	J
S7SB-16	1	IT 1993	Anthracene	220	J
S7SB-10	1	IT 1993	Benzoic acid	94	J
S7SB-16	1	IT 1993	Bis(2-ethylhexyl)phthalate	830	J
S7SB-16	1	IT 1993	Dibenzofuran	890	J
S7SB-16	1	IT 1993	Fluorene	790	J
S7SB-16	1	IT 1993	Naphthalene	7,900	
S7SB-16	1	IT 1993	Phenanthrene	1,200	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)					
S7SB-16	1	IT 1993	2-butanone	18	
S7SB-10	1	IT 1993	2-butanone	4	J
S7SB-10	1	IT 1993	Acetone	82	

TABLE 4-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT SWMU 7
NAS KEY WEST
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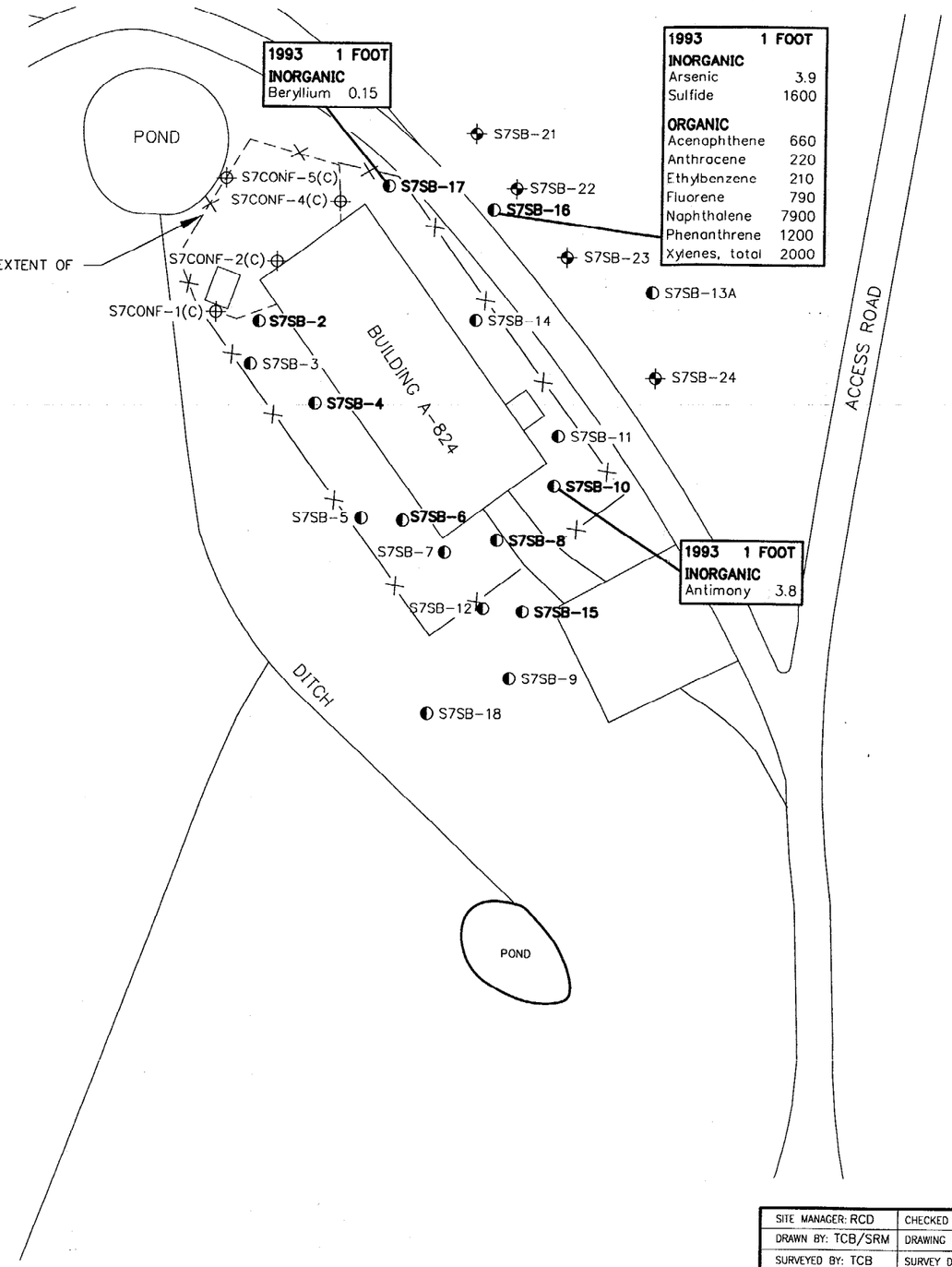
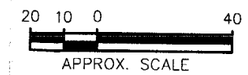
Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
S7SB-16	1	IT 1993	Acetone	77	
S7SB-16	1	IT 1993	Cis-1,2-dichloroethene	5	J
S7SB-10	1	IT 1993	Cis-1,2-dichloroethene	2	J
S7SB-16	1	IT 1993	Ethylbenzene	210	
S7SB-10	1	IT 1993	Methylene chloride	27	B_2
S7SB-16	1	IT 1993	Methylene chloride	19	B_2
S7SB-16	1	IT 1993	Toluene	46	
S7SB-16	1	IT 1993	Xylenes, total	2,000	D

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

1. Depths are in feet and represent top of sampling interval.
2. Data Sources:
   IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
3. 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.
   - B_2 - Analyte was found in the blank as well as the sample.
   - D - Compound analyzed at the secondary dilution factor.





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 APPENDIX C.

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)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682446	PROJ. NO.: HK7046

Brown & Root Environmental

FIGURE 4-6
SUBSURFACE SOIL CHEMICAL CONCENTRATIONS SWMU 7
NAVAL AIR STATION KEY WEST, FLORIDA

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 southeast corner of Building A-824), was the only SVOC detected in a boring other than S7SB-16 and was also below the FDEP Residential Goal used for screening purposes.

4.4.1.3 Pesticides

No pesticides were detected in the subsurface soil at SWMU 7.

4.4.1.4 Polychlorinated Biphenyls

No PCBs were detected in the subsurface soil at SWMU 7.

4.4.1.5 Inorganics

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 value at the southeast 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 criteria 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 at three other sample locations was slightly below the screening value. 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.

4.4.2 Surface Soil

Data from a number of sampling efforts including the 1993 IT Corporation RFI/RI, 1995 BEI Delineation Study, and this Supplemental RFI/RI were considered in the analysis of surface soil contamination at SWMU 7. Chemicals that were detected in surface soil samples are listed in Table 4-2. This table

TABLE 4-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 7
NAS KEY WEST
PAGE 1 OF 4

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
S7SB-23	B&RE 1996	Aluminum	5,195	
S7SB-22	B&RE 1996	Aluminum	2,650	
S7SB-21	B&RE 1996	Aluminum	2,570	
S7SB-24	B&RE 1996	Aluminum	1,780	
S7SB-9	IT 1993	Antimony	4.9	B_1
S7SB-7	IT 1993	Antimony	4.7	B_1
S7SB-13A	IT 1993	Antimony	4.2	B_1
S7SB-11	IT 1993	Antimony	3.7	B_1
S7SB-23	B&RE 1996	Antimony	1.1	J
S7SB-21	B&RE 1996	Arsenic	5.3	
S7SB-14	IT 1993	Arsenic	4.9	
S7SB-18	IT 1993	Arsenic	4.5	
S7SB-13A	IT 1993	Arsenic	3.5	
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-23	B&RE 1996	Barium	18.8	
S7SB-24	B&RE 1996	Barium	17.1	
S7SB-22	B&RE 1996	Barium	14.6	
S7SB-11	IT 1993	Barium	9.3	B_1
S7SB-21	B&RE 1996	Barium	7.8	
S7SB-13A	IT 1993	Barium	7.8	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

Location	Source[1]	Parameter	Result	Qual.[2]
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-13A	IT 1993	Beryllium	0.15	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-23	B&RE 1996	Cadmium	0.75	
S7SB-24	B&RE 1996	Cadmium	0.42	
S7SB-7	IT 1993	Chromium	31.5	
S7SB-11	IT 1993	Chromium	22.1	
S7SB-23	B&RE 1996	Chromium	12.1	
S7SB-22	B&RE 1996	Chromium	6.4	
S7SB-24	B&RE 1996	Chromium	5.7	
S7SB-21	B&RE 1996	Chromium	5.6	
S7SB-5	IT 1993	Chromium	5.2	
S7SB-13A	IT 1993	Chromium	4.4	
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-21	B&RE 1996	Cobalt	0.38	
S7SB-23	B&RE 1996	Cobalt	0.37	
S7SB-24	B&RE 1996	Cobalt	0.29	
S7SB-22	B&RE 1996	Copper	67.2	
S7SB-24	B&RE 1996	Copper	57.1	
S7SB-23	B&RE 1996	Copper	36.1	
S7SB-21	B&RE 1996	Copper	20.4	
S7SB-13A	IT 1993	Copper	11.1	
S7SB-7	IT 1993	Copper	5.7	

TABLE 4-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 7
NAS KEY WEST
PAGE 2 OF 4

Location	Source[1]	Parameter	Result	Qual.[2]
S7SB-11	IT 1993	Copper	4.4	
S7SB-23	B&RE 1996	Iron	3,785	
S7SB-21	B&RE 1996	Iron	3,090	
S7SB-22	B&RE 1996	Iron	1,730	
S7SB-24	B&RE 1996	Iron	1,430	
S7SB-23	B&RE 1996	Lead	252.5	
S7SB-21	B&RE 1996	Lead	172	
S7SB-24	B&RE 1996	Lead	78.3	
S7SB-22	B&RE 1996	Lead	71.3	
S7SB-7	IT 1993	Lead	36.5	
S7SB-13A	IT 1993	Lead	16.7	
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-23	B&RE 1996	Manganese	32.2	
S7SB-22	B&RE 1996	Manganese	26.1	
S7SB-24	B&RE 1996	Manganese	21.3	
S7SB-21	B&RE 1996	Manganese	15.2	
S7SB-23	B&RE 1996	Mercury	0.08	
S7SB-5	IT 1993	Mercury	0.06	
S7SB-24	B&RE 1996	Mercury	0.05	
S7SB-22	B&RE 1996	Mercury	0.05	
S7SB-21	B&RE 1996	Mercury	0.04	
S7SB-13A	IT 1993	Mercury	0.03	
S7SB-7	IT 1993	Mercury	0.03	
S7SB-14	IT 1993	Mercury	0.03	
S7SB-11	IT 1993	Mercury	0.03	
S7SB-23	B&RE 1996	Nickel	3.7	
S7SB-11	IT 1993	Nickel	2.9	B_1
S7SB-22	B&RE 1996	Nickel	2.4	
S7SB-21	B&RE 1996	Nickel	2.1	
S7SB-24	B&RE 1996	Nickel	1.8	
S7SB-23	B&RE 1996	Selenium	1.5	J
S7SB-22	B&RE 1996	Selenium	1	J
S7SB-21	B&RE 1996	Selenium	0.79	J
S7SB-23	B&RE 1996	Silver	0.34	
S7SB-13A	IT 1993	Sulfide	1,300	
S7SB-23	B&RE 1996	Vanadium	8.5	
S7SB-21	B&RE 1996	Vanadium	5.1	
S7SB-22	B&RE 1996	Vanadium	3.7	
S7SB-11	IT 1993	Vanadium	3.5	B_1
S7SB-24	B&RE 1996	Vanadium	2.7	
S7SB-5	IT 1993	Vanadium	2	B_1
S7SB-13A	IT 1993	Vanadium	1.4	B_1
S7SB-7	IT 1993	Vanadium	1.3	B_1
S7SB-7	IT 1993	Zinc	208	
S7SB-11	IT 1993	Zinc	119	
S7SB-23	B&RE 1996	Zinc	76.4	
S7SB-22	B&RE 1996	Zinc	32.5	
S7SB-24	B&RE 1996	Zinc	29.5	
S7SB-13A	IT 1993	Zinc	9.2	
S7SB-14	IT 1993	Zinc	6.7	
S7SB-21	B&RE 1996	Zinc	6.6	
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)				
S7SB-23	B&RE 1996	2,4,5-T	7	

TABLE 4-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 7
NAS KEY WEST
PAGE 3 OF 4

Location	Source[1]	Parameter	Result	Qual.[2]
S7SB-23	B&RE 1996	2,4,5-TP (silvex)	4	
S7SB-23	B&RE 1996	2,4-D	7.4	
S7SB-23	B&RE 1996	4,4'-DDD	32.2	
S7SB-22	B&RE 1996	4,4'-DDD	15.4	
S7SB-24	B&RE 1996	4,4'-DDD	11.5	
S7SB-21	B&RE 1996	4,4'-DDD	2.7	
S7SB-23	B&RE 1996	4,4'-DDE	31.7	J
S7SB-24	B&RE 1996	4,4'-DDE	23.3	
S7SB-22	B&RE 1996	4,4'-DDE	20.1	
S7SB-21	B&RE 1996	4,4'-DDE	4	
S7SB-23	B&RE 1996	4,4'-DDT	25.7	J
S7SB-22	B&RE 1996	4,4'-DDT	21.6	
S7SB-24	B&RE 1996	4,4'-DDT	9.3	J
S7SB-21	B&RE 1996	4,4'-DDT	2.1	J
S7SB-23	B&RE 1996	alpha-BHC	21.6	
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	
S7SB-23	B&RE 1996	Endosulfan I	14.9	J
S7SB-22	B&RE 1996	Endosulfan I	5.9	
S7SB-21	B&RE 1996	Endosulfan I	2.3	J
S7SB-21	B&RE 1996	Endosulfan II	1.2	J
S7SB-23	B&RE 1996	Endrin	23.8	J
S7SB-22	B&RE 1996	Endrin	7.1	J
S7SB-21	B&RE 1996	Endrin aldehyde	2.5	J
S7SB-21	B&RE 1996	Heptachlor	2.8	
S7SB-21	B&RE 1996	Heptachlor epoxide	0.89	

SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)

S7SB-23	B&RE 1996	1,2-dichlorobenzene	2,415	
S7SB-21	B&RE 1996	1,2-dichlorobenzene	1.6	J
S7SB-23	B&RE 1996	1,3-dichlorobenzene	481.5	
S7SB-23	B&RE 1996	1,4-dichlorobenzene	352.3	
S7SB-24	B&RE 1996	Benzo(a)anthracene	1,640	J
S7SB-22	B&RE 1996	Benzo(a)anthracene	406	J
S7SB-13A	IT 1993	Benzo(a)anthracene	270	J
S7SB-24	B&RE 1996	Benzo(a)pyrene	2,040	
S7SB-13A	IT 1993	Benzo(a)pyrene	360	J
S7SB-24	B&RE 1996	Benzo(b)fluoranthene	3,340	
S7SB-22	B&RE 1996	Benzo(b)fluoranthene	972	J
S7SB-13A	IT 1993	Benzo(b)fluoranthene	380	J
S7SB-24	B&RE 1996	Benzo(g,h,i)perylene	1,460	J
S7SB-13A	IT 1993	Benzo(g,h,i)perylene	260	J
S7SB-13A	IT 1993	Benzo(k)fluoranthene	310	J
S7SB-13A	IT 1993	Bis(2-ethylhexyl)phthalate	680	J
S7SB-5	IT 1993	Bis(2-ethylhexyl)phthalate	120	B_2J
S7SB-24	B&RE 1996	Chrysene	1,950	
S7SB-22	B&RE 1996	Chrysene	570	J
S7SB-13A	IT 1993	Chrysene	380	J
S7SB-24	B&RE 1996	Fluoranthene	3,020	
S7SB-22	B&RE 1996	Fluoranthene	704	J
S7SB-13A	IT 1993	Fluoranthene	380	J
S7SB-24	B&RE 1996	Indeno(1,2,3-cd)pyrene	1,480	J
S7SB-13A	IT 1993	Indeno(1,2,3-cd)pyrene	240	J
S7SB-24	B&RE 1996	Phenanthrene	106	J
S7SB-24	B&RE 1996	Pyrene	2,410	
S7SB-22	B&RE 1996	Pyrene	665	J
S7SB-13A	IT 1993	Pyrene	350	J

VOLATILE ORGANIC COMPOUNDS (µg/kg)

S7SB-5	IT 1993	Acetone	83	
S7SB-13A	IT 1993	Acetone	42	
S7SB-23	B&RE 1996	Chlorobenzene	117	

TABLE 4-2

CHEMICALS DETECTED IN SURFACE SOIL AT SWMU 7
NAS KEY WEST
PAGE 4 OF 4

Location	Source[1]	Parameter	Result	Qual.[2]
S7SB-5	IT 1993	Cis-1,2-dichloroethene	2	J
S7SB-13A	IT 1993	Cis-1,2-dichloroethene	1	J
S7SB-23	B&RE 1996	Ethylbenzene	91.3	
S7SB-5	IT 1993	Methylene chloride	28	B_2
S7SB-13A	IT 1993	Methylene chloride	18	B_2
S7SB-5	IT 1993	Toluene	1	J
S7SB-23	B&RE 1996	Xylenes, total	958	

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

1. Data Sources:
   IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
   B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental
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.

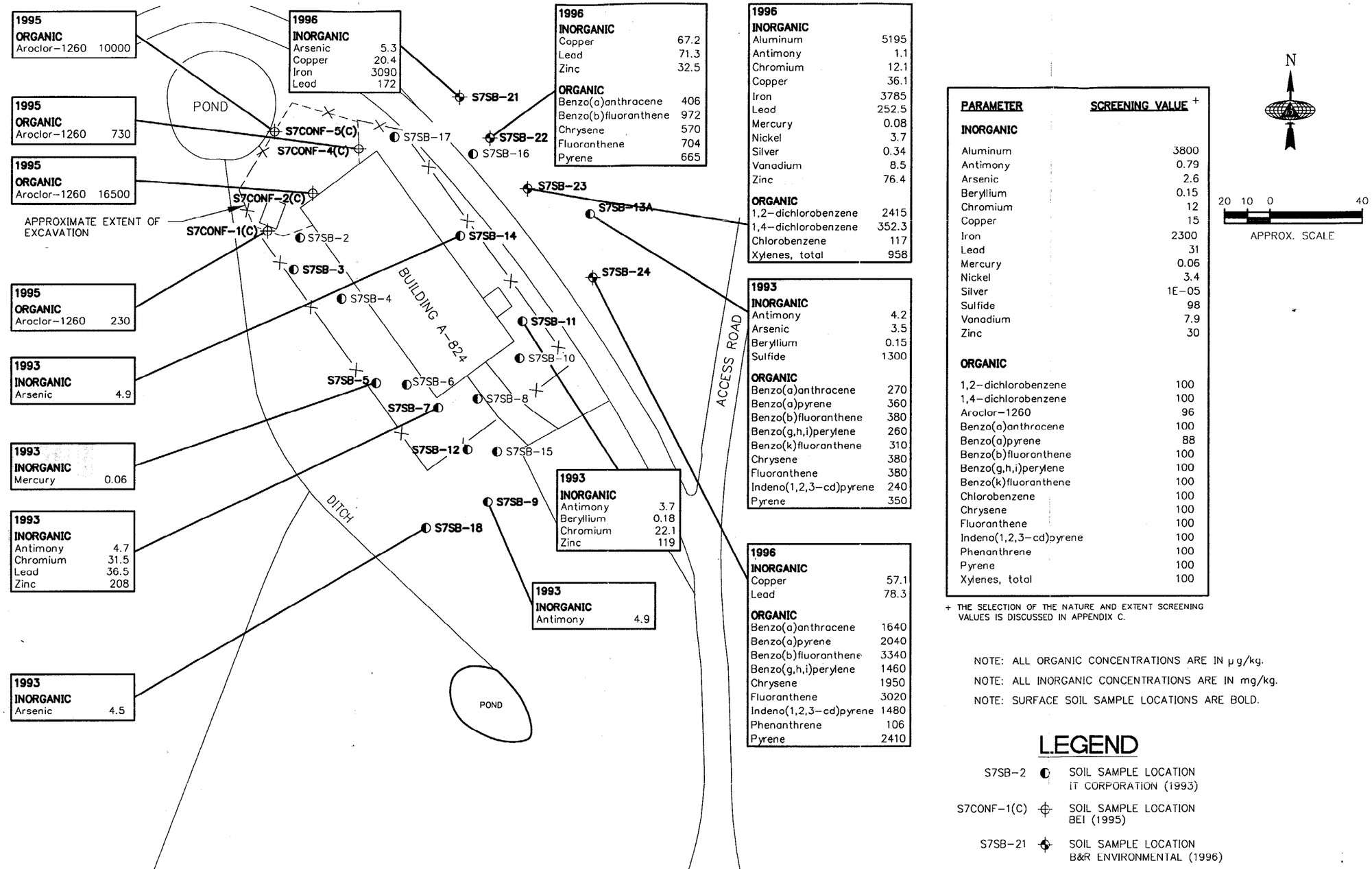
includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. The BEI samples were tested only for PCBs, which was used as an indicator chemical for the IRA. Figure 4-7 shows the occurrence of analytes that exceeded screening values and indicated possible surface soil contamination. Inorganics accounted for most of the chemicals detected in the surface soil at SWMU 7. In general, inorganic contamination occurred throughout the site, while semivolatiles were usually limited to samples collected east of Building A-824.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening levels is described in Appendix C Section 3.1.4.1 and Table C.3-1 contains all values considered, as well as values actually selected for the nature and extent screening of surface soil samples.

4.4.2.1 Volatile Organic Compounds

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. Other 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).

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Acetone was selected as an ecological COPC (see Section 4.7.4.1.2) based on a comparison with twice the average background concentration, because no suitable ecological threshold was available. The selected nature and extent screening value for acetone was not an ecological screening level and was greater than twice the average background concentration.



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 APPENDIX C.

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)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682447	PROJ. NO.: HK7046

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FIGURE 4-7
SURFACE SOIL CHEMICAL CONCENTRATIONS SWMU 7
NAVAL AIR STATION KEY WEST, FLORIDA

4.4.2.2 Semivolatile Organic Compounds

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 which exhibited VOC contamination. With the exception of one detection at the southwest 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 (2,41 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.

As discussed in Sections 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentration fell below the selected nature and extent screening levels. Bis(2-ethylhexyl)phthalate and acetone were selected as an ecological COPC (see Section 4.7.4.1.2) based on a comparison with twice the average background concentration, because no suitable ecological threshold was available. The selected nature and extent screening value for bis(2-ethylhexyl)phthalate was not an ecological screening level and was greater than twice the average background concentration.

4.4.2.3 Pesticides

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 by B&R Environmental at levels below the screening values. As prescribed in the Sampling and Analysis Plan (ABB, 1995), B&R Environmental's soil samples were limited to the region east of Building A-824, in order to better characterize that area. Although IT Corporation and BEI had previously analyzed soil throughout the rest of the site, only a few of the IT Corporation samples were tested for pesticides.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. 2,4,5-TP, 2,4,5-T, and 2,4-D were selected as ecological COPCs (see Section

4.7.4.1.2) based on a comparison with twice the average background concentration because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels, and were greater than twice the average background.

4.4.2.4 Polychlorinated Biphenyls

Aroclor-1260 was detected in excess of its 96.3 µg/kg screening value at four BEI confirmation sample locations at the north 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.

4.4.2.5 Inorganics

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 (5,195 mg/kg), iron (3,785 mg/kg), lead (252.5 mg/kg), mercury (0.08 mg/kg), nickel (3.7 mg/kg), silver (0.34 mg/kg), and vanadium (8.5 mg/kg) were detected at S7SB-23 to the east of Building A-824. Maximum concentrations of arsenic (5.3 mg/kg), copper (67.2 mg/kg), and sulfide (1,300 mg/kg) were detected in the same area. Maximum concentrations located at the south side of the building included antimony (4.9 mg/kg) at S7SB-9 and chromium (31.5 mg/kg) and zinc (208 mg/kg) at S7SB-7. The maximum concentration of beryllium was detected at S7SB-11 (0.18 mg/kg) at the southeast 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.

4.4.3 Sediment

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI, were considered in the analysis of sediment contamination at SWMU 7. Chemicals that were detected in sediment samples are listed in Table 4-3. This table lists analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Sediment samples were taken from the pond and mosquito ditch west of Building A-824. Figure 4-8 shows the occurrence of analytes that exceeded screening values and indicated possible sediment contamination.

TABLE 4-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 7
NAS KEY WEST
PAGE 1 OF 3

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
S7SS-6	B&RE 1996	Aluminum	4,330	
S7SS-5	B&RE 1996	Aluminum	2,605	
S7SS-4	B&RE 1996	Aluminum	2,070	
S7SS-7	B&RE 1996	Aluminum	1,780	
S7SS-8	B&RE 1996	Aluminum	1,630	
S7SS-4(IT)	IT 1993	Antimony	7	B_1
S7SS-5	B&RE 1996	Arsenic	5.8	
S7SS-1(IT)	IT 1993	Arsenic	4.2	
S7SS-7	B&RE 1996	Arsenic	3.9	
S7SS-4(IT)	IT 1993	Arsenic	3.7	
S7SS-2(IT)	IT 1993	Arsenic	3.6	
S7SS-3(IT)	IT 1993	Arsenic	3.6	B_1
S7SS-8	B&RE 1996	Barium	14.9	
S7SS-5	B&RE 1996	Barium	13.6	
S7SS-6	B&RE 1996	Barium	13.3	
S7SS-7	B&RE 1996	Barium	11.6	
S7SS-4(IT)	IT 1993	Barium	11	B_1
S7SS-4	B&RE 1996	Barium	9.3	
S7SS-3(IT)	IT 1993	Barium	8	B_1
S7SS-2(IT)	IT 1993	Barium	6.1	B_1
S7SS-1(IT)	IT 1993	Barium	5.6	B_1
S7SS-3(IT)	IT 1993	Beryllium	0.46	B_1
S7SS-2(IT)	IT 1993	Beryllium	0.43	B_1
S7SS-4(IT)	IT 1993	Beryllium	0.39	B_1
S7SS-1(IT)	IT 1993	Beryllium	0.28	B_1
S7SS-4(IT)	IT 1993	Cadmium	2.8	
S7SS-4	B&RE 1996	Cadmium	2.6	
S7SS-6	B&RE 1996	Cadmium	2.1	
S7SS-1(IT)	IT 1993	Cadmium	1.2	
S7SS-5	B&RE 1996	Cadmium	0.93	

Location	Source[1]	Parameter	Result	Qual.[2]
S7SS-8	B&RE 1996	Cadmium	0.77	
S7SS-4	B&RE 1996	Chromium	32.3	
S7SS-3(IT)	IT 1993	Chromium	26.2	
S7SS-4(IT)	IT 1993	Chromium	24.1	
S7SS-6	B&RE 1996	Chromium	24	
S7SS-8	B&RE 1996	Chromium	17.3	
S7SS-7	B&RE 1996	Chromium	14	
S7SS-1(IT)	IT 1993	Chromium	12.6	
S7SS-2(IT)	IT 1993	Chromium	12.4	
S7SS-5	B&RE 1996	Chromium	6.9	
S7SS-6	B&RE 1996	Copper	127	
S7SS-4	B&RE 1996	Copper	79.4	
S7SS-7	B&RE 1996	Copper	64.2	
S7SS-4(IT)	IT 1993	Copper	59.8	
S7SS-3(IT)	IT 1993	Copper	52.1	
S7SS-8	B&RE 1996	Copper	50	
S7SS-2(IT)	IT 1993	Copper	14.2	
S7SS-5	B&RE 1996	Copper	14.2	
S7SS-1(IT)	IT 1993	Copper	11.6	
S7SS-1(IT)	IT 1993	Cyanide	13	
S7SS-7	B&RE 1996	Iron	4,270	
S7SS-8	B&RE 1996	Iron	3,800	
S7SS-4	B&RE 1996	Iron	3,740	
S7SS-6	B&RE 1996	Iron	3,510	
S7SS-5	B&RE 1996	Iron	2,130	
S7SS-6	B&RE 1996	Lead	209	
S7SS-4	B&RE 1996	Lead	120	
S7SS-8	B&RE 1996	Lead	119	
S7SS-3(IT)	IT 1993	Lead	117	
S7SS-7	B&RE 1996	Lead	109	
S7SS-4(IT)	IT 1993	Lead	86.5	

TABLE 4-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 7
NAS KEY WEST
PAGE 2 OF 3

Location	Source[1]	Parameter	Result	Qual.[2]
S7SS-1(IT)	IT 1993	Lead	65.9	
S7SS-2(IT)	IT 1993	Lead	53.5	
S7SS-5	B&RE 1996	Lead	29.5	
S7SS-7	B&RE 1996	Manganese	30.5	
S7SS-8	B&RE 1996	Manganese	29.5	
S7SS-6	B&RE 1996	Manganese	28.8	
S7SS-4	B&RE 1996	Manganese	25.2	
S7SS-5	B&RE 1996	Manganese	14.6	
S7SS-4(IT)	IT 1993	Mercury	1.8	
S7SS-3(IT)	IT 1993	Mercury	0.44	
S7SS-6	B&RE 1996	Mercury	0.41	
S7SS-4	B&RE 1996	Mercury	0.25	
S7SS-2(IT)	IT 1993	Mercury	0.15	
S7SS-1(IT)	IT 1993	Mercury	0.13	
S7SS-6	B&RE 1996	Nickel	11	
S7SS-4(IT)	IT 1993	Nickel	10	
S7SS-4	B&RE 1996	Nickel	9.1	
S7SS-7	B&RE 1996	Nickel	6.7	
S7SS-8	B&RE 1996	Nickel	6.3	
S7SS-5	B&RE 1996	Nickel	3.6	
S7SS-4(IT)	IT 1993	Silver	29.1	
S7SS-6	B&RE 1996	Silver	10.6	
S7SS-4	B&RE 1996	Silver	6.2	
S7SS-3(IT)	IT 1993	Silver	4.7	B_1
S7SS-5	B&RE 1996	Silver	0.7	
S7SS-1(IT)	IT 1993	Sulfide	300	
S7SS-4(IT)	IT 1993	Sulfide	100	
S7SS-1(IT)	IT 1993	Tin	200	
S7SS-4(IT)	IT 1993	Tin	31.8	B_1
S7SS-3(IT)	IT 1993	Tin	23.5	B_1
S7SS-8	B&RE 1996	Vanadium	16.6	
S7SS-6	B&RE 1996	Vanadium	16.1	
S7SS-4	B&RE 1996	Vanadium	14.7	
S7SS-7	B&RE 1996	Vanadium	11	
S7SS-3(IT)	IT 1993	Vanadium	9.3	B_1
S7SS-5	B&RE 1996	Vanadium	7.8	
S7SS-4(IT)	IT 1993	Vanadium	5.9	B_1
S7SS-1(IT)	IT 1993	Vanadium	2.4	B_1
S7SS-4	B&RE 1996	Zinc	487	
S7SS-6	B&RE 1996	Zinc	436	
S7SS-1(IT)	IT 1993	Zinc	382	
S7SS-3(IT)	IT 1993	Zinc	350	
S7SS-8	B&RE 1996	Zinc	295	
S7SS-4(IT)	IT 1993	Zinc	274	
S7SS-7	B&RE 1996	Zinc	254	
S7SS-2(IT)	IT 1993	Zinc	141	
S7SS-5	B&RE 1996	Zinc	83.7	
PESTICIDES/PCBs (µg/kg)				
S7SS-4(IT)	IT 1993	4,4'-DDD	58	
S7SS-6	B&RE 1996	4,4'-DDD	35.1	J
S7SS-5	B&RE 1996	4,4'-DDD	10.1	J
S7SS-4(IT)	IT 1993	4,4'-DDE	450	F
S7SS-6	B&RE 1996	4,4'-DDE	142	J
S7SS-1(IT)	IT 1993	4,4'-DDE	140	DJ
S7SS-8	B&RE 1996	4,4'-DDE	26.9	J
S7SS-7	B&RE 1996	4,4'-DDE	14.8	J
S7SS-5	B&RE 1996	4,4'-DDE	12.9	J
S7SS-6	B&RE 1996	4,4'-DDT	674	J
S7SS-5	B&RE 1996	4,4'-DDT	5.7	J
S7SS-4	B&RE 1996	alpha-BHC	5.6	
S7SS-5	B&RE 1996	alpha-BHC	2.5	J
S7SS-3(IT)	IT 1993	Aroclor-1260	510	A

TABLE 4-3

CHEMICALS DETECTED IN SEDIMENT* AT SWMU 7
NAS KEY WEST
PAGE 3 OF 3

Location	Source[1]	Parameter	Result	Qual.[2]
S7SS-2(IT)	IT 1993	Aroclor-1260	220	A
S7SS-5	B&RE 1996	Aroclor-1260	56.4	J
S7SS-8	B&RE 1996	delta-BHC	13	J
S7SS-4	B&RE 1996	delta-BHC	11.5	
S7SS-5	B&RE 1996	delta-BHC	5	J
S7SS-5	B&RE 1996	Dieldrin	6	J
S7SS-8	B&RE 1996	Endrin	8.1	J
S7SS-7	B&RE 1996	Endrin	6.6	J
S7SS-8	B&RE 1996	gamma-BHC (lindane)	11.6	J
S7SS-4(IT)	IT 1993	gamma-chlordane	51	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
S7SS-6	B&RE 1996	Benzo(a)anthracene	1,910	J
S7SS-6	B&RE 1996	Benzo(b)fluoranthene	3,500	J
S7SS-6	B&RE 1996	Benzo(g,h,i)perylene	992	J
S7SS-4(IT)	IT 1993	Bis(2-ethylhexyl)phthalate	620	J
S7SS-1(IT)	IT 1993	Bis(2-ethylhexyl)phthalate	580	J
S7SS-6	B&RE 1996	Chrysene	2,120	J
S7SS-6	B&RE 1996	Fluoranthene	4,000	J
S7SS-2(IT)	IT 1993	Phenanthrene	900	
S7SS-6	B&RE 1996	Pyrene	4,000	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
S7SS-4(IT)	IT 1993	2-butanone	8	J
S7SS-4(IT)	IT 1993	Acetone	190	
S7SS-1(IT)	IT 1993	Acetone	60	
S7SS-4(IT)	IT 1993	Cis-1,2-dichloroethene	3	J
S7SS-4(IT)	IT 1993	Methylene chloride	49	B_2J
S7SS-1(IT)	IT 1993	Methylene chloride	34	B_2

*All sediment samples at SWMU 7 were surface samples.
Shading indicates a concentration in excess of the screening values (See Table C.3-2).

1. Data Sources:
   IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
   B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental
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.
   F - Peak offscale and therefore out of linear range.
   D - Compound analyzed at a secondary dilution factor.
   A - Sample exhibits alteration of standard Aroclor pattern.
   B_2 - Analyte was found in the blank as well as the sample.

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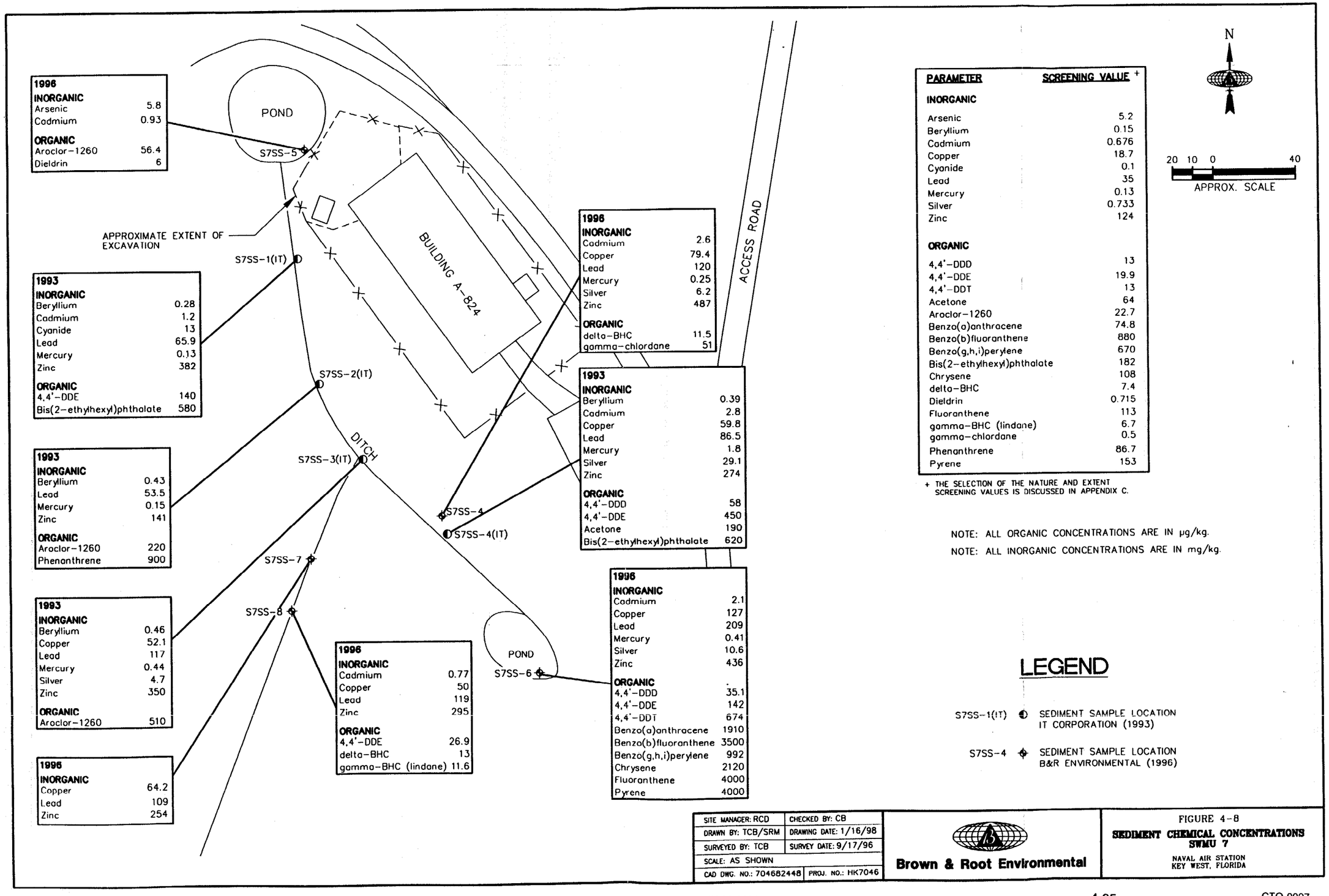

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: TCB/SRM	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682448	PROJ. NO.: HK7046

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FIGURE 4-8
SEDIMENT CHEMICAL CONCENTRATIONS
SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F162

Screening values were obtained from a variety of sources including FDEP SQAGs, EPA Region IV Screening Values, EPA SQCs for Marine and Freshwater Sediments, ER-L Criteria, ER-M Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1 and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples.

4.4.3.1 Volatile Organic Compounds

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 criteria 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 Sampling and Analysis Plan (ABB, 1995).

4.4.3.2 Semivolatile Organic Compounds

Of the SVOCs detected in sediment at SWMU 7 all, except bis(2-ethylhexyl)phthalate, were isolated detections. 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 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). S7SS-2 was the only other sample location where an SVOC was detected. There, phenanthrene was detected in excess of its 86.7 μg/kg screening value at a concentration of 900 μg/kg.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Endrin was selected as a COPC based on the fact that its hazard quotient was greater than one (Section 4.7.4.1.2); however, endrin concentrations in sediment at SWMU 7 were less than the average background concentration which was selected for nature and extent screening.

4.4.3.3 Pesticides

Several pesticides were detected in excess of sediment screening values at SWMU 7. Several locations along the mosquito ditch and in the pond contained pesticide concentrations in excess of screening values. Maximum concentrations of 4,4'-DDD (58 μg/kg) and 4,4'-DDE (450 μg/kg) 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 (674 μg/kg) was detected in the same area at S7SS-6. The maximum concentration of dieldrin (6 μg/kg) was detected at S7SS-5 in the pond at the northern end of the mosquito ditch. Maximum concentrations of delta-BHC (13 μg/kg), and gamma-BHC (lindane) (11.6 μg/kg) were detected at S7SS-8, in the southwestern branch of the mosquito ditch. Gamma-chlordane (51 μg/kg) was selected once in sediment at S7SS-4. Other pesticides that were detected below screening criteria included alpha-BHC, and endrin.

4.4.3.4 Polychlorinated Biphenyls

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 22.7μg/kg screening criteria at S7SS-2 (220 μg/kg) and S7SS-3 (510 μg/kg). Aroclor-1260 was also detected in excess of its screening value in 1996 B&R Environmental sampling at S7SS-5 (56.4 μg/kg) collected at the pond.

4.4.3.5 Inorganics

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 there 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 criteria at only one sample location, S7SS-1(IT) (13 mg/kg), at the north end of the ditch. Barium, chromium, copper, lead, and zinc were the most frequently detected inorganics in sediment at SWMU 7. They were detected at all nine sample locations. 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.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Antimony and iron were identified as COPCs (see Section 4.6.2.2) in the human health risk assessment, but did not exceed the selected nature and extent screening level due to the conservative non-cancer hazard index applied to the EPA RBCs during the risk assessment process. Aluminum, tin, and vanadium were selected as ecological COPCs (see Section 4.7.4.1.2) based on a comparison with twice the average background concentrations, because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels and were higher than twice the average background concentrations.

4.4.4 Surface-water

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI, were considered in the analysis of surface water contamination at SWMU 7. Chemicals that were detected in surface-water samples are listed in Table 4-4. This table lists analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Figure 4-9 shows the occurrence of analytes that exceeded screening values and indicated possible surface-water contamination. Inorganics were the dominant class of contaminants detected in these samples.

Screening values were obtained from a variety of sources including FDEP SWQSs, EPA Region IV Freshwater and Marine Screening Values, EPA AWQCs for Fresh and Marine Waters, Proposed RCRA Action Levels (ALs), EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1 and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples.

TABLE 4-4

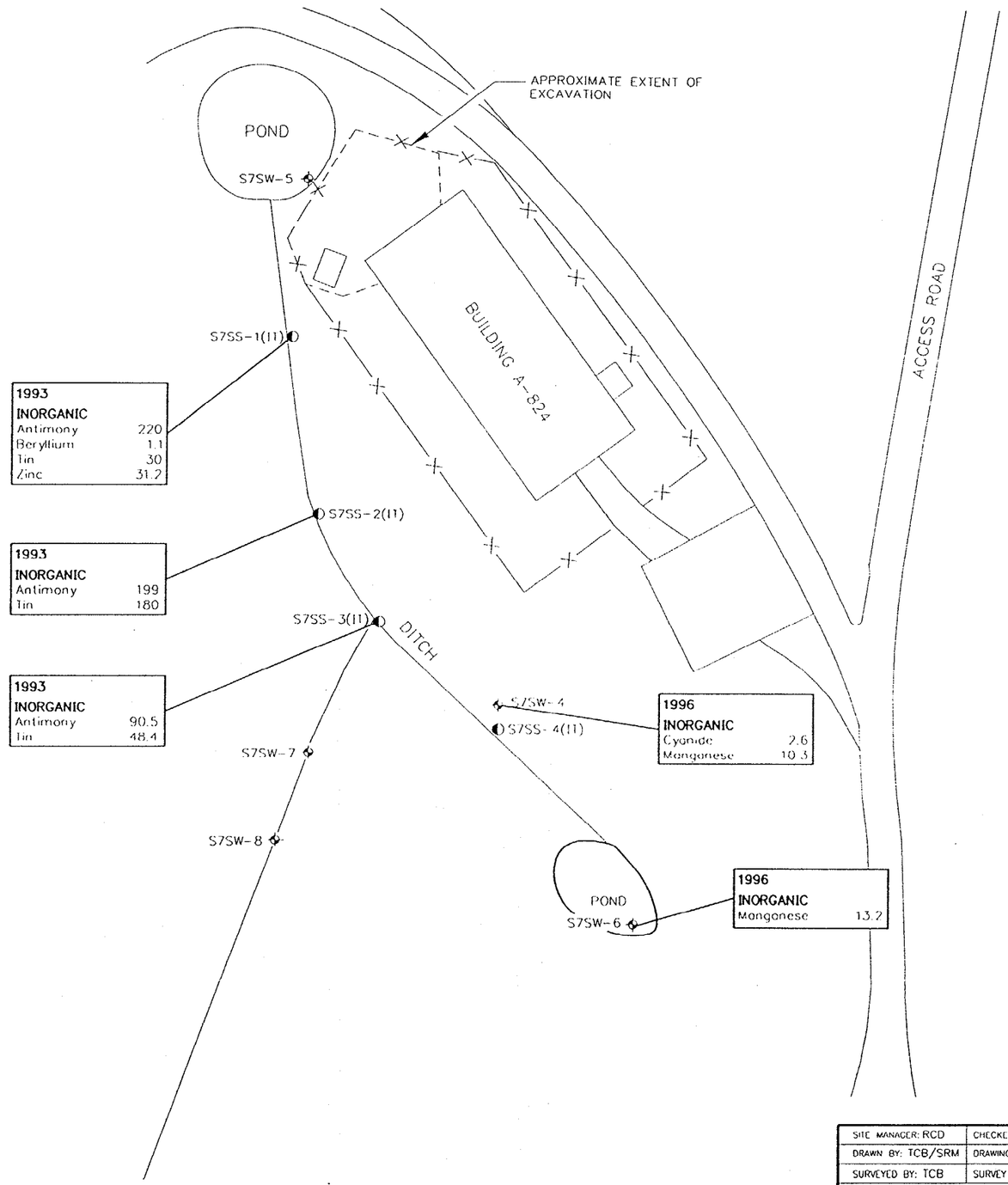
CHEMICALS DETECTED IN SURFACE WATER AT SWMU 7
NAS KEY WEST

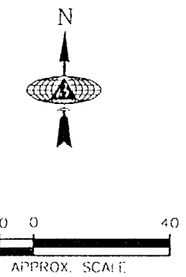
Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
S7SS-1(IT)	IT 1993	Antimony	220	
S7SS-2(IT)	IT 1993	Antimony	199	
S7SS-3(IT)	IT 1993	Antimony	90.5	
S7SS-1(IT)	IT 1993	Arsenic	2.5	B_1
S7SS-2(IT)	IT 1993	Barium	40.4	B_1
S7SS-1(IT)	IT 1993	Barium	38.5	B_1
S7SS-3(IT)	IT 1993	Barium	20.9	B_1
S7SW-6	B&RE 1996	Barium	9.9	
S7SW-4	B&RE 1996	Barium	9.9	
S7SW-7	B&RE 1996	Barium	8.8	
S7SW-5	B&RE 1996	Barium	8.1	
S7SW-8	B&RE 1996	Barium	8	
S7SS-1(IT)	IT 1993	Beryllium	1.1	B_1
S7SW-4	B&RE 1996	Chromium	2.7	
S7SW-7	B&RE 1996	Chromium	2.6	
S7SW-8	B&RE 1996	Chromium	2.5	
S7SW-6	B&RE 1996	Chromium	2.3	
S7SW-4	B&RE 1996	Cyanide	2.6	
S7SW-6	B&RE 1996	Iron	168	
S7SW-6	B&RE 1996	Manganese	13.2	
S7SW-4	B&RE 1996	Manganese	10.3	
S7SW-8	B&RE 1996	Manganese	9.1	
S7SW-5	B&RE 1996	Manganese	8.8	
S7SW-7	B&RE 1996	Manganese	8.7	
S7SW-4	B&RE 1996	Mercury	0.34	
S7SW-5	B&RE 1996	Mercury	0.17	
S7SW-7	B&RE 1996	Mercury	0.13	
S7SW-6	B&RE 1996	Mercury	0.12	
S7SS-4(IT)	IT 1993	Sulfide	6,000	
S7SS-1(IT)	IT 1993	Sulfide	3,000	
S7SS-2(IT)	IT 1993	Tin	180	B_1
S7SS-3(IT)	IT 1993	Tin	48.4	B_1
S7SS-1(IT)	IT 1993	Tin	30	
S7SS-1(IT)	IT 1993	Zinc	31.2	
S7SS-2(IT)	IT 1993	Zinc	7.9	B_1
S7SS-4(IT)	IT 1993	Zinc	6.4	B_1
S7SS-3(IT)	IT 1993	Zinc	3.8	B_1
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S7SS-1(IT)	IT 1993	Methylene chloride	2	B_2J
S7SS-4(IT)	IT 1993	Methylene chloride	2	B_2J

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994).
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.





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 APPENDIX C

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)

SITE MANAGER: RCD	CHECKED BY: KW
DRAWN BY: TCB/SRM	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/17/96
SCALE: AS SHOWN	
CAD DWG. NO.: 704682449	PROJ. NO.: HK7046

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FIGURE 4-9
SURFACE-WATER CHEMICAL CONCENTRATIONS
SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F172

4.4.4.1 Volatile Organic Compounds

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 AL for surface water that was used as a screening value for methylene chloride. VOCs were not tested by B&R Environmental during the Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995).

4.4.4.2 Semivolatile Organic Compounds

No SVOCs were detected in surface water at SWMU 7.

4.4.4.3 Pesticides

No pesticides were detected in surface water at SWMU 7.

4.4.4.4 Polychlorinated Biphenyls

No PCBs were detected in surface water at SWMU 7.

4.4.4.5 Inorganics

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 mg/kg screening value at the three northerly sample locations along the mosquito ditch [S7SS-1(IT), S7SS-2(IT), and S7SS-3(IT)]. The maximum concentration was 220 mg/kg, detected at S7SS-1(IT). Tin exceeded its 0.01 mg/kg screening criteria at the same three sample locations. However, the maximum concentration of tin (180 mg/kg) occurred at S7SS-2(IT). Manganese was detected in excess of its 10 mg/kg screening criteria at two sample locations in the southeastern portion of the ditch [S7SW-4 (10.3 mg/kg) and S7SW-6 (13.2 mg/kg)]. 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 mg/kg 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.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Barium and iron were identified as COPCs (see Section 4.6.2.2) in the human health risk assessment due to toxicity, since they do not have RBCs. All barium concentrations in surface water at SWMU 5 were less than the RCRA AL selected for surface-water screening in this section. All iron concentrations in surface water at SWMU 7 were less than the Florida Water Quality Standard selected for nature and extent screening.

4.4.5 Groundwater

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI were considered in the analysis of groundwater contamination at SWMU 7. Chemicals that were detected in groundwater samples are listed in Table 4-5. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. 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. The same two monitoring well locations were sampled during both investigations. Figure 4-10 shows the occurrence of analytes that exceeded the screening values and indicated possible groundwater contamination. Groundwater contamination beneath the site is predominantly attributable to inorganics.

Screening values were obtained from a variety of sources including SDWA MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1 and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

TABLE 4-5

CHEMICALS DETECTED IN GROUNDWATER AT SWMU 7 NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
S7MW-3	IT 1993	Antimony	46	B_1
S7MW-1	IT 1993	Arsenic	4.7	B_1
S7MW-3	IT 1993	Arsenic	4.3	B_1
S7MW-3	IT 1993	Barium	39.5	B_1
S7MW-1	IT 1993	Barium	26.2	B_1
S7MW-3	B&RE 1996	Barium	13	
S7MW-1	B&RE 1996	Barium	10	
S7MW-3	IT 1993	Chromium	22.1	
S7MW-1	IT 1993	Chromium	13.9	
S7MW-1	IT 1993	Cyanide	190	
S7MW-1	IT 1993	Lead	9.5	
S7MW-3	IT 1993	Lead	5.9	
S7MW-1	B&RE 1996	Manganese	9	
S7MW-3	B&RE 1996	Manganese	6.2	
S7MW-1	B&RE 1996	Mercury	0.24	
S7MW-1	IT 1993	Sulfide	4,000	
S7MW-1	IT 1993	Zinc	17.8	B_1
S7MW-3	IT 1993	Zinc	16.7	B_1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
S7MW-1	IT 1993	Bis(2-ethylhexyl)phthalate	2	J
VOLATILE ORGANIC COMPOUNDS (µg/L)				
S7MW-1	IT 1993	2-butanone	2	J
S7MW-1	IT 1993	Acetone	5	J
S7MW-1	IT 1993	Methylene chloride	1	B_2J

Shading indicates a concentration in excess of the screening values (see Table C.3-4).

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
B_2 - Analyte was found in the blank as well as the sample.

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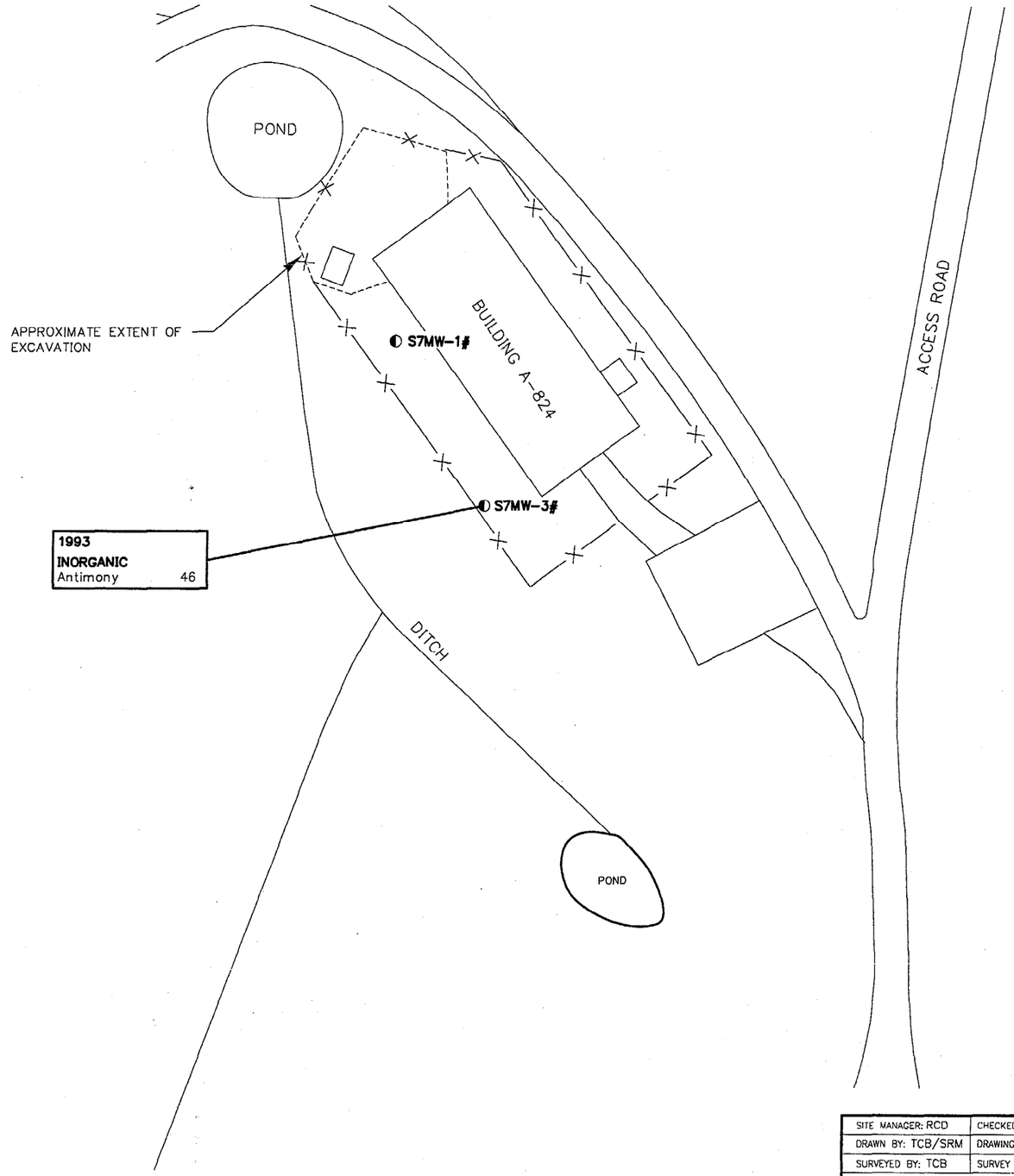

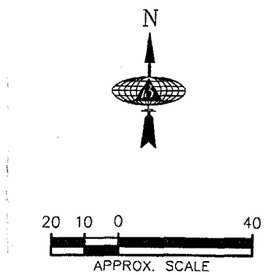

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

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

LEGEND

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

\# ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

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

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FIGURE 4-10
1993 GROUNDWATER CHEMICAL CONCENTRATIONS SWMU 7
NAVAL AIR STATION
KEY WEST, FLORIDA

4.4.5.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the groundwater samples at SWMU 7. However, three VOCs were detected in S7MW-1 (located near the mosquito ditch to the west of Building A-824) by IT Corporation in 1993: 2-butanone, acetone, and methylene chloride. VOCs were not tested by B&R Environmental during the Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995).

4.4.5.2 Semivolatile Organic Compounds

A single SVOC, bis(2-ethyhexyl)phthalate, was detected in the groundwater sample collected at S7MW-1 by IT Corporation in 1993. Several VOCs were detected in this same sample, as noted above. SVOCs were not tested by B&R Environmental during the Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995).

4.4.5.3 Pesticides

No pesticides were detected in groundwater at SWMU 7.

4.4.5.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at SWMU 7.

4.4.5.5 Inorganics

Several inorganics were detected in the groundwater at SWMU 7; however, only antimony was detected in excess of its 6 mg/kg screening criteria. Antimony was detected by IT Corporation in 1993 at a concentration of 46 mg/kg at S7MW-3 at the southwest corner of the building. Antimony was not detected in 1996. Manganese and mercury were detected (at levels 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.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature

and extent screening levels. Florida Water Quality Standards were used as ecological thresholds for groundwater from areas where there appeared to be a hydrologic connection to a nearby surface-water body. Although mercury concentrations in groundwater at SWMU 7 exceeded the Florida Water Quality Standard (Section 4.7.4.1.2), the maximum concentration was below the MCL selected for nature and extent screening.

4.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at SWMU 7. Section 4.5.1 presents those chemicals detected in excess of the nature and extent screening values discussed in the nature and extent sections, along with apparent temporal and spatial trends. Section 4.5.2 addresses the potential routes of migration, and Section 4.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. Section 3.1.5.1 Appendix C quantifies the physical and chemical properties of the detected contaminants.

4.5.1 Summary of Contaminant Release

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 OVA readings and naphthalene in one subsurface soil sample (IT Corporation, 1994).

Metals were the most common contaminants in soil at SWMU 7. Metals detected in excess of the selected nature and extent screening values in surface soil included aluminum, antimony, arsenic, beryllium, chromium, copper, iron, lead, mercury, nickel, silver, sulfide, vanadium, and zinc. Antimony, arsenic, beryllium, and sulfide were also detected in excess of screening values in subsurface soil samples at SWMU 7. VOCs and SVOCs were detected in excess of screening values in subsurface and surface soil samples to the east of the building. The detection of the contaminants in one sample, and their absence from other areas of the site suggests that the source of this PAH contamination is unclear and the extent of contamination may not be defined; however, a potential source might be the roadside

diesel fuel spill identified by IT Corporation (IT Corporation, 1994). Fourteen SVOCs were detected in excess of screening values in soil east of the road on the eastern side of Building A-824. No pesticides were detected in excess of the nature and extent screening levels in soil at SWMU 7. A single PCB, Aroclor-1260, was detected in excess of its screening value in surface soil at the four samples collected by BEI in 1995.

Inorganic contamination in sediment appeared to be fairly widespread along the mosquito ditch at SWMU 7. Arsenic, beryllium, cadmium, copper, cyanide, lead, mercury, silver, and zinc were all detected in sediment at SWMU 7 in excess of the selected nature and extent screening values. All of these, except cadmium and cyanide, were also detected in excess of soil screening values at SWMU 7. Lead and zinc were detected in excess of screening values at nine of nine sample locations at SWMU 7. A single VOC, acetone, was detected in excess of screening criteria at a single sample location at the southeastern end of the mosquito ditch. Several SVOCs were detected in excess of screening values in the same area including bis(2-ethyhexyl)phthalate, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, and pyrene. Bis(2-ethylhexyl)phthalate was also detected in excess of screening criteria at the northern end of the mosquito ditch. Phenanthrene was detected in excess of its screening value in the same area at a single sample location. Most of these SVOCs were also detected in excess of screening values in soil samples collected on the east side of Building A-824. Several locations along the mosquito ditch and in the pond contained pesticide concentrations in excess of the screening criteria for 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, delta-BHC, dieldrin, and gamma-BHC (lindane). A single PCB, Aroclor-1260, was detected in excess of screening criteria in sediment along the mosquito ditch at SWMU 7.

Inorganics were the only class of contaminants detected in excess of the selected nature and extent screening value in surface-water samples collected at SWMU 7. Antimony, beryllium, cyanide, manganese, tin, and zinc were all detected in excess of screening values at sample locations along the main line of the mosquito ditch.

Antimony was the only compound detected in excess of screening values in groundwater samples collected at SWMU 7. Antimony was detected in its excess of its screening value at a single site at the southwest corner of Building A-824 in 1993 sampling. Antimony was not detected in 1996.

4.5.2 Potential Routes of Migration

The contaminant source at SWMU 7 consists of former equipment (e.g., drums, transformers) stored at Buildings A-824. The contaminant release pathways from this area include volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in soil could volatilize from surficial material

or become airborne via resuspension. Contaminated fugitive dust could be generated during ground-disturbing activities, such as construction or excavation. The contaminants could then be dispersed in the surrounding environment and transported to downwind locations where they could repartition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. Most of the site is covered with grasses and weeds, minimizing the erosion pathway. The endangered Lower Keys marsh rabbit and several other ecological receptors are believed to utilize the site and vicinity; therefore, the potential for contaminant intake is present at SWMU 7.

Precipitation runoff can carry contaminants to nearby soils, and to surface waters and sediments in the ditch and ponds. Infiltrating precipitation can cause the contamination of subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in soil are expected to migrate at a slower rate. After reaching the water table, contaminants can be carried with the flow of groundwater to downgradient locations. Groundwater in the vicinity of the site is shallow and probably is connected hydrologically to open surface water in an inlet of the Gulf of Mexico approximately 1,000 feet east of the site. Contaminants can subsequently be deposited in sediment or surface water and can potentially accumulate in the tissues of marine aquatic organisms.

4.5.3 Contaminant Transport Potential and Persistence

The primary source of contamination at SWMU 7 was associated with the activity at Building A-824. Inorganics were the most common contaminants in soil and sediment at SWMU 7. Although no reported release of contaminants is recorded, spillage from drums and releases from the building would be to the soil. Metals are adsorbed onto soil and sediment but may exist in dissolved or suspended forms. Although, many metals are water-insoluble, some soluble species of metals have increased mobility. Arsenic, mercury, and chromium, for example, exhibit mobilities that are strongly influenced by pH and speciation or, in the case of mercury, by the presence of organic compounds such as alkylated mercury compounds. The transport of lead in the environment is strongly influenced by speciation of the ion. Sorption processes appear to exert a dominant effect on the distribution of lead in the environment. Lead is strongly complexed to organic materials present in both aquatic systems and soil (Clement Associates, 1985).

Inorganics were also detected in surface water at SWMU 7. Adsorption to organic materials usually controls the mobility of lead and results in strong partitioning of lead to the bed sediments in aquatic systems (Clement Associates, 1985). Although sorption of inorganics tends to reduce their mobility in the subsurface, strong association with soil and sediment particles may increase the persistence of inorganic contamination at a site.

Volatiles and semivolatiles, which were detected in site-related soils and sediment, are not expected to migrate significantly due to soil/water partition coefficients that strongly favor soil sorption. In addition, the low persistence of VOCs in soil is influenced greatly by their solubility and high volatility. Naphthalene and related PAHs typically exhibit moderate but lower solubilities than VOCs. PAHs undergo very limited biodegradation rates in soil, with the heavier PAH compounds considered more persistent. Naphthalene and related compounds are considered among the more readily biodegradable PAHs (Clement Associates, 1985).

The commercial PCB mixture that was detected in soil and sediment at SWMU 7 (i.e., Aroclor-1260) is not expected to migrate significantly due to (1) the relatively low solubility of PCBs in water, (2) low vapor pressures, (3) low Henry's Law constants, and especially, (4) soil and sediment/water partition coefficients that strongly favor soil and sediment sorption. PCBs are also extremely persistent and degrade in the environment only at a very slow rate through partitioning, chemical transformation, and preferential bioaccumulation (EPA, 1996b).

Partitioning in the environment of PCB congeners found in Aroclor-1260 would be by adsorption of PCBs to organic materials, sediments, and soils. This behavior tends to increase with chlorine content of the PCBs (e.g., Aroclor-1260 is highly chlorinated with an average chlorine content of 60 percent by weight). Limited volatilization and solubility of these highly chlorinated congeners is expected. During biodegradation of PCBs, anaerobic bacteria in sediments selectively remove chlorines from meta and para positions of the PCB congener appearing to reduce the toxicity and bioaccumulation potential of residues. Aerobic bacteria break open the carbon rings through oxidation and also remove chlorines; however, aerobic biodegradation occurs mostly with PCBs containing lower percentages of chlorine (i.e., PCB congeners found in Aroclor-1242 and lower that typically contain 1 to 4 chlorines). Photolysis can also slowly break down congeners with high chlorine content.

4.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section presents the baseline human health risk assessment for SWMU 7. It describes a qualitative and quantitative assessment of actual or potential risks for SWMU 7. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and RGOs. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 4.6.8.

4.6.1 Preliminary Risk Evaluation

A PRE was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 4-6 and 4-7 summarize the preliminary risk evaluation for SWMU 7 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. However, the risk ratios calculated for the residential land use scenario are greater than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. Therefore, a baseline human health risk assessment is necessary for SWMU 7. The primary contributors to carcinogenic risk are Aroclor-1260 in soil; and arsenic and beryllium in sediment. The primary contributors to noncarcinogenic risk are antimony, arsenic, and iron in soil; antimony, arsenic, and iron in sediment; and antimony and arsenic in surface water.

4.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

4.6.2.1 Soils

Several VOCs, SVOCs, PAHs, a PCB, pesticides, and metals were detected in one or more of the surface soil samples collected at SWMU 7. Several VOCs, SVOCs, PAHs, and metals were detected in subsurface soil samples collected at SWMU 7. The occurrence and distribution of chemicals in surface and subsurface soils are presented in Tables 4-8 through 4-11. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in SWMU 7 soils are also presented in these tables.

TABLE 4-6

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
SWMU 7
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	5.3	5.8	2.5	0.43	0.43	0.045	3.8	1E-05	1E-05	6E-05	1E-06
Beryllium	0.18	0.46	1.1	0.15	0.15	0.016	1.3	1E-06	3E-06	7E-05	1E-07
PESTICIDES/PCBs											
4,4'-DDD	32.2	58	ND	2,700	2,700	0.28	24,000	1E-08	2E-08	NA	1E-09
4,4'-DDE	31.7	450	ND	1,900	1,900	0.2	17,000	2E-08	2E-07	NA	2E-09
4,4'-DDT	25.7	674	ND	1,900	1,900	0.2	17,000	1E-08	4E-07	NA	2E-09
alpha-BHC	21.6	5.6	ND	100	100	0.011	910	2E-07	6E-08	NA	2E-08
Aroclor-1260	16,500	510	ND	320	320	0.0087	2,800	5E-05	2E-06	NA	6E-06
Dieldrin	ND	6	ND	40	40	0.0042	360	NA	2E-07	NA	NA
gamma-BHC (lindane)	ND	11.6	ND	490	490	0.052	4,400	NA	2E-08	NA	NA
gamma-chlordane	ND	51	ND	490	490	0.052	4,400	NA	1E-07	NA	NA
Heptachlor	2.8	ND	ND	140	140	0.0023	1,300	2E-08	NA	NA	2E-09
Heptachlor epoxide	0.89	ND	ND	70	70	0.0012	630	1E-08	NA	NA	1E-09
SEMIVOLATILE ORGANIC COMPOUNDS											
1,4-dichlorobenzene	352.3	ND	ND	27,000	27,000	0.44	240,000	1E-08	NA	NA	1E-09
Benzo(a)anthracene	1,640	1,910	ND	880	880	0.092	7,800	2E-06	2E-06	NA	2E-07
Benzo(a)pyrene	2,040	ND	ND	88	88	0.0092	780	2E-05	NA	NA	3E-06
Benzo(b)fluoranthene	3,340	3,500	ND	880	880	0.092	7,800	4E-06	4E-06	NA	4E-07
Benzo(k)fluoranthene	310	ND	ND	8,800	8,800	0.92	78,000	4E-08	NA	NA	4E-09
Bis(2-ethylhexyl)phthalate	830	620	ND	46,000	46,000	4.8	410,000	9E-08	1E-08	NA	2E-09
Chrysene	1,950	2,120	ND	88,000	88,000	9.2	780,000	2E-08	2E-08	NA	3E-09
Indeno(1,2,3-cd)pyrene	1,480	ND	ND	880	880	0.092	7,800	2E-06	NA	NA	2E-07
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	28	49	2	85,000	85,000	4.1	760,000	3E-10	6E-10	5E-07	4E-11
							Risk Sums by Medium	**1E-04**	**3E-05**	**1E-04**	**1E-05**
							Risk Sums by Use Scenario	**2E-04**			**1E-05**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 4-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
SWMU 7
NAS KEY WEST
PAGE 1 OF 2

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	5,195	4330	ND	78,000	78,000	37,000	1,000,000	7E-01	6E-01	NA	5E-02
Antimony	4.9	7	220	31	31	15	820	2E+00	2E+00	1E+02	6E-02
Arsenic	5.3	5.8	2.5	23	23	11	610	2E+00	3E+00	2E+00	9E-02
Barium	18.8	14.9	40.4	5,500	5,500	2,600	140,000	3E-02	3E-02	2E-01	1E-03
Beryllium	0.18	0.46	1.1	390	390	180	1,000	5E-03	1E-02	6E-02	2E-03
Cadmium	0.75	2.8	ND	39	39	18	1,000	2E-01	7E-01	NA	8E-03
Chromium VI	31.5	32.3	2.7	390	390	180	10,000	8E-01	8E-01	2E-01	3E-02
Cobalt	0.38	ND	ND	4,700	4,700	2,200	120,000	8E-04	NA	NA	3E-05
Copper	67.2	127	ND	3,100	3,100	1,500	82,000	2E-01	4E-01	NA	8E-03
Cyanide	ND	13	2.6	1,600	1,600	730	41,000	NA	8E-02	4E-02	NA
Iron	3785	4270	168	23,000	23,000	11,000	610,000	2E+00	2E+00	2E-01	6E-02
Manganese	32.2	30.5	13.2	390	390	180	10,000	8E-01	8E-01	7E-01	3E-02
Mercury	0.08	1.8	0.34	23	23	11	610	3E-02	8E-01	3E-01	1E-03
Nickel	3.7	11	ND	1,600	1,600	730	41,000	2E-02	7E-02	NA	9E-04
Selenium	1.5	ND	ND	390	390	180	10,000	4E-02	NA	NA	1E-03
Silver	0.34	29.1	ND	390	390	180	10,000	9E-03	7E-01	NA	3E-04
Tin	ND	200	180	47,000	47,000	22,000	1,000,000	NA	4E-02	8E-02	NA
Vanadium	8.5	16.6	ND	550	550	2,600	14,000	2E-01	3E-01	NA	6E-03
Zinc	208	487	31.2	23,000	23,000	11,000	610,000	9 E-02	2E-01	3E-02	3E-03
PESTICIDES/PCBs											
2,4-D	7.4	ND	ND	780,000	780,000	61	20,000,000	1E-04	NA	NA	4E-06
2,4,5-T	7	ND	ND	780,000	780,000	370	20,000,000	9E-05	NA	NA	3E-06
2,4,5-TP (Silvex)	4	ND	ND	630,000	630,000	290	16,000,000	6E-05	NA	NA	3E-06
4,4'-DDT	25.7	674	ND	39,000	39,000	18	1,000,000	7E-03	2E-01	NA	3E-04
Dieldrin	ND	6	ND	3,900	3900	1.8	100,000	NA	2E-02	NA	NA
Endosulfan I	14.9	ND	ND	470,000	470,000	220	12,000,000	3E-04	NA	NA	1 E-05
Endosulfan II	1.2	ND	ND	470,000	470,000	220	12,000,000	3E-05	NA	NA	1E-06
Endrin	23.8	8.1	ND	23,000	23,000	11	610,000	1E-02	4E-03	NA	4E-04
gamma-BHC (lindane)	ND	11.6	ND	39,000	39,000	180	610,000	NA	3E-03	NA	NA
gamma-chlordane	ND	51	ND	4,700	4700	2.2	120,000	NA	1E-01	NA	NA
Heptachlor	2.8	ND	ND	39,000	39,000	18	1,000,000	7E-04	NA	NA	3E-05
Heptachlor epoxide	0.89	ND	ND	1,000	1,000	0.47	27,000	9E-03	NA	NA	3E-04

TABLE 4-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
SWMU 7
NAS KEY WEST
PAGE 2 OF 2

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
SEMIVOLATILE ORGANIC COMPOUNDS											
1,2-dichlorobenzene	2,415	ND	ND	7,000,000	7,000,000	270	180,000,000	3E-03	NA	NA	1E-04
Bis(2-ethylhexyl)phthalate	830	620	ND	1,600,000	1,600,000	730	41,000,000	5E-03	4E-03	NA	2 E-05
Fluoranthene	3,020	4,000	ND	3,100,000	3,100,000	1,500	82,000,000	1E-02	1E-02	NA	4E-04
Pyrene	2,410	4,000	ND	2,300,000	2,300,000	1,100	61,000,000	1E-02	2E-02	NA	4E-04
VOLATILE ORGANIC COMPOUNDS											
Cis-1,2-dichloroethene	5	3	ND	780,000	780,000	61	20,000,000	6E-06	6E-06	NA	3E-07
2-butanone	18	8	ND	47,000,000	47,000,000	1,900	1,000,000,000	4E-07	2E-06	NA	2E-08
Acetone	83	190	ND	7,800,000	7,800,000	3,700	200,000,000	1E-04	2E-04	NA	4E-06
Chlorobenzene	117	ND	ND	1,600,000	1,600,000	39	41,000,000	7E-04	NA	NA	3E-05
Ethylbenzene	210	ND	ND	7,800,000	7,800,000	1,300	200,000,000	3E-05	NA	NA	1E-06
Methylene chloride	28	49	2	4,700,000	4,700,000	260	120,000,000	6E-05	1E-04	8E-02	2E-06
Toluene	46	ND	ND	16,000,000	16,000,000	750	410,000,000	3E-06	NA	NA	1E-07
Xylenes (total)	2,000	ND	ND	160,000,000	160,000,000	12,000	1,000,000,000	1E-05	NA	NA	2E-06
Hazard Sums by Medium								**9E+00**	**1E+01**	**2E+02**	**4E-01**
Hazard Sums by Use Scenario								**2E+02**			**4E-01**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 4-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT SWMU 7 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	14/14	120 - 4,250	1,887	4/4	1,780 - 5,195	3,049	3,049	7,800	5,200	N	A
Antimony	2/15	0.26 - 0.48	0.39	5/13	1.1 - 4.9	3.72	2.22	3.1	4.51	Y	C
Arsenic	6/15	0.63 - 2.7	1.29	10/13	0.29 - 5.3	2.37	2.14	0.43	4.52	Y	C
Barium	15/15	4.4 - 17.7	10.51	13/13	4 - 18.8	8.76	8.76	550	12	N	A
Beryllium	2/15	0.13 - 0.15	0.05	5/13	0.13 - 0.18	0.15	0.08	0.15	0.17	Y	C
Cadmium	4/15	0.11 - 0.45	0.15	2/13	0.42 - 0.75	0.59	0.32	3.9	0.382	N	A
Chromium**	15/15	1.9 - 15.5	6.02	13/13	2.6 - 31.5	8.50	8.50	39	13.9	N	A
Cobalt	7/15	0.22 - 0.51	0.29	3/13	0.29 - 0.38	0.35	0.87	470	0.38	N	A
Copper	14/15	1.3 - 15.6	5.43	7/13	4.4 - 67.2	28.85	15.79	310	67.2	N	A
Iron	14/14	98.1 - 2,260	1,167	4/4	1,430 - 3,785	2,509	2,509	2,300	3,790	Y	C
Lead	14/15	0.65 - 48.3	15.66	11/13	0.3 - 252.5	59.07	50	400	253	N	A
Manganese	14/14	2.6 - 33.7	17.65	4/4	15.2 - 32.2	23.70	23.70	180	32.2	N	A
Mercury	5/15	0.03 - 0.08	0.03	9/13	0.03 - 0.078	0.04	0.03	2.3	0.059	N	A
Nickel	11/15	0.63 - 4.1	1.67	5/13	1.8 - 3.7	2.58	1.68	160	2.18	N	A
Selenium	5/15	0.46 - 1.8	0.65	3/13	0.79 - 1.5	1.08	0.41	39	0.867	N	A
Silver	0/15	Not detected	–	1/13	0.34 - 0.34	0.34	0.25	39	0.309	N	A
Sulfide	1/1	49 - 49	49	1/2	1,300 - 1,300	1,300	650.50		1,300	N	D
Vanadium	15/15	0.8 - 8.8	3.97	8/13	1.3 - 8.5	3.53	2.38	55	5.55	N	A
Zinc	12/15	0.63 - 89.1	15.22	13/13	0.75 - 208	38.25	38.25	2,300	208	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
D - Not COPC (nut./mineral)
**As Cr VI

TABLE 4-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT SWMU 7 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBs											
2,4,5-T	0/13	Not detected	–	1/6	7 - 7	6.95	25.38	78,000	6.95	N	A
2,4,5-TP (silvex)	0/13	Not detected	–	1/6	4 - 4	4.00	24.89	63,000	4	N	A
2,4-D	0/13	Not detected	–	1/6	7.4 - 7.4	7.43	25.46	78,000	7.43	N	A
4,4'-DDD	3/14	2 - 233	22.46	4/6	2.7 - 32.2	15.44	13.71	2,700	32.2	N	A
4,4'-DDE	7/14	1.8 - 741	63.23	4/6	4 - 31.7	19.78	16.60	1,900	31.7	N	A
4,4'-DDT	7/14	1.8 - 557	46.78	4/6	2.1 - 25.7	14.68	13.20	1,900	25.7	N	A
alpha-BHC	0/11	Not detected	–	1/6	21.6 - 21.6	21.60	6.11	100	21.6	N	A
Aroclor-1260	1/17	69 - 69	43.28	4/13	230 - 16,500	6,865	2,146	320	16,500	Y	B
Endosulfan I	1/14	1 - 3.5	5.99	3/6	2.3 - 14.9	7.68	5.86	47,000	14.9	N	A
Endosulfan II	0/11	Not detected	–	1/6	1.2 - 1.2	1.20	8.45	47,000	1.2	N	A
Endrin	2/14	1.2 - 1.2	11.46	2/6	7.1 - 23.8	15.44	9.40	2,300	23.8	N	A
Endrin aldehyde	0/10	Not detected	–	1/4	2.5 - 2.5	2.50	7.87	2,300	2.5	N	A
Heptachlor	0/11	Not detected	–	1/6	2.8 - 2.8	2.80	4.55	140	2.8	N	A
Heptachlor epoxide	0/11	Not detected	–	1/6	0.89 - 0.89	0.89	4.23	70	0.89	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
1,2-dichlorobenzene	0/14	Not detected	–	2/12	1.6 - 2415	1,208.30	307.88	700,000	2,420	N	A
1,3-dichlorobenzene	0/14	Not detected	–	1/12	481.5 - 481.5	481.50	147.23	700,000	482	N	A
1,4-dichlorobenzene	0/14	Not detected	–	1/12	352.3 - 352.3	352.25	136.23	27,000	352	N	A
Benzo(a)anthracene	0/14	Not detected	–	3/13	270 - 1,640	772	339.61	880	1,640	Y	B
Benzo(a)pyrene	0/14	Not detected	–	2/13	360 - 2,040	1,200	424.34	88	2,040	Y	B
Benzo(b)fluoranthene	1/14	390 - 390	414.89	3/13	380 - 3,340	1,564	522.38	880	3,340	Y	B
Benzo(g,h,i)perylene	0/14	Not detected	–	2/13	260 - 1,460	860	371.84	–	1,460	Y	EF
Benzo(k)fluoranthene	0/14	Not detected	–	1/13	310 - 310	310	327.61	8,800	310	Y	E
Bis(2-ethylhexyl)phthalat	1/11	330 - 330	470.55	2/2	120 - 680	400	400	46,000	680	N	A
Chrysene	1/14	280 - 280	407.04	3/13	380 - 1,950	966.67	384.53	88,000	1,950	Y	E
Fluoranthene	1/14	660 - 660	434.18	3/13	380 - 3,020	1,368	477.14	310,000	3,020	N	A

TABLE 4-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT SWMU 7 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Indeno(1,2,3-cd)pyrene	0/14	Not detected	–	2/13	240 - 1,480	860	371.84	880	1,480	Y	B
Phenanthrene	0/14	Not detected	–	1/13	106 - 106	106	329.35	–	106	Y	F
Pyrene	1/14	470 - 470	420.61	3/13	350 - 2,410	141.67	424.91	230,000	2,410	N	A
VOLATILE ORGANIC COMPOUNDS											
Acetone	1/12	1 - 1	3.67	2/2	42 - 83	62.50	62.50	780,000	83	N	A
Chlorobenzene	0/15	Not detected	–	1/12	117 - 117	117	11.22	160,000	20.9	N	A
Cis-1,2-dichloroethene	0/3	Not detected	–	2/8	1 - 2	1.50	0.81	70,000	1.2	N	A
Ethylbenzene	1/15	0.31 - 0.31	1.58	1/12	91.3 - 91.3	91.25	9.07	780,000	16.50	N	A
Methylene chloride	6/12	0.11 - 14	2.80	2/8	18 - 28	23	12.25	85,000	18.40	N	A
Toluene	1/15	1 - 1	1.62	1/12	1 - 1	1	3.75	1,600,000	1	N	A
Xylenes, total	1/15	2.1 - 2.1	3.73	1/12	958 - 958	958	81.70	16,000,000	613	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)
B - COPC (Max>RBC, organics)
E - COPC - (same family)
F - COPC (eval. qual.)

TABLE 4-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SUBSURFACE SOILS AT SWMU 7 (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Antimony	2/15	0.26 - 0.48	0.39	1/8	3.8 - 3.8	3.8	1.99	8,200	2.48	N	A
Arsenic	6/15	0.63 - 2.7	1.29	7/8	0.3 - 3.9	0.93	0.83	4	3.21	Y	C
Barium	15/15	4.4 - 17.7	10.51	8/8	3.8 - 5.8	4.83	4.83	14,000	5.34	N	A
Beryllium	2/15	0.13 - 0.15	0.05	4/8	0.12 - 0.15	0.13	0.10	1	0.14	N	A
Chromium**	15/15	1.9 - 15.5	6.02	8/8	2.8 - 4.2	3.54	3.54	1,000	3.95	N	A
Lead	14/15	0.65 - 48.3	15.66	5/8	0.28 - 1.6	0.58	0.40	400	1.19	N	A
Mercury	5/15	0.03 - 0.08	0.03	4/8	0.02 - 0.04	0.03	0.02	61	0.04	N	A
Sulfide	1/1	49 - 49	49	2/2	74 - 1,600	837	837	–	1,600	N	D
Zinc	12/15	0.63 - 89.1	15.22	8/8	1.5 - 2.6	1.95	1.95	61,000	2.28	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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 industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
D - Not COPC (nut./mineral)
**As Chromium VI

TABLE 4-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SUBSURFACE SOILS AT SWMU 7 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
SEMIVOLATILE ORGANIC COMPOUNDS											
2-methylnaphthalene	0/11	Not detected	–	1/2	19,000 - 19,000	19,000	9,605	–	19,000	Y	F
Acenaphthene	0/14	Not detected	–	1/8	660 - 660	660	115.19	2,000,000	660	N	A
Anthracene	1/14	390 - 390	414.89	1/8	220 - 220	220	57.44	1,000,000	220	N	A
Benzoic acid	0/1	Not detected	–	1/2	94 - 94	94	2,522	10,000,000	94	N	A
Bis(2-ethylhexyl)phthalate	1/11	330 - 330	470.55	1/2	830 - 830	830	520	410,000	830	N	A
Dibenzofuran	0/11	Not detected	–	1/2	890 - 890	890	550	820,000	890	N	A
Fluorene	0/14	Not detected	–	1/8	790 - 790	790	128.69	8,200,000	790	N	A
Naphthalene	0/14	Not detected	–	1/8	7,900 - 7,900	7,900	1020.19	8,200,000	7,900	N	A
Phenanthrene	0/14	Not detected	–	1/8	1,200 - 1,200	1,200	188.06	–	1,200	Y	F
VOLATILE ORGANIC COMPOUNDS											
2-butanone	0/12	Not detected	–	2/2	4 - 18	11	11	1,000,000	18	N	A
Acetone	1/12	1 - 1	3.67	2/2	77 - 82	79.5	79.50	20,000,000	82	N	A
Cis-1,2-dichloroethene	0/3	Not detected	–	2/8	2 - 5	3.5	1.34	2,000,000	3.09	N	A
Ethylbenzene	1/15	0.31 - 0.31	1.58	1/8	210 - 210	210	27.56	20,000,000	210	N	A
Methylene chloride	6/12	0.11 - 14	2.80	2/8	19 - 27	23	12.80	760,000	18.2	N	A
Toluene	1/15	1 - 1	1.62	1/8	46 - 46	46	7.06	41,000,000	35.4	N	A
Xylenes, total	1/15	2.1 - 2.1	3.73	1/8	2,000 - 2,000	2,000	250.84	100,000,000	2,000	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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 industrial exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

F - COPC (eval. qual.)

The following chemicals were selected as COPCs at SWMU 7 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
Antimony	Aroclor-1260	Arsenic	2-Methylnaphthalene*
Arsenic	Benzo(a)anthracene		Phenanthrene*
Beryllium	Benzo(a)pyrene		
Iron	Benzo(b)fluoranthene		
	Benzo(k)fluoranthene		
	Chrysene		
	Indeno(1,2,3-cd)pyrene		
	Benzo(g,h,i)perylene*		
	Phenanthrene*		

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section.

Antimony, arsenic, beryllium, and iron were selected as COPCs in surface soil. The concentrations of these metals exceeded RBCs developed for the residential land use scenario. Aroclor-1260 was detected in 4 out of 13 samples with a maximum of 16,500 µg/kg. Aroclor-1260 was selected as a COPC. Carcinogenic PAHs were also selected as COPCs in surface soils. They were detected infrequently; however, the maximum concentrations of these organics exceeded residential RBC values. Benzo(g,h,i)perylene and phenanthrene will be evaluated qualitatively in the uncertainty section because they lack quantitative toxicity values.

Arsenic is selected as the only COPC in subsurface soil. It was detected in seven out of eight samples at a range of 0.3 mg/kg to 3.9 mg/kg. The maximum concentration of arsenic exceeded RBCs developed for the industrial land use scenario. Organic chemicals were detected in subsurface soils, but at levels less than industrial RBC values. Phenanthrene and 2-methylnaphthalene will be evaluated qualitatively in the uncertainty section because they lack quantitative toxicity values.

4.6.2.2 Sediment and Surface Water

Several VOCs, phthalates, PAHs, PCBs, pesticides and metals were detected in one or more of the sediment samples collected at SWMU 7. Methylene chloride and metals were detected in surface-water samples collected at SWMU 7. The occurrence and distribution of chemicals in sediment and surface water are presented in Tables 4-12 through 4-15. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in SWMU 7 sediment and surface water are also

TABLE 4-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SEDIMENT AT SWMU 7 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	12/12	97.7 - 3,350	1,332	5/5	1,630 - 4,330	2,483	2,483	7,800	4,190	N	A
Antimony	0/13	Not detected	–	1/9	7 - 7	7	3.21	3.1	7.	Y	C
Arsenic	8/12	1.5 - 7	2.63	6/9	3.6 - 5.8	4.13	3.23	0.43	5.38	Y	C
Barium	13/13	5 - 15.2	9.27	9/9	5.6 - 14.9	10.4	10.40	550	14	N	A
Beryllium	1/13	0.12 - 0.12	0.06	4/9	0.28 - 0.46	0.39	0.21	0.15	0.46	Y	C
Cadmium	3/13	0.06 - 0.9	0.22	6/9	0.77 - 2.8	1.73	1.45	3.9	2.39	N	A
Chromium**	8/13	2.1 - 11.7	5.01	9/9	6.9 - 32.3	18.86	18.86	39	28.4	N	A
Copper	13/13	0.76 - 34.6	8.88	9/9	11.6 - 127	52.49	52.49	310	127.	N	A
Cyanide	0/13	Not detected	–	1/2	13 - 13	13	9.00	160	13.	N	A
Iron	12/12	109 - 3,640	1,199	5/5	2,130 - 4,270	3,490	3,490	2,300	4,270	Y	C
Lead	12/13	5.5 - 56.5	17.97	9/9	29.45 - 209	101.03	101	400	169	N	A
Manganese	12/12	4 - 38.6	15.39	5/5	14.6 - 30.5	25.71	25.71	180	30.5	N	A
Mercury	4/13	0.04 - 0.07	0.05	6/9	0.13 - 1.8	0.53	0.37	2.3	1.8	N	A
Nickel	10/13	0.7 - 5.5	2.15	6/9	3.6 - 11	7.78	6.34	160	10.8	N	A
Silver	1/13	0.5 - 0.5	0.27	5/9	0.7 - 29.1	10.25	6.01	39	29.1	N	A
Sulfide	1/1	340 - 340	340	2/2	100 - 300	141.42	200.00	–	300.	N	D
Tin	1/2	0.99 - 0.99	3	3/4	24 - 200	85.10	64.97	4,700	200	N	A
vanadium	13/13	1.6 - 11.7	5.08	8/9	2.4 - 16.6	10.48	9.48	55	16.6	N	A
Zinc	8/13	3.5 - 140	25.74	9/9	83.7 - 487	300.29	300.29	2,300	487	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Sediment RBCs are adapted using residential soil RBC.

An RBC for lead based on cancer risk or hazard index is not available. The 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
D - Not COPC (nut./mineral)
**As Chromium VI

TABLE 4-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SEDIMENT AT SWMU 7 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBs											
4,4'-DDD	1/12	3.9 - 3.9	13.03	3/5	10.05 - 58	34.38	24.72	2,700	58	N	A
4,4'-DDE	5/12	2.2 - 149	19.85	6/7	12.9 - 450	131.09	113.14	1,900	450	N	A
4,4'-DDT	1/12	3.7 - 3.7	13.02	2/5	5.7 - 674	339.85	144.43	1,900	674	N	A
alpha-BHC	3/8	1.1 - 1.5	7.11	2/4	2.5 - 5.6	4.05	6.65	100	5.6	N	A
Aroclor-1260	1/15	40.8 - 40.8	70.57	3/6	56.4 - 510	262.13	195.57	320	510	Y	B
Delta-BHC	2/12	2.8 - 15.7	7.35	3/5	5 - 13	9.83	9.60	–	13	Y	F
Dieldrin	0/12	Not detected	–	1/4	6 - 6	6	12.11	40	6	N	A
Endrin	1/12	1.4 - 1.4	12.89	2/5	6.6 - 8.1	7.35	11.43	2,300	8.1	N	A
gamma-BHC (lindane)	4/12	1.2 - 2.1	6.72	1/4	11.6 - 11.6	11.6	8.20	490	11.6	N	A
gamma-chlordane	0/1	Not detected	–	1/2	51 - 51	51	63	490	51	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Benzo(a)anthracene	0/13	Not detected	–	1/9	1,910 - 1,910	1,910	1,151	880	1,910	Y	B
Benzo(b)fluoranthene	1/13	489 - 489	966.92	1/9	3,500 - 3,500	3,500	1,328	880	3,500	Y	B
Benzo(g,h,i)perylene	0/13	Not detected	–	1/9	992 - 992	992	1,030	–	992	Y	EF
Bis(2-ethylhexyl)phthalate	1/6	4,500 - 4,500	1,992	2/7	580 - 620	600	942.50	46,000	620	N	A
Chrysene	1/13	417 - 417	961.38	1/9	2,120 - 2,120	2,120	1,155	88,000	2,120	Y	E
Fluoranthene	1/13	690 - 690	982.38	1/9	4,000 - 4,000	4,000	1,364	310,000	4,000	N	A
Phenanthrene	0/13	Not detected	–	1/9	900 - 900	900	1,101	–	900	Y	F
Pyrene	1/13	509 - 509	968.46	1/9	4,000 - 4,000	4,000	1,364	230,000	4,000	N	A
VOLATILE ORGANIC COMPOUNDS											
2-butanone	1/6	4 - 4	8.49	1/2	8 - 8	8	8.75	4,700,000	8	N	A
Acetone	3/6	4 - 120	30.90	2/2	60 - 190	125	125	780,000	190	N	A
Cis-1,2-dichloroethene	0/2	Not detected	–	1/4	3 - 3	3	2.94	78,000	3	N	A
Methylene chloride	1/6	5 - 5	5.83	2/4	34 - 49	41.50	36.60	85,000	49	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Sediment RBCs are adapted using residential soil RBC.

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

*A - Not COPC (Max<RBC)
B - COPC (Max>RBC, organics)
E - COPC - (same family)
F - COPC (eval. qual.)

TABLE 4-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE WATER AT SWMU 7 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Antimony	4/12	3.5 - 205	33.71	3/8	90.5 - 220	169.83	64.94	14	220	Y	C
Arsenic	3/13	2.6 - 5.2	3.97	1/9	2.5 - 2.5	2.5	2.97	0.018	2.5	N	G
Barium	11/13	4.7 - 16.3	6.93	8/8	8 - 40.4	18.06	18.06	–	37.3	Y	H
Beryllium	2/13	0.17 - 0.26	0.22	1/9	1.1 - 1.1	1.1	0.34	0.0077	1.1	Y	C
Chromium**	1/13	16.4 - 16.4	2.62	4/9	2.3 - 2.7	2.53	3.46	170	2.7	N	A
Cyanide	0/8	Not detected	–	1/6	2.6 - 2.6	2.6	9.23	700	2.6	N	A
Iron	5/12	8.5 - 170	24.7	1/5	168 - 168	168	99.82	–	168	Y	H
Manganese	2/12	3.2 - 12.3	2.0	5/5	8.7 - 13.2	10.02	10.02	–	12.1	Y	H
Mercury	6/13	0.29 - 4.2	0.52	4/9	0.12 - 0.34	0.19	0.13	0.14	0.205	N	G
Sulfide	1/1	4,000 - 4,000	4,000	2/2	3,000 - 6,000	4,500	4,500	–	6,000	N	D
Tin	0/4	Not detected	–	3/4	30 - 180	86.13	68.35	–	180	Y	H
Zinc	5/13	1.4 - 39.6	7.19	4/9	3.8 - 31.2	12.31	6.03	–	31.2	Y	H

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg)

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

D - Not COPC (nut./mineral)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

H - COPC (lacks an RBC, but has a quantitative toxicity)

**As Chromium VI

TABLE 4-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE WATER AT SWMU 7 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	3/9	1 - 1	1.5	2/4	2 - 2	2	4.75	4.7	2	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

presented in these tables. The following chemicals were selected as COPCs for SWMU 7 sediment and surface water:

SEDIMENT		SURFACE WATER	
Inorganics	Organics	Inorganics	Organics
Antimony	Aroclor-1260	Antimony	None Selected
Arsenic	Benzo(a)anthracene	Beryllium	
Beryllium	Benzo(b)fluoranthene	Barium**	
Iron	Chrysene	Iron**	
	delta-BHC*	Manganese**	
	Benzo(g,h,i)perylene*	Tin**	
	Phenanthrene*	Zinc**	

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No WQSs (for consumption of water and organisms) were listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Antimony, arsenic, beryllium, and iron were selected as COPCs for sediment at SWMU 7. Antimony, arsenic, and beryllium were detected sporadically in sediment samples. All detections of these metals exceeded residential RBCs. Iron was detected in five sediment samples at a range of 2,130 mg/kg through 4,270 mg/kg. The maximum and representative concentration of iron exceeded RBCs for residential soil exposure. Carcinogenic PAHs, including benzo(a)anthracene, benzo(b)fluoranthene, and chrysene were selected as COPCs in sediment at SWMU 7. They were each detected in one out of nine sediment samples. The maximum and representative concentrations of these PAHs were detected at concentrations exceeding residential soil RBCs. Aroclor-1260 was detected in 3 out of 6 samples at a range of 56.4 µg/kg through 510 µg/kg. The maximum and representative concentration of Aroclor-1260 exceeded RBCs for residential soil exposure. Soil RBCs are used because RBCs protective of human health for sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health. Delta-BHC, benzo(g,h,i)perylene, and phenanthrene will be evaluated quantitatively in the uncertainty section because they lack qualitative toxicity values.

WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure basis for developing an applicable WQS. Thus, the use of WQSs as RBCs to select surface-water COPCs is conservative regarding protection of human health.

Antimony and beryllium were selected as COPCs for surface water. Antimony was detected in three out of eight samples at a range of 90.5 µg/L to 220 µg/L. All concentrations of antimony exceeded the WQS. Beryllium was detected in one out of nine samples at a concentration of 1.1 µg/L that exceeded the WQS. Barium, iron, manganese, tin, and zinc were also selected as COPCs for surface water at SWMU 7. These chemicals did not have listed WQS values, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

4.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at SWMU 7 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

4.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at SWMU 7 are presented in Section 4.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

4.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under a RME and a CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if an HI (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in three parts:

- Carcinogenic risks
- Noncarcinogenic risks
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

4.6.5.1 Carcinogenic Risks

Table 4-16 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents is 3E-04, which is greater than both the EPA "target risk range" of 1E-04 to 1E-06 and the FDEP target risk of 1E-06. Dermal contact with surface soil for the future resident has an incremental cancer risk of 2E-04. The dermal exposure route contributes the most to the cumulative carcinogenic risk for the future resident. This exposure route is also associated with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPCs contributing to this cancer risk are Aroclor-1260 and arsenic in surface soil. The estimated carcinogenic risks for trespasser adults (1E-05), trespasser adolescents (1E-05), maintenance workers (6E-06), and occupation workers (5E-05) are within the EPA target risk range but exceed the FDEP target risk. The estimated carcinogenic risk for excavation workers is below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 4.6.8.

Table 4-17 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents of 4E-05 is at the lower end of the EPA "target risk range" of 1E-04 to 1E-06, but exceed the FDEP target risk of 1E-06. The dermal contact with surface soil contributes the most to the cumulative carcinogenic risk for the future resident. The estimated carcinogenic risks for all other receptors are below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 4.6.8.

4.6.5.2 Noncarcinogenic Risks

Table 4-16 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The incidental ingestion route contributes the most to the cumulative carcinogenic risk for the future resident. The dermal exposure route also contributes to the cumulative carcinogenic risk for the future resident. This exposure route is also associated with high uncertainty based on the absorption

TABLE 4-16

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
SWMU 7*
NAS KEY WEST, KEY WEST, FLORIDA

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	9E-05	2E-06	2E-06	1E-06	NA	1E-05
Dermal Contact	2E-04	7E-06	7E-06	5E-06	NA	4E-05
Inhalation of Fugitive Dust	1E-12	9E-15	6E-15	1E-14	NA	2E-13
Subtotal	3E-04	9E-06	9E-06	6E-06	NA	5E-05
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	3E-08	NA
Dermal Contact	NA	NA	NA	NA	7E-08	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	1E-15	NA
Subtotal	NA	NA	NA	NA	1E-07	NA
Sediment						
Incidental Ingestion	6E-06	3E-07	4E-07	NA	NA	NA
Dermal Contact	1E-05	2E-06	2E-06	NA	NA	NA
Subtotal	2E-05	2E-06	2E-06	NA	NA	NA
Surface Water						
Incidental Ingestion	2E-06	2E-07	2E-07	NA	NA	NA
Dermal Contact	7E-07	9E-08	8E-08	NA	NA	NA
Subtotal	2E-06	2E-07	3E-07	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	3E-04	1E-05	1E-05	6E-06	1E-07	5E-05
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	5E-01	4E-03	8E-03	2E-03	NA	2E-02
Dermal Contact	3E-01	1E-02	2E-02	7E-03	NA	6E-02
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	8E-01	2E-02	3E-02	9E-03	NA	8E-02
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	5E-03	NA
Dermal Contact	NA	NA	NA	NA	1E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	2E-02	NA
Sediment						
Incidental Ingestion	1E-01	3E-03	6E-03	NA	NA	NA
Dermal Contact	1E-01	2E-02	2E-02	NA	NA	NA
Subtotal	2E-01	2E-02	3E-02	NA	NA	NA
Surface Water						
Incidental Ingestion	1E+00	7E-02	1E-01	NA	NA	NA
Dermal Contact	9E-01	4E-02	6E-02	NA	NA	NA
Subtotal	2E+00	1E-01	2E-01	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	3E+00	1E-01	3E-01	9E-03	2E-02	8E-02

* = Chemical-Specific Risks are presented in Section 4.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
NA = Not Applicable; pathway is not applicable for the respective media.

TABLE 4-17

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
SWMU 7*
NAS KEY WEST, KEY WEST, FLORIDA

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	3E-05	1E-07	9E-08	2E-07	NA	4E-06
Dermal Contact	1E-05	3E-07	1E-07	4E-07	NA	3E-06
Inhalation of Fugitive Dust	4E-13	2E-15	6E-16	4E-15	NA	9E-14
Subtotal	4E-05	4E-07	2E-07	5E-07	NA	7E-06
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	2E-09	NA
Dermal Contact	NA	NA	NA	NA	3E-09	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	3E-16	NA
Subtotal	NA	NA	NA	NA	5E-09	NA
Sediment						
Incidental Ingestion	9E-07	3E-08	2E-08	NA	NA	NA
Dermal Contact	4E-07	7E-08	3E-08	NA	NA	NA
Subtotal	1E-06	1E-07	5E-08	NA	NA	NA
Surface Water						
Incidental Ingestion	3E-07	3E-08	2E-08	NA	NA	NA
Dermal Contact	3E-07	2E-08	8E-09	NA	NA	NA
Subtotal	5E-07	5E-08	3E-08	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	4E-05	6E-07	3E-07	5E-07	5E-09	7E-06
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	5E-01	9E-04	2E-03	9E-04	NA	2E-02
Dermal Contact	6E-02	1E-03	4E-04	1E-03	NA	1E-02
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	6E-01	2E-03	2E-03	2E-03	NA	3E-02
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	7E-04	NA
Dermal Contact	NA	NA	NA	NA	1E-03	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	2E-03	NA
Sediment						
Incidental Ingestion	6E-02	7E-04	2E-03	NA	NA	NA
Dermal Contact	1E-02	2E-03	2E-03	NA	NA	NA
Subtotal	7E-02	2E-03	4E-03	NA	NA	NA
Surface Water						
Incidental Ingestion	7E-01	3E-02	7E-02	NA	NA	NA
Dermal Contact	6E-01	2E-02	3E-02	NA	NA	NA
Subtotal	1E+00	5E-02	1E-01	NA	NA	NA
Shellfish						
Ingestion of Shellfish	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E+00	6E-02	1E-01	2E-03	2E-03	3E-02

* = Chemical-Specific Risks are presented in Section 4.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

NA = Not Applicable; pathway is not applicable for the respective media.

efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPCs contributing to the noncarcinogenic risk are arsenic, antimony, and iron in surface soil and antimony in surface water. The target organs are as follows: arsenic (skin), antimony (heart), and iron (pancreas and liver). The HI for antimony (via exposure to surface soil and surface water) is greater than 1.0. The HIs for arsenic and iron (via exposure to surface soil) are less than 1.0. The HIs for all other receptors at SWMU 7 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 4.6.8.

Table 4-17 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The HI for antimony (via exposure to surface soil and surface water) is greater than 1.0. The HIs for arsenic and iron (via exposure to surface soil) are less than 1.0. The HIs for all other receptors at SWMU 7 are less than or equal to 1.0. Chemical-specific risks for COPCs are presented in Section 4.6.8.

4.6.5.3 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the SWMU 7 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 4-18 and 4-19 for inorganics and organics, respectively. The results of this preliminary comparison for SWMU 7 are presented in this section.

The maximum values of antimony exceeded both its respective MCL and tap water RBC values. Antimony was detected in one out of four samples at a concentration of 46 µg/L. Arsenic, chromium VI, and cyanide concentrations exceeded tap water RBCs; however, this is not uncommon for unfiltered groundwater. Four organic chemicals, 2-butanone, acetone, bis(2-ethylhexyl)phthalate, and methylene chloride, were detected in groundwater. These chemicals are considered common laboratory contaminants. The concentrations of these organic constituents did not exceed either MCLs or RBCs.

TABLE 4-18

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 - 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	0.24	0.12	2	N	1.1	N
Sulfide	3/3	10,000 - 52,000	28000	1/1	4,000 - 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 4-19

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

Chemical	Background			Site				Maximum Contami-nant Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentra-tion	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				
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.

4.6.6 Uncertainties for SWMU 7

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of SWMU 7 risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and HI (via surface soils and surface water) for the future residential receptors. The uncertainty associated with the dermal exposure route may overestimate the risk at SWMU 7.

- Arsenic is a major contributor to the cumulative carcinogenic risks in surface soil. The carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Since arsenic is a major contributor to the risk, risks may be overstated.

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at SWMU 7 (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

- Four chemicals (delta-BHC, benzo(g,h,i)perylene, 2-methylnaphthalene, and phenanthrene) did not have a listed toxicity value for use in the quantitative risk assessment; therefore, no risks were estimated for exposure to these chemicals in surface soil and sediment. These chemicals were detected at low frequencies and levels that were comparable to other pesticides and PAHs in sediment. These conditions could possibly underestimate the carcinogenic and noncarcinogenic risk at SWMU 7, but without additional toxicity information, this uncertainty remains unknown.

4.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for SWMU 7.

4.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment, a subset of chemicals, called Chemicals of Concern (COCs), was selected for the evaluation of remedial clean-up goal options (RGOs). At SWMU 7, COCs were included in the RGO evaluation only if the COC's contribution to risk exceeds a cancer risk level of 1E-06 or a hazard quotient of 0.1. The COCs selected at SWMU 7 are as follows:

- Surface Soils

  - Aroclor-1260
  - Arsenic
  - Antimony
  - Benzo(a)anthracene
  - Benzo(a)pyrene
  - Benzo(b)fluoranthene
  - Beryllium
  - Indeno(1,2,3-cd)pyrene
  - Iron

Arsenic was selected as a COC in soil because its contribution to the cancer risk level is greater than 1E-06 and because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor). Aroclor-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, and indeno(1,2,3-cd)pyrene were selected as COCs in soil because their contribution to the cancer risk was greater than 1E-06 (future residential receptor). Antimony and iron were selected as COCs in soil because their contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor).

- Sediment

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

Aroclor-1260, arsenic, and benzo(b)fluoranthene were selected as COCs in sediment because their contribution to the cancer risk was greater than 1E-06 (future residential receptor).

- Surface water

  - Antimony
  - Beryllium

Antimony was selected as a COC in surface water because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor). Beryllium was selected as a COC in surface water because its contribution to the cancer risk is greater than 1E-06 (future residential receptor).

4.6.7.2 Remedial Goal Options

RGO based on generic FDEP and RCRA TBCs for COCs in surface soils are listed in Table 4-20 for residential exposure scenarios. Table 4-21 lists RGOs for COCs in surface water based on WQSs (for consumption of water and organisms). RGOs are not listed for sediment because generic levels for sediment exposure have not been established. The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 4-22 (surface soil - future resident), Table 4-23 (sediment - future resident), and Table 4-24 (surface water - future resident). These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

4.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 4-25 and 4-26. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium

- Representative concentrations for each COPC in each applicable medium

TABLE 4-20

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE SOIL AT SWMU 7 NAS KEY WEST

COC	RCRA Subpart S Action Levels (mg/kg)	FDEP Residential Soil Cleanup Goals (mg/kg)
INORGANICS		
Arsenic	80	0.8
Antimony	32	26
Beryllium	0.2	0.2
Iron	NA	NA
ORGANICS		
Aroclor-1260	0.09	0.9
Benzo(a)anthracene	1	1.4
Benzo(a)pyrene	0.1	0.1
Benzo(b)fluoranthene	1	1.4
Indeno(1,2,3-cd)pyrene	1	1.4

NA = Not applicable

TABLE 4-21
TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE WATER AT SWMU 7 NAS KEY WEST

COC	Human Health Criteria Water+Organism Consumption (µg/L)
Antimony	14
Beryllium	0.0077

TABLE 4-22
REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE SOIL AT SWMU 7 NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	0.09	0.9	9	0.92	9.2	28
Antimony	-	-	-	3	30	90
Beryllium	0.15	1.5	15	-	-	-
Iron	-	-	-	2,300	23,000	67,000
ORGANICS (µg/kg)						
Aroclor-1260	82	821	8,200	-	-	-
Benzo(a)anthracene	877	8,800	88,000	-	-	-
Benzo(a)pyrene	87	875	8,800	-	-	-
Benzo(b)fluoranthene	874	8,800	88,000	-	-	-
Indeno(1,2,3-cd)pyrene	875	8,800	88,000	-	-	-

TABLE 4-23
REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SEDIMENT AT SWMU 7
NAS KEY WEST

	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
COC	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	0.33	3.3	33	-	-	-
ORGANICS (µg/kg)						
Aroclor-1260	288	2,900	29,000	-	-	-
Benzo(b)fluoranthene	3,200	32,000	320,000			

TABLE 4-24
REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE WATER AT SWMU 7
NAS KEY WEST

	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
COC	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Antimony	-	-	-	10.1	101	303
Beryllium	0.45	`4.5	45	-	-	-

TABLE 4-25

RME--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	1.4E-01	6.9E-03	NA	1.5E-01
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	1.1E-05	4.1E-05	6.8E-13	5.1E-05	1.9E-01	3.0E-01	NA	4.9E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.1E-06	1.4E-07	3.4E-14	1.3E-06	4.3E-04	2.1E-05	NA	4.6E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	1.6E-01	7.7E-03	NA	1.7E-01
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	5.2E-05	1.5E-04	NA	2.0E-04	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	1.9E-06	NA	4.3E-14	1.9E-06	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	2.3E-05	NA	5.4E-13	2.3E-05	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	3.8E-06	NA	8.8E-14	3.8E-06	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	3.5E-08	NA	8.2E-16	3.5E-08	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	2.2E-08	NA	5.1E-16	2.2E-08	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	1.7E-06	NA	3.9E-14	1.7E-06	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	9.4E-05	1.9E-04	1.4E-12	2.8E-04	5.0E-01	3.1E-01	NA	8.1E-01
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	3.4E-06	1.3E-05	NA	1.6E-05	6.2E-02	9.5E-02	NA	1.6E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	5.2E-02	2.5E-03	NA	5.4E-02
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	4.6E-07	1.3E-06	NA	1.8E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	6.2E-07	NA	NA	6.2E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	1.1E-06	NA	NA	1.1E-06	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	6.9E-09	NA	NA	6.9E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.6E-06	1.4E-05	NA	2.0E-05	1.1E-01	9.7E-02	NA	2.1E-01
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	1.3E+00	8.8E-01	NA	2.2E+00
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	1.3E-03	8.5E-04	NA	2.1E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	1.8E-06	6.6E-07	NA	2.4E-06	5.2E-04	3.5E-04	NA	8.7E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	1.3E-03	8.9E-04	NA	2.2E-03
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	1.2E-03	8.4E-04	NA	2.1E-03
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	7.1E-04	4.8E-04	NA	1.2E-03
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	2.5E-04	1.7E-04	NA	4.1E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.8E-06	6.6E-07	NA	NA	1.3E+00	8.8E-01	NA	2.2E+00
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.0E-04	2.0E-04	1.4E-12	3.0E-04	1.9E+00	1.3E+00	NA	3.2E+00

TABLE 4-25

RME--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	1.1E-03	3.0E-04	NA	1.4E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	1.7E-07	1.6E-06	4.2E-15	1.8E-06	1.4E-03	1.3E-02	NA	1.4E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.9E-08	5.4E-09	2.1E-16	2.4E-08	3.2E-06	9.2E-07	NA	4.1E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	1.2E-03	3.4E-04	NA	1.5E-03
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	8.4E-07	5.8E-06	NA	6.6E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	3.1E-08	NA	2.7E-16	3.1E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	3.8E-07	NA	3.4E-15	3.8E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	6.2E-08	NA	5.5E-16	6.2E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	5.8E-10	NA	5.1E-18	5.8E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	3.6E-10	NA	3.2E-18	3.6E-10	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	2.8E-08	NA	2.4E-16	2.8E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.5E-06	7.4E-06	8.9E-15	8.9E-06	3.7E-03	1.4E-02	NA	1.7E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	1.9E-07	1.8E-06	NA	2.0E-06	1.6E-03	1.5E-02	NA	1.6E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	1.3E-03	3.8E-04	NA	1.7E-03
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	2.6E-08	1.8E-07	NA	2.1E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	3.6E-08	NA	NA	3.6E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	6.5E-08	NA	NA	6.5E-08	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	3.9E-10	NA	NA	3.9E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.2E-07	2.0E-06	NA	2.3E-06	2.9E-03	1.5E-02	NA	1.8E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	6.7E-02	3.9E-02	NA	1.1E-01
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	6.5E-05	3.7E-05	NA	1.0E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	1.6E-07	9.0E-08	NA	2.5E-07	2.7E-05	1.5E-05	NA	4.2E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	6.8E-05	3.9E-05	NA	1.1E-04
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	6.4E-05	3.7E-05	NA	1.0E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	3.7E-05	2.1E-05	NA	5.8E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	1.3E-05	7.3E-06	NA	2.0E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.6E-07	9.0E-08	NA	2.5E-07	6.7E-02	3.9E-02	NA	1.1E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.0E-06	9.5E-06	8.9E-15	1.1E-05	7.4E-02	6.7E-02	NA	1.4E-01

TABLE 4-25

RME--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser – Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	2.3E-03	4.8E-04	NA	2.8E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	2.2E-07	1.4E-06	3.1E-15	1.7E-06	3.1E-03	2.0E-02	NA	2.4E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	2.4E-08	4.9E-09	1.5E-16	2.8E-08	7.0E-06	1.4E-06	NA	8.4E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	2.6E-03	5.4E-04	NA	3.1E-03
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	1.1E-06	5.3E-06	NA	6.3E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	3.9E-08	NA	2.0E-16	3.9E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	4.8E-07	NA	2.4E-15	4.8E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	7.9E-08	NA	4.0E-16	7.9E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	7.3E-10	NA	3.7E-18	7.3E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	4.6E-10	NA	2.3E-18	4.6E-10	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	3.5E-08	NA	1.8E-16	3.5E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.9E-06	6.7E-06	6.4E-15	8.7E-06	8.0E-03	2.1E-02	NA	2.9E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	2.5E-07	1.6E-06	NA	1.9E-06	3.5E-03	2.3E-02	NA	2.6E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	2.9E-03	6.0E-04	NA	3.5E-03
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	3.3E-08	1.6E-07	NA	2.0E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	4.5E-08	NA	NA	4.5E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	8.3E-08	NA	NA	8.3E-08	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	5.0E-10	NA	NA	5.0E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	4.1E-07	1.8E-06	NA	2.2E-06	6.4E-03	2.4E-02	NA	3.0E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	1.5E-01	6.1E-02	NA	2.1E-01
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	1.4E-04	5.9E-05	NA	2.0E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	2.0E-07	8.2E-08	NA	2.8E-07	5.9E-05	2.4E-05	NA	8.3E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	1.5E-04	6.2E-05	NA	2.1E-04
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	1.4E-04	5.8E-05	NA	2.0E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	8.0E-05	3.3E-05	NA	1.1E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	2.8E-05	1.1E-05	NA	3.9E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.0E-07	8.2E-08	NA	2.8E-07	1.5E-01	6.1E-02	NA	2.1E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.5E-06	8.6E-06	6.4E-15	1.1E-05	1.6E-01	1.1E-01	NA	2.7E-01

TABLE 4-25

RME--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	6.2E-04	1.5E-04	NA	7.8E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	1.3E-07	1.0E-06	5.6E-15	1.2E-06	8.4E-04	6.5E-03	NA	7.3E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.4E-08	3.5E-09	2.8E-16	1.8E-08	1.9E-06	4.6E-07	NA	2.3E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	7.0E-04	1.7E-04	NA	8.7E-04
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	6.5E-07	3.8E-06	NA	4.5E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	2.4E-08	NA	3.6E-16	2.4E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	2.9E-07	NA	4.4E-15	2.9E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	4.8E-08	NA	7.2E-16	4.8E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	4.5E-10	NA	6.7E-18	4.5E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	2.8E-10	NA	4.2E-18	2.8E-10	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	2.1E-08	NA	3.2E-16	2.1E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.2E-06	4.9E-06	1.2E-14	6.1E-06	2.2E-03	6.8E-03	NA	9.0E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.2E-06	4.9E-06	1.2E-14	6.1E-06	2.2E-03	6.8E-03	NA	9.0E-03

TABLE 4-25

RME--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	3.4E-08	6.6E-08	1.1E-15	1.0E-07	5.3E-03	1.0E-02	NA	1.6E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.4E-08	6.6E-08	1.1E-15	1.0E-07	5.3E-03	1.0E-02	NA	1.6E-02
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.4E-08	6.6E-08	1.1E-15	1.0E-07	5.3E-03	1.0E-02	NA	1.6E-02

TABLE 4-25

RME--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
PAGE 6 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	5.5E-03	1.3E-03	NA	6.8E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	1.2E-06	8.7E-06	1.2E-13	9.9E-06	7.4E-03	5.4E-02	NA	6.2E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.3E-07	2.9E-08	5.8E-15	1.6E-07	1.7E-05	3.8E-06	NA	2.0E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	6.2E-03	1.4E-03	NA	7.6E-03
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	5.8E-06	3.2E-05	NA	3.8E-05	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	2.1E-07	NA	7.4E-15	2.1E-07	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	2.6E-06	NA	9.2E-14	2.6E-06	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	4.3E-07	NA	1.5E-14	4.3E-07	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	4.0E-09	NA	1.4E-16	4.0E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	2.5E-09	NA	8.8E-17	2.5E-09	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	1.9E-07	NA	6.7E-15	1.9E-07	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.1E-05	4.1E-05	2.4E-13	5.1E-05	1.9E-02	5.7E-02	NA	7.6E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.1E-05	4.1E-05	2.4E-13	5.1E-05	1.9E-02	5.7E-02	NA	7.6E-02

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

TABLE 4-26

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	1.4E-01	1.4E-03	NA	1.5E-01
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	3.4E-06	2.5E-06	2.1E-13	5.9E-06	1.9E-01	5.8E-02	NA	2.5E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	3.7E-07	8.3E-09	1.1E-14	3.8E-07	4.3E-04	4.1E-06	NA	4.4E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	1.6E-01	1.5E-03	NA	1.6E-01
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	1.7E-05	9.0E-06	NA	2.6E-05	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	6.0E-07	NA	1.4E-14	6.0E-07	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	7.5E-06	NA	1.7E-13	7.5E-06	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	1.2E-06	NA	2.8E-14	1.2E-06	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	1.1E-08	NA	2.6E-16	1.1E-08	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	7.2E-09	NA	1.6E-16	7.2E-09	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	5.4E-07	NA	1.2E-14	5.4E-07	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.0E-05	1.1E-05	4.5E-13	4.2E-05	5.0E-01	6.1E-02	NA	5.6E-01
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	5.5E-07	4.0E-07	NA	9.4E-07	3.1E-02	9.4E-03	NA	4.0E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	2.6E-02	2.5E-04	NA	2.6E-02
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	7.3E-08	4.0E-08	NA	1.1E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	1.0E-07	NA	NA	1.0E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	1.8E-07	NA	NA	1.8E-07	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	1.1E-09	NA	NA	1.1E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	9.0E-07	4.3E-07	NA	1.3E-06	5.7E-02	9.6E-03	NA	6.7E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	6.5E-01	5.8E-01	NA	1.2E+00
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	6.3E-04	5.6E-04	NA	1.2E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	2.8E-07	2.7E-07	NA	5.5E-07	2.6E-04	2.3E-04	NA	4.9E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	6.6E-04	5.9E-04	NA	1.3E-03
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	6.2E-04	5.5E-04	NA	1.2E-03
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	3.6E-04	3.2E-04	NA	6.7E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	1.2E-04	1.1E-04	NA	2.3E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.8E-07	2.7E-07	NA	NA	6.6E-01	5.8E-01	NA	1.2E+00
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.1E-05	1.2E-05	4.5E-13	4.3E-05	1.2E+00	6.5E-01	NA	1.9E+00

TABLE 4-26

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
PAGE 2 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	2.6E-04	3.0E-05	NA	3.0E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	1.6E-08	5.9E-08	7.8E-16	7.5E-08	3.5E-04	1.3E-03	NA	1.7E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.7E-09	2.0E-10	3.9E-17	1.9E-09	8.0E-07	9.2E-08	NA	8.9E-07
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	3.0E-04	3.4E-05	NA	3.3E-04
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	7.7E-08	2.1E-07	NA	2.9E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	2.8E-09	NA	5.0E-17	2.8E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	3.5E-08	NA	6.2E-16	3.5E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	5.7E-09	NA	1.0E-16	5.7E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	5.3E-11	NA	9.4E-19	5.3E-11	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	3.3E-11	NA	5.9E-19	3.3E-11	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	2.5E-09	NA	4.5E-17	2.5E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.4E-07	2.7E-07	1.6E-15	4.1E-07	9.2E-04	1.4E-03	NA	2.3E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	1.8E-08	6.6E-08	NA	8.4E-08	4.0E-04	1.5E-03	NA	1.9E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	3.3E-04	3.8E-05	NA	3.7E-04
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	2.4E-09	6.6E-09	NA	9.0E-09	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	3.3E-09	NA	NA	3.3E-09	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	6.0E-09	NA	NA	6.0E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	3.6E-11	NA	NA	3.6E-11	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.0E-08	7.2E-08	NA	1.0E-07	7.3E-04	1.5E-03	NA	2.2E-03
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	3.4E-02	1.9E-02	NA	5.3E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	3.3E-05	1.9E-05	NA	5.1E-05
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	2.9E-08	1.7E-08	NA	4.5E-08	1.3E-05	7.7E-06	NA	2.1E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	3.4E-05	2.0E-05	NA	5.4E-05
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	3.2E-05	1.8E-05	NA	5.1E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	1.8E-05	1.1E-05	NA	2.9E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	6.3E-06	3.7E-06	NA	1.0E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.9E-08	1.7E-08	NA	4.5E-08	3.4E-02	1.9E-02	NA	5.3E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.0E-07	3.6E-07	1.6E-15	5.6E-07	3.5E-02	2.2E-02	NA	5.8E-02

TABLE 4-26

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
PAGE 3 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	5.8E-04	8.9E-06	NA	5.9E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	1.0E-08	2.7E-08	2.8E-16	3.7E-08	7.7E-04	3.8E-04	NA	1.2E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.1E-09	9.1E-11	1.4E-17	1.2E-09	1.7E-06	2.7E-08	NA	1.8E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	6.5E-04	1.0E-05	NA	6.6E-04
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	4.8E-08	9.9E-08	NA	1.5E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	1.8E-09	NA	1.8E-17	1.8E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	2.2E-08	NA	2.2E-16	2.2E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	3.6E-09	NA	3.6E-17	3.6E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	3.3E-11	NA	3.4E-19	3.3E-11	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	2.1E-11	NA	2.1E-19	2.1E-11	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	1.6E-09	NA	1.6E-17	1.6E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	8.8E-08	1.3E-07	5.9E-16	2.1E-07	2.0E-03	4.0E-04	NA	2.4E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	1.1E-08	3.0E-08	NA	4.2E-08	8.7E-04	2.4E-03	NA	3.2E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	7.3E-04	6.2E-05	NA	7.9E-04
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	1.5E-09	3.1E-09	NA	4.5E-09	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	2.0E-09	NA	NA	2.0E-09	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	3.8E-09	NA	NA	3.8E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	2.3E-11	NA	NA	2.3E-11	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.9E-08	3.3E-08	NA	5.2E-08	1.6E-03	2.4E-03	NA	4.0E-03
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	7.3E-02	3.1E-02	NA	1.0E-01
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	7.1E-05	3.0E-05	NA	1.0E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	1.8E-08	7.7E-09	NA	2.6E-08	2.9E-05	1.2E-05	NA	4.2E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	7.5E-05	3.2E-05	NA	1.1E-04
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	7.0E-05	3.0E-05	NA	1.0E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	4.0E-05	1.7E-05	NA	5.7E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	1.4E-05	5.9E-06	NA	2.0E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.8E-08	7.7E-09	NA	2.6E-08	7.4E-02	3.1E-02	NA	1.1E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.2E-07	1.7E-07	5.9E-16	2.9E-07	7.7E-02	3.4E-02	NA	1.1E-01

TABLE 4-26

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	2.6E-04	3.0E-05	NA	3.0E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	2.0E-08	7.5E-08	2.0E-15	9.6E-08	3.5E-04	1.3E-03	NA	1.7E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	2.2E-09	2.5E-10	1.0E-16	2.5E-09	8.0E-07	9.2E-08	NA	8.9E-07
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	3.0E-04	3.4E-05	NA	3.3E-04
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	1.0E-07	2.7E-07	NA	3.7E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	3.6E-09	NA	1.3E-16	3.6E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	4.5E-08	NA	1.6E-15	4.5E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	7.4E-09	NA	2.6E-16	7.4E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	6.8E-11	NA	2.4E-18	6.8E-11	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	4.3E-11	NA	1.5E-18	4.3E-11	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	3.3E-09	NA	1.2E-16	3.3E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.8E-07	3.5E-07	4.2E-15	5.3E-07	9.2E-04	1.4E-03	NA	2.3E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.8E-07	3.5E-07	4.2E-15	5.3E-07	9.2E-04	1.4E-03	NA	2.3E-03

TABLE 4-26

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	2.1E-09	3.3E-09	2.6E-16	5.4E-09	6.5E-04	1.0E-03	NA	1.7E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.1E-09	3.3E-09	2.6E-16	5.4E-09	6.5E-04	1.0E-03	NA	1.7E-03
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.1E-09	3.3E-09	2.6E-16	5.4E-09	6.5E-04	1.0E-03	NA	1.7E-03

TABLE 4-26

CTE--CHEMICAL SPECIFIC RISKS AT SWMU 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	4.51	NA	NA	NA	NA	5.5E-03	2.5E-04	NA	5.8E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	4.52	4.3E-07	6.3E-07	4.2E-14	1.1E-06	7.4E-03	1.1E-02	NA	1.8E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	4.6E-08	2.1E-09	2.1E-15	4.8E-08	1.7E-05	7.7E-07	NA	1.7E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	3,790	NA	NA	NA	NA	6.2E-03	2.8E-04	NA	6.5E-03
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	16,500	2.1E-06	2.3E-06	NA	4.4E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,640	7.5E-08	NA	2.7E-15	7.5E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	2,040	9.4E-07	NA	3.3E-14	9.4E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,340	1.5E-07	NA	5.4E-15	1.5E-07	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	310	1.4E-09	NA	5.0E-17	1.4E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	1,950	9.0E-10	NA	3.2E-17	9.0E-10	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,480	6.8E-08	NA	2.4E-15	6.8E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.8E-06	2.9E-06	8.8E-14	6.7E-06	1.9E-02	1.1E-02	NA	3.0E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.21	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	7	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.46	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,270	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	510	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	1,910	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3,500	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	2,120	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	37.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	12.1	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	180	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	31.2	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.8E-06	2.9E-06	8.8E-14	6.7E-06	1.9E-02	1.1E-02	NA	3.0E-02

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use

- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways.

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents and excavation workers) receptors. COPCs in SWMU 7 media were not present at sufficient concentrations to cause adverse noncarcinogenic health effects to any current potential receptors or future excavation worker. The cancer risks estimated for the current potential receptors or future excavation receptors were below or within the 1E-04 to 1E-06 target risk range that is often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation. For the reasonable maximum exposure calculations, all scenarios except the future excavation worker exceeded the FDEP target risk range of 1E-06. For the central tendency exposure calculation, this was true only for hypothetical future resident and the occupational worker.

COPCs at SWMU 7 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Additionally, cancer risks for this receptor were estimated at levels exceeding 1E-04. Aroclor-1260 and arsenic are the main contributors to the carcinogenic risk, and arsenic, antimony, and iron are the main contributors to the noncarcinogenic risk.

4.7 ECOLOGICAL RISK ASSESSMENT

This section discusses the results of the ecological risk assessment performed at SWMU 7, including a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

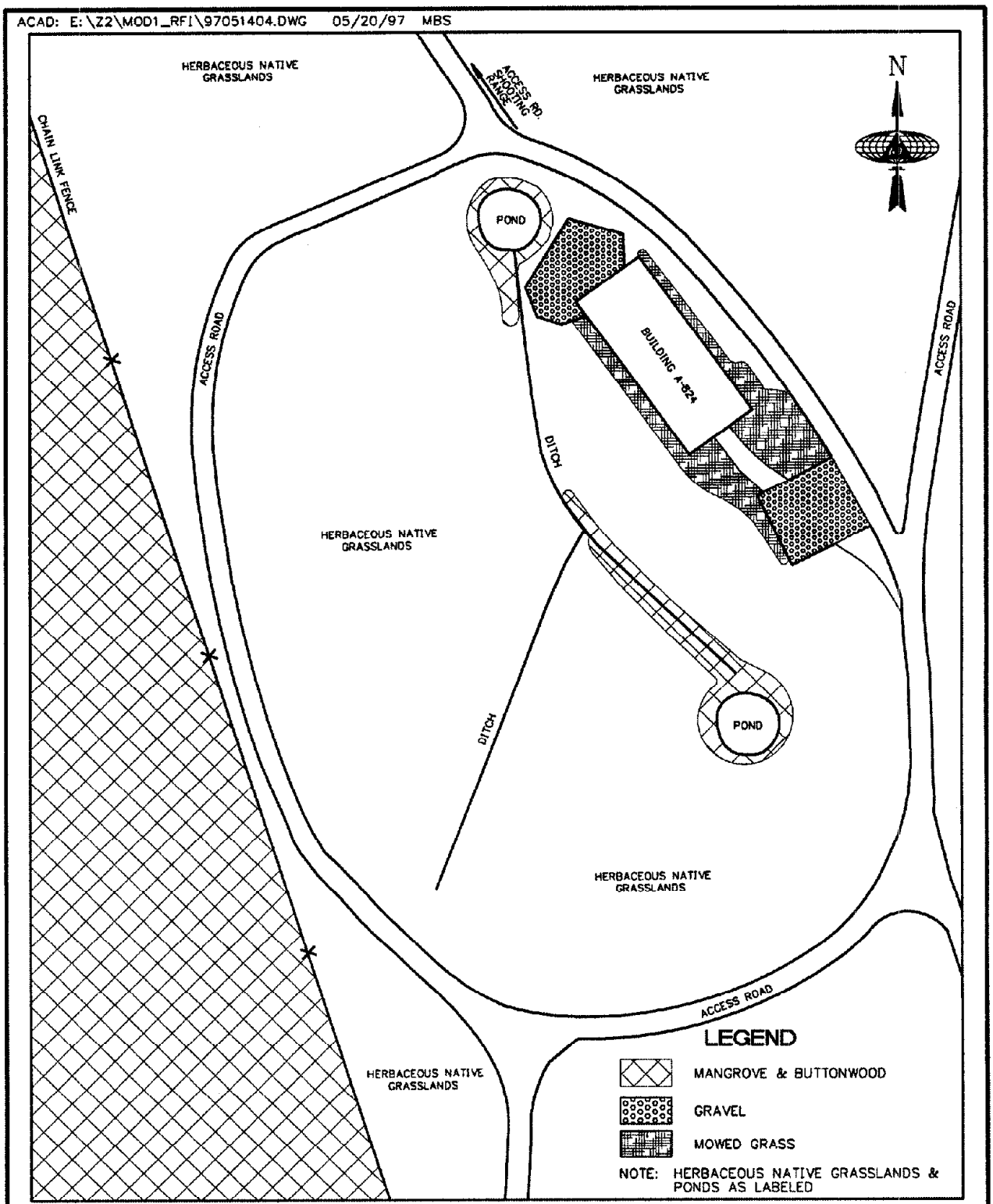
4.7.1 Problem Formulation

This section presents the ecological problem formulation including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

4.7.1.1 Habitat Types and Ecological Receptors

Section 4.1 (See Figure 4-11) describes the physical setting at SWMU 7. 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. A ditch extends southward from the northern pond. The ditch is approximately 18 inches deep and 18 inches wide. The northern pond is approximately 30 feet by 30 feet in size, and 3 to 4 feet deep. The ditch extends southward where it connects with a smaller pond approximately 150 feet south of Building A-824. The southern pond is a 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. Surface water in the ditch and ponds is stagnant and dark in color, and some portions of the ditch contained no standing water during sampling activities in October 1996. The two ponds and ditch are not connected to other areas via surface hydrology and there are no other surface-water bodies at the site. The nearest surface water is the Gulf of Mexico, which lies approximately 800 feet to the east. The ponds are surrounded by narrow strips of black mangrove and buttonwood. Native herbaceous grasslands surround the site (Figure 4-11). Vegetation consists of broom sedge (*Andropogon virginicus*), Muhly grass (*Muhlenbergia capillaris*), cordgrass (*Spartina spp.*), sea oxeye daisy, seashore dropseed, and other grasses and weeds. The vegetation is quite thick in some areas, while small areas of limestone substrate are exposed in other areas. The natural vegetation is not mowed due to the presence of the endangered Lower Keys marsh rabbit.

Water levels in the ditch and ponds are probably maintained by a combination of rain water, surface runoff, and inflow from shallow groundwater. As a result, the salinity is low, ranging from 1.7 ppt to 2.0 ppt at the time of the October sampling (Appendix C, Table C.1-3). Salinity in the northern pond was higher (18.2 ppt) during a site visit in June 1996. Water temperature was approximately 28-29°C (86°F). DO concentrations were variable at the five locations where water samples were collected (Figure 4-4), ranging from 0.57 mg/L to 5.03 mg/L. DO levels at the lower end of this range are too low to support most fish and aquatic life. Surface water associated with isolated mangrove wetlands is characteristically turbid, dark colored (stained with organic acids and tannins), and low in oxygen (Odum et al., 1982). These types of isolated wetlands tend to act as nutrient sinks and consumers of oxygen. Nutrients are removed and oxygen is consumed by a combination of periphyton on mangrove prop roots, organic detritus on the surface of sediments, the fine root systems of mangroves, small invertebrates, benthic and epiphytic algae, and bacteria and fungi on all of these surfaces. As a result, DO concentrations in mangroves are often "below saturation, typically 2 to 4 mg/L and near zero in stagnant locations" (Odum et al., 1982).



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SCALE: 1"=80'	
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BROWN & ROOT ENVIRONMENTAL

FIGURE 4-11
HABITATS AT SWMU 7

NAVAL AIR STATION
BOCA CHICA KEY, FLORIDA

Isolated mangrove wetlands, particularly those subject to seasonal cycles of flooding and drought, are harsh environments "which few species of fish can tolerate" (Odum et al., 1982). DO concentrations are frequently low in these types of wetlands, and hydrogen sulfide (a natural substance that is toxic to fish) levels are often high. The fish families best adapted to this kind of habitat are the cyprinodonts (killifishes, including the sheepshead minnow) and the poecilids (livebearers, including the mosquitofish and the sailfin molly). While the species richness of fishes in isolated mangrove wetlands is typically low, densities of fish are often surprisingly high (Odum et al., 1982). Field personnel observed minnows in the small ponds and adjoining ditch during site visits in October 1996, but none were collected or identified.

Due to the small sizes of the ponds and ditch, the use of this habitat by aquatic receptors other than minnows and invertebrates is probably insignificant. Water depth along the shoreline of the ponds is approximately 2 feet, due to steep, almost vertical banks, and prevents foraging at the site by wading piscivorous birds. Terrestrial receptors in the surrounding area probably include a variety of invertebrates as well as vertebrates such as raccoons, snakes, lizards, and birds. The use of the site and vicinity by receptors listed as threatened, endangered, or of special concern is probably limited to the endangered Lower Keys marsh rabbit, whose scat was observed in the grassy area to the west and east of the larger pond. The red rat snake (state-listed as an SSC) and endangered silver rice rat may possibly utilize some portions of nearby off-site habitats. Foliage of sea oxeye daisy and seashore dropseed, two plant species known to be consumed by the Lower Keys marsh rabbit, was collected from the vicinity of the site for tissue analysis.

4.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways at SWMU 7 is presented in Section 4.5.2.

4.7.1.3 Exposure Routes

Terrestrial animals at SWMU 7 can be exposed to soil contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation, although the airborne pathway at SWMU 7 is assumed to be insignificant. Terrestrial receptors can also come into contact with contaminants in surface water by using it for drinking. Surface-water salinity at SWMU 7 was measured only on 2 days. The salinity on one of the 2 days (18.3 ppt) would preclude the use of the water for drinking. Apparently, the salinity of site surface water varies with

environmental conditions, and the salinity may be low enough on some occasions to be used as drinking water by ecological receptors. However, this exposure route generally represents a negligible portion of total exposure for most receptors.

Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue. Volatile constituents could be present in some site soils, and soil-bound contaminant airborne suspension could occur at SWMU 7. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors.

Aquatic and terrestrial organisms inhabiting or utilizing the ponds and ditch at SWMU 7 can be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semi-aquatic organisms can also be exposed to constituents in contaminated groundwater that discharges to surface water. As mentioned above, due to the small size of the pond and ditch, the use of this habitat by aquatic receptors other than minnows is probably minimal. In addition, water depth along the shoreline of the ponds prevents foraging in the ponds by wading piscivorous birds. Wading birds may forage in the ditch, but the narrow width of the ditch (18 inches) probably prevents extensive foraging. No wading birds were seen in the ditch during sampling activities of August through October 1996.

4.7.1.4 Selection of Ecological Chemicals of Potential Concern

Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water and groundwater. Otherwise, contaminants selected for evaluation consisted of all analytes detected during current and previous sampling of surface water, sediment, and surface soil at SWMU 7. Groundwater analytes selected for evaluation consisted of analytes detected during current sampling of the two monitoring wells west of Building A-824. Inorganic contaminants in groundwater, surface water, sediment, and surface soil whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

4.7.1.5 Assessment and Measurement Endpoints

A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3 .1.1.5 of Appendix C.

4.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 4-12 shows the conceptual model for SWMU 7. The figure shows complete exposure routes for the wind erosion and volatile emission pathways and for aquatic receptors. However, since most of the site is covered with grasses and weeds, the erosion pathway is minimal. In addition, use of the site by aquatic receptors is probably minimal.

4.7.2 Ecological Effects Characterization

Ecologically-based thresholds (e.g., concentrations of contaminants in various media protective of ecological receptors) were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at SWMU 7. Brief descriptions of each COPC are included in Appendix B Part 3. Terrestrial plant thresholds were obtained to assess potential risks to plants from soil contaminants. Contaminant intake doses for the Lower Keys marsh rabbit, cotton rat, raccoon, and kestrel were modeled, and estimated doses were compared to TRVs (doses above which potential risks might be present). Example doses and TRVs are provided in Appendix B, Part 4. Surface-water, sediment, terrestrial plant, and surface soil thresholds, as well as TRVs used in foodchain modeling, are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Foliage of sea oxeye daisy and seashore dropseed (major food sources of the Lower Keys marsh rabbit) was collected from the area between the northern pond and the fence surrounding Building A-824, as well as from the area to the west of the ditch. Concentrations of metals, pesticides, and PCBs in the vegetation were compared to concentrations in vegetation collected at background sites, and maximum and mean concentrations in the vegetation samples were also used to estimate doses to the Lower Keys marsh rabbit.

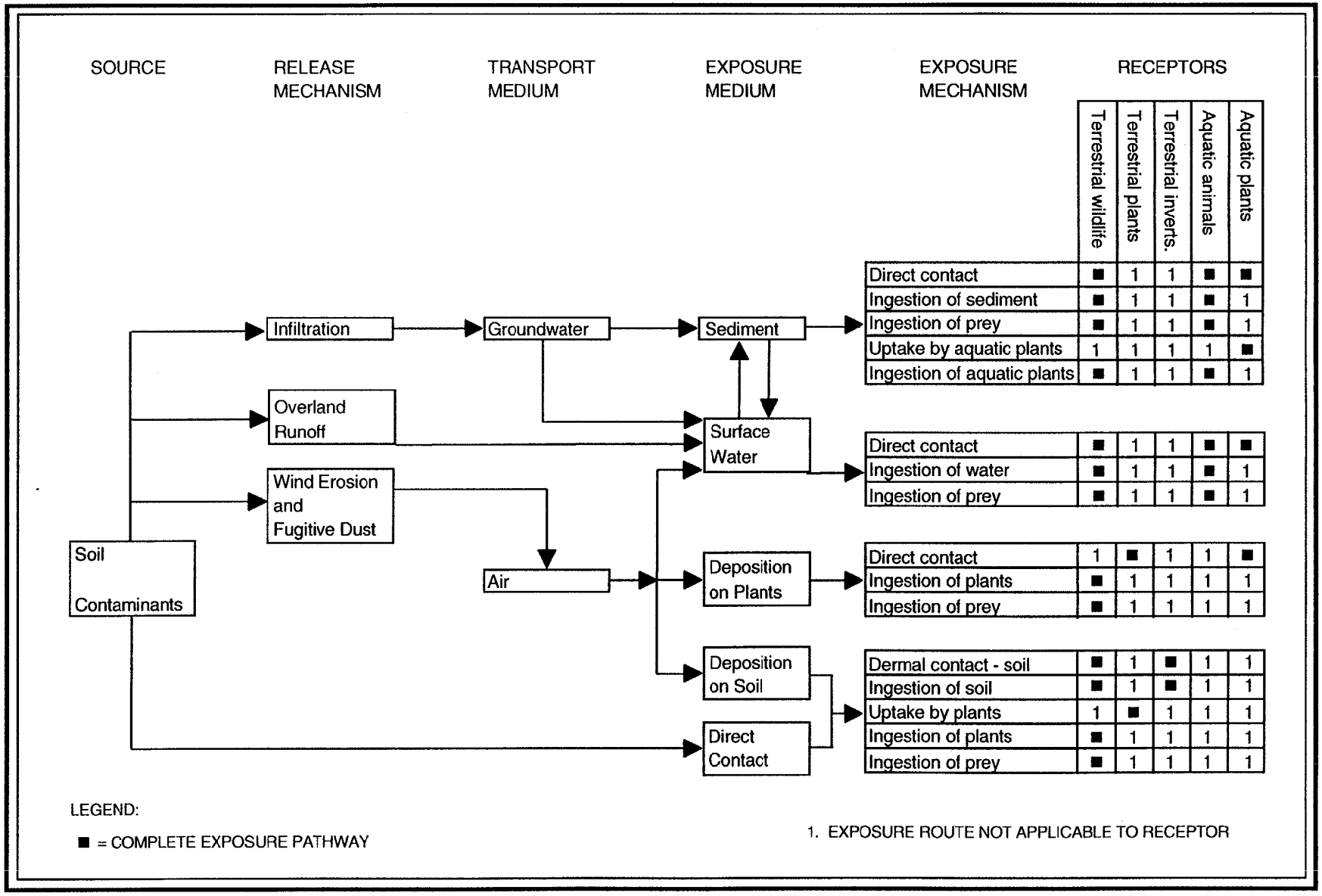

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Figure 4-12. Conceptual Site Model - SWMU 7, NAS Key West, Boca Chica Key, Florida

4.7.3 Exposure Assessment

This section presents the ecological exposure assessment for SWMU 7 through a discussion of exposure point contaminant concentrations and dose calculations.

4.7.3.1 Exposure Point Contaminant Concentrations

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil were used as representative exposure point concentrations for screening against threshold values. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.

4.7.3.2 Dose Calculations

The potential risks to ecological receptors resulting from exposure to SWMU 7-related contaminants were also evaluated by estimating the total contaminant dose that an organism inhabiting the site might receive for each contaminant and comparing those doses to toxicity reference values (TRVs), which are doses above which adverse effects might occur. The Lower Keys marsh rabbit, cotton rat, raccoon, and kestrel were selected as representative terrestrial receptors for foodchain modeling at SWMU 7. Section 3.3.2.1.2 of Appendix C provides a detailed description of dose calculations and exposure parameters used for the foodchain modeling.

4.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at SWMU 7.

4.7.4.1 Results

The results of the ecological risk characterization at SWMU 7 are presented in this section with a discussion of the results from the Phase I and Phase II ecological screening assessments, foodchain modeling for selected mammalian and avian receptors, and tissue analyses.

4.7.4.1.1 Phase I

The Phase I ecological risk assessment for SWMU 7 conducted by IT Corporation (1994) identified no groundwater COCs and no groundwater pathway. Antimony was identified as a COC in surface water.

Mercury, silver, tin, vanadium, and zinc were identified as sediment COCs. Estimated concentrations of lead, mercury, silver, and zinc in fish were considered to pose potential risks to piscivores. Chromium, 2-methylnapthalene, and Aroclor-1260 were identified as soil COCs. Consumption of 2-methylnapthalene and Aroclor-1260 in vegetation were considered to pose potential risks to terrestrial receptors that forage on plants. The overall conclusion of the assessment was that SWMU 7 appeared to pose low to moderate risks to ecological receptors and that limited investigations to better define ecological risks at the site were warranted. In addition, IT Corporation recommended that an IRA be conducted to remove contaminated soils from what apparently was a roadside diesel fuel spill east of the access road (IT Corporation, 1994).

4.7.4.1.2 Phase II - Ecological Screening Assessment

Only three metals were detected in groundwater and of these, only mercury was retained as a COPC since its maximum concentration exceeded twice the average background value and its ecological threshold (Table 4-27). No pesticides or PCBs were detected in 1996 groundwater samples (Appendix H). VOCs and SVOCs were detected rarely and at low concentrations in groundwater samples collected by IT Corporation in 1993. Therefore, in accordance with the Sampling and Analysis Plan (ABB, 1995), analyses of 1996 groundwater samples were not conducted for VOCs and SVOCs.

Maximum concentrations of beryllium, cyanide, manganese, and tin in surface water exceeded twice the average background concentrations and screening thresholds and were retained as COPCs in surface water (cyanide and tin were not detected in background) (Table 4-28). No organic compounds were retained as COPCs in surface water. Cadmium, copper, and lead were retained as COPCs in SWMU 7 sediments, but their maximum concentrations did not exceed less conservative thresholds (Table 4-29). Mercury, silver, and zinc were retained as sediment COPCs since their maximum concentrations exceeded two times average background and most and less conservative thresholds. Aluminum, beryllium, tin, and vanadium were conservatively retained as sediment COPCs since their maximum concentrations exceeded two times their average background concentrations but no suitable screening thresholds were available. Cyanide was retained as a sediment COPC since it exceeded the only threshold available. Several pesticides, SVOCs (primarily PAHs), Aroclor 1260, and acetone were retained as COPCs in SWMU 7 sediments due to exceedances of ecological thresholds (Table 4-29). One volatile compound, 2-butanone, was conservatively retained as a sediment COPC since no suitable threshold was available.

TABLE 4-27

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 4-28

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 4-29

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 Rention 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

TABLE 4-29

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 Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
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
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 4-30

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - 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	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
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

TABLE 4-30

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - 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)
PESTICIDES/PCBs (µg/kg) (continued)						
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
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.

Maximum surface soil concentrations of the metals aluminum, chromium, copper, and zinc exceeded two times average background concentrations and thresholds and were retained as COPCs (Table 4-30). Antimony, beryllium, 2,4,5-T, 2,4,5-TP, 2,4-D, Aroclor-1260, bis(2-ethylhexyl)phthalate, and acetone were conservatively retained as surface soil COPCs since thresholds were not available. Several SVOCs in soils (mostly PAH compounds) and xylene were retained as COPCs since they exceeded screening levels.

Aluminum, chromium, lead, selenium, vanadium, and zinc were metals that exceeded two times their average background concentrations and were detected at maximum concentrations in excess of terrestrial plant thresholds (Table 4-31). The organics Aroclor-1260 and xylene were terrestrial plant COPCs since their maximum concentrations exceeded thresholds. Several pesticides, SVOCs, and VOCs were conservatively retained as terrestrial plant COPCs at SWMU 7 since no suitable thresholds were available.

4.7.4.1.3 Tissue Analysis

Analytes detected in foliage of sea oxeye daisy and seashore dropseed consisted of arsenic, barium, cadmium, copper, lead, manganese, mercury, zinc, and ten pesticides or daughter products (Table 4-32).

4.7.4.1.4 Foodchain Modeling

Aluminum, arsenic, and Aroclor-1260 were the primary contributors of potential risks to the Lower Keys marsh rabbit and cotton rat using the maximum contaminant concentrations while aluminum and arsenic accounted for primary potential risks using average contaminant concentrations (Tables 4-33 through 4-36). Individual HI values for both these mammals under the maximum and average contaminant concentration scenarios exceeded 1.0 only for aluminum. Incidental ingestion of contaminated soil accounted for the overwhelming majority of contaminant exposure. Aroclor-1260, zinc, and arsenic were the primary contributors of potential risks for the kestrel using maximum contaminant concentrations, and Aroclor-1260, zinc, arsenic, 4,4'-DDE, and 4,4'-DDT were the primary major contributors to potential risks using mean contaminant concentrations (Tables 4-37 and 4-38). Total HI values for the maximum and average concentration scenarios were 1.44 and 0.58, respectively. Since ingestion of soil and water were not considered in the model for the kestrel, ingestion of contaminated food accounted for 100 percent of contaminant exposure for this raptor. Mercury, Aroclor-1260, 4,4'-DDT, 4,4'-DDE, and alpha-BHC were the primary contributors of potential risks to the raccoon using the maximum contaminant concentrations (Table 4-39). Aroclor-1260, mercury, and alpha-BHC were the primary contributors of potential risks to

TABLE 4-31

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - 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	4/4	1,887.29	1,780 - 5,195	50	103.9	Retained - exceeds 2 X background and HQ > 1
Antimony	5/13	0.39	1.1 - 4.9	5	0.98	Eliminated - does not exceed threshold
Arsenic	10/13	1.29	0.29 - 5.3	10	0.53	Eliminated - does not exceed threshold
Barium	13/13	10.51	4 - 18.8	500	0.04	Eliminated - does not exceed 2 X background
Beryllium	5/13	0.05	0.13 - 0.18	10	0.02	Eliminated - does not exceed threshold
Cadmium	2/13	0.15	0.42 - 0.75	3	0.25	Eliminated - does not exceed threshold
Chromium	13/13	6.02	2.6 - 31.5	1	31.5	Retained - exceeds 2 X background and HQ > 1
Cobalt	3/13	0.29	0.29 - 0.38	20	0.02	Eliminated - does not exceed 2 X background
Copper	7/13	5.43	4.4 - 67.2	100	0.67	Eliminated - does not exceed threshold
Lead	11/13	15.66	0.3 - 252.5	50	5.05	Retained - exceeds 2 X background and HQ > 1
Manganese	4/4	17.65	15.2 - 32.2	500	0.06	Eliminated - does not exceed 2 X background
Mercury	9/13	0.03	0.03 - 0.08	0.3	0.25	Eliminated - does not exceed threshold
Nickel	5/13	1.67	1.8 - 3.7	30	0.12	Eliminated - does not exceed threshold
Selenium	3/13	0.65	0.79 - 1.5	1	1.45	Retained - exceeds 2 X background and HQ > 1
Silver	1/13	ND	0.34	2	0.17	Eliminated - does not exceed threshold
Vanadium	8/13	3.97	1.3 - 8.5	2	4.25	Retained - exceeds 2 X background and HQ > 1
Zinc	13/13	15.22	0.75 - 208	50	4.16	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	4/6	22.46	2.7 - 32.2	NA	–	Retained - no suitable threshold available
4,4'-DDE	4/6	63.23	4 - 31.7	NA	–	Retained - no suitable threshold available
4,4'-DDT	4/6	46.78	2.1 - 25.7	NA	–	Retained - no suitable threshold available
alpha-BHC	1/6	ND	21.6	NA	–	Retained - no suitable threshold available
Aroclor-1260	4/13	43.28	230 - 16,500	40	412.5	Retained - HQ > 1
Endosulfan I	3/6	5.99	2.3 - 14.9	NA	–	Retained - no suitable threshold available
Endosulfan II	1/6	ND	1.2	NA	–	Retained - no suitable threshold available
Endrin	2/6	11.46	7.1 - 23.8	NA	–	Retained - no suitable threshold available

TABLE 4-31

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - 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)
PESTICIDES/PCBs (µg/kg) (continued)						
Endrin aldehyde	1/4	ND	2.50	NA	–	Retained - no suitable threshold available
Heptachlor	1/6	ND	2.80	NA	–	Retained - no suitable threshold available
Heptachlor epoxide	1/6	ND	0.89	NA	–	Retained - no suitable threshold available
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
1,2-dichlorobenzene	2/12	ND	1.6 - 2,415	NA	–	Retained - no suitable threshold available
1,3-dichlorobenzene	1/12	ND	481.5	NA	–	Retained - no suitable threshold available
1,4-dichlorobenzene	1/12	ND	352.2	NA	–	Retained - no suitable threshold available
Benzo(a)anthracene	3/13	ND	270 - 1,640	NA	–	Retained - no suitable threshold available
Benzo(a)pyrene	2/13	ND	360 - 2,040	NA	–	Retained - no suitable threshold available
Benzo(b)fluoranthene	3/13	414.89	380 - 3,340	NA	–	Retained - no suitable threshold available
Benzo(g,h,i)perylene	2/13	ND	260 - 1,460	NA	–	Retained - no suitable threshold available
Benzo(k)fluoranthene	1/13	ND	310	NA	–	Retained - no suitable threshold available
Bis(2-ethylhexyl)phthalate	2/2	470.55	120 - 680	NA	–	Retained - no suitable threshold available
Chrysene	3/13	407.04	380 - 1,950	NA	–	Retained - no suitable threshold available
Fluoranthene	3/13	434.18	380 - 3,020	NA	–	Retained - no suitable threshold available
Indeno(1,2,3-cd)pyrene	2/13	ND	240 - 1,480	NA	–	Retained - no suitable threshold available
Phenanthrene	1/13	ND	106	NA	–	Retained - no suitable threshold available
Pyrene	3/13	420.61	350 - 2,410	NA	–	Retained - no suitable threshold available
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
Acetone	2/2	3.67	42 - 83	NA	–	Retained - no suitable threshold available
Chlorobenzene	1/12	ND	117	NA	–	Retained - no suitable threshold available
Cis-1,2-dichloroethene	2/8	ND	1 - 2	NA	–	Retained - no suitable threshold available
Ethylbenzene	1/12	1.58	91.3	NA	–	Retained - no suitable threshold available
Methylene chloride	2/8	2.8	18 - 3	NA	–	Retained - no suitable threshold available
Toluene	1/12	1.62	1	200	0.005	Eliminated - does not exceed threshold
Xylenes, total	1/12	3.73	958	100	9.58	Retained - HQ > 1

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

TABLE 4-32

SUMMARY STATISTICS FOR ANALYTES DETECTED IN VEGETATION FROM SWMU 7 AND BACKGROUND SITES NAS KEY WEST

	SWMU 7			BACKGROUND		
Analytes	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Arsenic	1/4	1.2	0.65	0/6		
Barium	2/4	4.9-5.9	2.82	1/6	3.50	0.69
Cadmium	1/4	0.20	0.08	0/6		
Copper	1/4	3.1	1.48	0/6		
Lead	2/4	0.44-0.52	0.32	0/6		
Manganese	2/4	2.7-18.9	5.69	4/6	3.60-6.70	3.63
Mercury	4/4	0.01-0.19	0.06	6/6	0.01-0.02	0.01
Zinc	4/4	3.1-50.9	22.75	2/6	12.80-55.50	12.42
PESTICIDE/PCBs (µg/kg)						
4,4'-DDE	1/4	0.56	1.38	0/6		
Aldrin	1/4	0.30	0.71	1/6	0.23	0.75
alpha-BHC	1/4	0.51	0.77	1/6	0.58	0.81
delta-BHC	2/4	0.06-1.7	0.87	1/6	0.21	0.74
gamma-BHC (lindane)	1/4	0.97	0.88	2/6	0.05-0.21	0.61
Aroclor-1260	2/4	32-420	121.25	0/6		
Endosulfan I	1/4	0.37	0.73	2/6	0.13-0.24	0.63
Endrin aldehyde	2/4	0.78-1.7	1.45	6/6	0.26-1.20	0.75
Heptachlor	2/4	0.30-0.59	0.65	1/6	0.29	0.76
Heptachlor epoxide	1/4	1.6	1.04	0/6		

1 One-half the detection limit used for all non-detected values.

TABLE 4-33

MAJOR CONTRIBUTORS TO RISK FOR THE LOWER KEYS MARSH RABBIT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	11.20	85.9
Arsenic	0.76	5.9
Aroclor-1260	0.51	3.9
Antimony	0.16	1.3
Lead	0.14	1.0
All others	0.23	2.1
Total receptor HI	13.0	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	12.31	94.4
Food	0.72	5.6

TABLE 4-34

MAJOR CONTRIBUTORS TO RISK FOR THE LOWER KEYS MARSH RABBIT MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	6.57	90.9
Arsenic	0.39	5.4
Antimony	0.07	1.0
Aroclor-1260	0.07	1.0
Barium	0.04	0.6
All others	0.09	1.2
Total receptor HI	7.23	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	6.85	94.7
Food	0.38	5.3

TABLE 4-35

**MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT
MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 7
NAS KEY WEST**

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	4.95	80.0
Arsenic	0.69	11.1
Aroclor-1260	0.23	3.6
Barium	0.08	1.3
Antimony	0.07	1.2
All others	0.17	2.9
Total receptor HI	6.19	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	5.44	87.9
Food	0.75	12.1

TABLE 4-36

**MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT
MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 7
NAS KEY WEST**

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	2.91	84.9
Arsenic	0.36	10.5
Barium	0.04	1.1
Antimony	0.03	1.0
Aroclor-1260	0.03	1.0
All others	0.05	1.6
Total receptor HI	3.42	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	3.03	88.5
Food	0.39	11.5

TABLE 4-37

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aroclor-1260	0.90	62.5
Zinc	0.23	16.2
Arsenic	0.12	8.4
Mercury	0.06	3.8
4,4'-DDE	0.05	3.2
All others	0.08	5.9
Total receptor HI	1.44	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	1.44	100.0

TABLE 4-38

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aroclor-1260	0.28	48.2
Zinc	0.09	15.1
Arsenic	0.06	10.7
4,4'-DDE	0.06	9.9
4,4'-DDT	0.05	8.6
All others	0.04	7.6
Total receptor HI	0.58	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.07	0.0
Food	0.58	100.0

TABLE 4-39

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - SWMU 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Mercury	0.68	39.7
Aroclor-1260	0.67	39.6
4,4'-DDT	0.15	8.8
4,4'-DDE	0.10	5.9
alpha-BHC	0.07	4.3
All others	0.03	1.8
Total receptor HI	1.70	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.02	1.4
Food	1.68	98.6

TABLE 4-40

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MEAN CONTAMINANT CONCENTRATION SCENARIO - SWMU 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aroclor-1260	0.26	45.4
Mercury	0.14	24.4
alpha-BHC	0.09	15.2
4,4'-DDT	0.03	5.7
4,4'-DDE	0.03	4.4
All others	0.03	4.9
Total receptor HI	0.57	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.01	1.7
Food	0.56	98.3

the raccoon using the mean contaminant concentrations (Table 4-40). Individual HIs under both scenarios were all less than 1.0, and the total HI was 1.7 and 0.57 for the maximum and mean scenarios, respectively.

4.7.4.2 Discussion

Mercury was the only COPC in groundwater (HQ=9.6), and was detected in one of two groundwater samples. Mercury was not a COPC in surface water, where its maximum concentration was less than its average background value. However, mercury was a COPC in sediment. The significance of mercury as an ecological COPC is discussed later in this section, through an examination of its concentrations in individual sediment samples and the results of the foodchain modeling.

Beryllium, cyanide, manganese, and tin were COPCs in surface water. Beryllium was detected in only one of nine surface-water samples and was not detected in any of five samples collected in 1996. Cyanide was detected in only one of six surface-water samples, and its HQ (HQ=2.6) was indicative of relatively low potential risk. Two of five water samples exceeded the ecological threshold for manganese and three of four samples exceeded the ecological threshold for tin (Tables 4-4 and 4-28). The HQs for manganese (HQ=1.3) and tin (HQ=2.5) were indicative of relatively low potential risk. Overall, the infrequent detections and relatively low hazard quotients of surface-water COPCs are indicative of low potential risks to aquatic receptors.

Several inorganics were identified as COPCs in SWMU 7 sediments. The highest HQs were for cyanide, mercury, silver, and zinc. All mercury and zinc concentrations equaled or exceeded the most conservative sediment thresholds, but most zinc and mercury concentrations did not exceed the least conservative of the two ecological thresholds used in this risk assessment (Tables 4-3 and 4-29). Silver concentrations exceeded the least conservative of two sediment threshold values in four samples, but silver was not detected in four other samples. The HQ for cyanide was indicative of high potential risk (HQ=130) in one 1993 sample, but cyanide was not detected in a second 1993 sample. Analyses of cyanide were conducted on five 1996 sediment samples, but the results were rejected because the matrix spike percent recoveries were below quality control limits. Therefore, the extent of potential ecological risks from cyanide are uncertian. Several pesticides were detected in sediments at values indicative of moderate to high potential risks. Pesticide COPCs with the highest frequencies of detection and highest HQs include 4,4'-DDT, 4,4'-DDE, 4',4-DDD, delta-BHC, gamma chlordane, and endrin. Aroclor-1260 was the only PCB mixture detected in sediments. Concentrations of this compound were indicative of moderate to high potential risks in two samples, but it was not detected in three of six samples. Aroclor-

1260 concentrations were 510 μg/kg and 220 μg/kg in two 1993 ditch samples and 56.4 μg/kg in a sample from the northern pond in 1996. Six of eight semivolatile COPCs were detected only in sediment sample S7SS-6, collected from the southern pond in 1996. The other two semivolatile COPCs were not detected in 1996 sediment samples.

Overall, COPC concentrations in sediment suggest moderate potential risks for cyanide, mercury, silver, 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, gamma-BHC (lindane), gamma chlordane, Aroclor-1260, and most semivolatiles, and low potential risks for other sediment COPCs. However, 4,4'-DDT, gamma-BHC (lindane), gamma chlordane, Aroclor-1260, and the semivolatiles were detected in only half or less of the sediment samples. Nevertheless, the large number of COPCs is noteworthy. While individual sediment contaminants can appear to pose low or moderate risks, the large number of sediment contaminants could result in additive toxic effects that could potentially result in significant potential risks to ecological receptors. In addition, some of the COPCs at SWMU 7 are known to biomagnify in the foodchain (e.g., mercury, Aroclor-1260, and the organochlorine pesticides). However, the benthic community is likely to be low in diversity and abundance regardless of the presence of contaminants, based on water quality and the small size of the aquatic system. The principal issue, in view of the sediment COPCs, is the extent to which the site is utilized by aquatic and semi-aquatic receptors. A discussion of this, as well as potential risks to the raccoon (the representative mammalian carnivore) from sediment contaminants, is provided later in this section.

HQs for metals in soil were indicative of relatively low potential risk except for aluminum and chromium. The only aluminum sample that exceeded twice the average background concentration was S7SB-23, collected from east of the access road that parallels Building A-824. Chromium was elevated (compared to background values) in three samples: two of these were collected in 1993 from near the south end of Building A-824 (S7SB-7: 31.5 mg/kg, S7SB-11: 22.1 mg/kg), and one was sample S7SB-23 (12.1 mg/kg), collected in 1996. There were no soil ecological thresholds for beryllium or antimony, but these metals were detected in only 5 of 13 samples. There was no suitable soil ecological threshold for Aroclor-1260, which was detected in 4 of 13 samples. All detected values for Aroclor-1260 were in confirmation samples collected within the area in which interim remediation was conducted in 1995. This area is currently filled with crushed rock and is enclosed by a chain link fence. Thus, use of this area by terrestrial ecological receptors such as small mammals is non-existent under current conditions. Aroclor-1260 was not detected in sediment from the pond immediately north of this area.

Herbicides (2,4,5-T; 2,4,5-TP; and 2,4-D), SVOCs, and VOCs were infrequently detected in soils, but some HQs were indicative of moderate potential risks. With very few exceptions, these compounds were detected only in samples east of the road that parallels Building A-824 (See Figures 4-6 and 4-7 and

Tables 4-1 and 4-2). IT Corporation (1994) previously concluded that a roadside diesel fuel spill had apparently occurred here, based on OVA readings and the presence of naphthalene at 7,900 µg/kg in subsurface soil sample S7SB-16. Personnel at NAS Key West have no record of a fuel spill in this area. Nevertheless, the presence of ethylbenzene and xylene in sample S7SB-23 in 1996 samples from this area (and their absence from other areas at the site) could potentially have resulted from an unrecorded petroleum spill. The source of the PAH compounds in this area is also unclear. Potential sources include fuel spills, previous burning activities, or other sources. Their absence from other sampling locations and their presence at elevated concentrations suggest a localized source of contamination. Ecological thresholds are not available from FDEP or EPA for these volatile and semivolatile compounds. The only thresholds available (100 µg/kg) were from EPA Region III (USEPA, 1995e). The extent to which the HQ values of these COPCs are the result of overly conservative thresholds is not clear, and the source of the thresholds is not provided in the EPA region III guidelines. However, most of the concentrations in samples east of the road are greater than what Beyer (1990) has suggested are typical of background conditions, and some values exceed Beyer's criteria for "moderate soil contamination that requires additional study." Even though these compounds have very little bioaccumulation potential, their presence at elevated concentrations could pose potential risks to the endangered Lower Keys marsh rabbit, which is known to inhabit this area. The extent of soil contamination is limited to the east side of the access road that parallels Building A-824 and does not extend northward past soil sample S7SB-21, where they were not detected. However, the extent of contamination to the east and south has not been delineated. Thus, further investigation should be conducted to delineate the extent of hydrocarbon contamination to the east and south of the 1996 soil sampling locations.

HQs for plant COPCs were relatively low except for aluminum (HQ=103.9), chromium (HQ=31.5), and Aroclor-1260 (HQ=412.5). However, aluminum and chromium were not detected in any of the four vegetation samples collected from the site. The authors who derived the plant thresholds for metals in soil consider the thresholds to be very conservative (Will and Suter, 1995b). This is because soluble salts of metals are applied to growth substrates as the route of exposure in most plant toxicity tests. As a result, the metals are more bioavailable than most naturally-occurring metals or metals at many waste sites (Will and Suter, 1995b). The scarcity of terrestrial plant thresholds for organic compounds precluded a detailed assessment of potential risks to terrestrial plants from organics in surface soil. However, plants do not translocate organics to the extent that they translocate inorganics. Overall, the concentrations of COPCs in soil suggest low potential risk to terrestrial receptors. In addition, results of the foodchain modeling (discussed below) indicate low potential risks from soil COPCs.

Four vegetation samples were collected from SWMU 7. Samples S7V-1 and S7V-2 were collected from the area southwest of the northern pond (Figure 4-4). Samples S7V-3 and S7V-4 were collected from the

area between the northern pond and the chain-link fence north of Building A-824. The chain-link fence forms the northwestern boundary of the area in which interim remediation was conducted. Mercury and zinc were detected in all four vegetation samples, but concentrations of these two metals did not significantly exceed those in background samples. Other analytes were detected in only one or two samples. Concentrations of most analytes were similar to those in background vegetation or were only slightly above the detection limit. Aroclor-1260 was detected in the two samples nearest the remediation area (S7V-3 at 32 μg/kg and S7V-4 at 420 μg/kg) but not in vegetation samples to the west. This suggests that soil immediately outside the chain-link fence may be contaminated by this PCB mixture. Soil samples were not collected from this area. Concentrations of most analytes tended to be highest in vegetation sample S7SV-2. Plant tissue thresholds were not available, but the significance of analytes detected plant tissue can be interpreted, in part, from the results of the foodchain modeling (discussed below).

Results of the foodchain modeling indicated that incidental ingestion of aluminum in soil was the major contributor of potential risks to the Lower Keys marsh rabbit and the cotton rat. The ability of aluminum to bioaccumulate and biomagnify in the foodchain is low, and aluminum was not a contributor of risk to the kestrel in the foodchain model. Analyses of soils in previous investigations did not include aluminum, and aluminum was detected in all four soil samples collected in 1996. These four samples were collected from the area east of the access road that parallels Building A-824. Aluminum concentrations exceeded twice the average background concentration only in sample S7SB-23. This single value (5,195 mg/kg) accounted for the elevated HI under the maximum contaminant scenario, and to a great extent, even the mean contaminant scenario. Mean soil concentrations of aluminum without this sample were 2,333 mg/kg. Aluminum is one of the most abundant metals in the earth's crust and is ubiquitous in the environment (Goyer, 1986). However, the elevated value in sample S7SB-23 probably does not reflect background conditions, and is assumed to be due to contamination from an unknown source. Aluminum was not detected in vegetation samples collected from west of the access road, and vegetation was not collected from east of the access road. In conclusion, aluminum in soil was elevated in only one of four samples, does not bioaccumulate or biomagnify in the foodchain, and was not detected in vegetation samples. For these reasons, its presence in soil is not believed to pose significant potential risks to terrestrial receptors at the site.

Incidental ingestion of arsenic in soil was identified as the second greatest contributor of potential risks to the Lower Keys marsh rabbit and cotton rat, but its HI was less than 1.0 under the maximum contaminant scenario. The HI for arsenic under the mean contaminant scenario was 0.36 for both the rabbit and rat, and was negligible for the kestrel under both scenarios. Aroclor-1260 was the major contributor of potential risks (HI=0.9) to the kestrel under the maximum contaminant scenario, but the HI was only 0.28

under the under the mean contaminant scenario, and HI values for Aroclor-1260 were low for the marsh rabbit and cotton rat under both scenarios. Exposure to mean concentrations is a more realistic foraging scenario. The relatively low HI values in all three terrestrial receptors and infrequent detection in soil (4 of 13 samples) suggests that bioaccumulation and biomagnification of this PCB mixture are not sources of potential risks to terrestrial receptors at SWMU 7. HI values of other chemicals were negligible for all three terrestrial receptors.

Sediment contamination at SWMU 7 was investigated, in part, through foodchain modeling using the raccoon as a representative receptor. Thus, the raccoon was considered to be a semi-aquatic receptor (instead of a terrestrial receptor) for the purposes of this risk assessment. Mercury and Aroclor-1260 were the major contributors of potential risks to the raccoon using the maximum contaminant concentrations, but HI values were less than 1.0. No contaminants were significant contributors of potential risks using mean contaminant concentrations. This suggests that despite some moderately high HQs in the sediment screening exercise and consequent potential risks to benthos, the potential for risks from consumption of prey exposed to sediment contaminants at SWMU 7 are low for this representative carnivore. Similarly, results of the modeling indicate that potential risks are low to the raccoon from incidental ingestion of contaminated sediments.

Overall, the foodchain modeling indicates low potential risks to terrestrial and semi-aquatic receptors. The estimated potential risks to these receptor species, while relatively low, are further mitigated by the conservative assumptions used in the foodchain model. The model assumed an absorption fraction of 80 percent (i.e., 80 percent of the ingested contaminant was absorbed) for the dose calculations describing the intake of vegetation, prey, and soil. Actual absorption fractions range widely but are often considerably less than 80 percent (Hrudey et al., 1996). In addition, the model assumed that these species forage on the site 100 percent of the time. This could potentially be the case for the marsh rabbit and cotton rat but certainly not for the kestrel and raccoon.

4.7.4.3 Ecological Risk Summary

The Phase I ecological risk assessment conducted by IT Corporation (1994) identified no groundwater COCs and no groundwater pathway. Antimony was identified as a COC in surface water, while mercury, silver, tin, vanadium, and zinc were identified as sediment COCs. Estimated concentrations of lead, mercury, silver, and zinc in fish were considered to pose potential risks to piscivores. Chromium, 2-methylnapthalene, and Aroclor-1260 were identified as soil COCs. Consumption of 2-methylnapthalene and Aroclor-1260 in vegetation were considered to pose potential risks to terrestrial receptors that forage

on plants. The overall conclusion of the assessment was that SWMU 7 appeared to pose low to moderate risks to ecological receptors and that limited investigations to better define ecological risks at the site were warranted. In addition, IT Corporation recommended that an IRA be conducted to remove what apparently was a roadside diesel fuel spill east of the access road (IT Corporation, 1994).

In this Phase II assessment, several metals and organic compounds were detected in groundwater, surface-water, sediment, soil, and vegetation samples collected from the site and vicinity. Mercury was the only COPC in groundwater, but mercury was not a COPC in surface water, where concentrations were below the average background value. Thus, there is no evidence of contaminant migration from groundwater to surface water. Beryllium, cyanide, manganese, and tin were COPCs in surface water, but the infrequent detections and relatively low HQs of these COPCs are indicative of low potential risks to aquatic receptors.

Several contaminants exceeded ecological thresholds in sediment and soil. The number of COPCs, the magnitude of some HQ values, and the potential ability of some COPCs to bioaccumulate and biomagnify indicate significant risks to ecological receptors. However, the foodchain modeling indicates low potential risks to terrestrial and semi-aquatic receptors. The resolution of the apparent disparity between significant potential risks indicated by the screening assessment and the low potential risks indicated by the foodchain modeling is accomplished by an assessment of the habitats and exposure routes at the site, and the locations where contaminants were detected, as discussed below.

Both terrestrial and aquatic habitats exist at SWMU 7. Although the conceptual model (Figure 4-12) shows a complete exposure pathway for aquatic receptors, actual use of the site by aquatic receptors is probably minimal. Aquatic habitat is limited to two small ponds (30 by 30 feet and 15 by 20 feet) and an interconnecting ditch. Water in the ditch is only a few inches deep and is absent in portions of the ditch during dry years. Surface waters in the two ponds and ditch are not hydrologically connected to any other water bodies, even during storm events (exclusive of hurricanes). Water depth along the shoreline of the ponds is approximately 2 feet, and prevents foraging at the site by wading piscivorous birds. For these reasons, the use of this habitat by aquatic receptors other than minnows and invertebrates is probably insignificant. Therefore, the potential risks to ecological receptors posed by sediment contaminants at SWMU 7 are low.

Terrestrial habitat at SWMU 7 consists of a large area of native herbaceous grasslands. Several soil COPCs were identified in the vicinity of SWMU 7. HQs for metals in soil were indicative of relatively low potential risk except for aluminum and chromium. However, aluminum was elevated only in one sample, and elevated concentrations of chromium (relative to background) were limited to only 3 of 13 samples.

Two of these three samples were collected from the south end of Building A-824, which is within the chain-link fence in an area of poor habitat. Aluminum and chromium were not detected in vegetation samples. Aroclor-1260 was detected in 4 of 13 soil samples; all detected values were in samples collected from within the PCB soil-remediation area. Aroclor-1260 was detected in the two vegetation samples nearest the remediation area, but not in vegetation samples to the west. This suggests that soil immediately outside the chain-link fence may be contaminated by this PCB mixture, but as mentioned above, PCBs were not detected in 9 of 13 soil samples. Thus, widespread PCB contamination of soil beyond the immediate vicinity of Building A-824 does not appear to exist, and Aroclor-1260 will not be retained as a final COC. Overall, the concentrations of most COPCs in soil and the results of the foodchain modeling indicate low potential risk to terrestrial receptors. Herbicides, SVOCs, and VOCs were detected (with very few exceptions) only in samples east of the road on the eastern side of Building A-824. As discussed above, aluminum and chromium were elevated in soil sample S7SB-23. However, these two metals were not elevated in other nearby samples, and potential risks to ecological receptors from aluminum and chromium are relatively low. Therefore, aluminum and chromium will not be retained as final COCs. Similarly, 2,4-D, 2,4,5-T, and 2,4,5-TP were detected in sample S7SB-23 but were not detected in other samples. These herbicides do not appear to be widespread and they will not be retained as final COCs.

In summary, groundwater and surface-water contaminants do not appear to pose significant environmental risks. Aquatic habitat at the site is of minimal areal extent and quality, resulting in minimal use of the site and vicinity by aquatic and semiaquatic receptors. Sediment contaminants do not appear to pose significant potential risks to benthos or to semi-aquatic receptors higher on the foodchain, based largely on the poor habitat at the site, the lack of connection with other aquatic habitats, and the results of the foodchain modeling of risks to the raccoon from sediment-associated contaminants. Soil contaminants of concern consist of semivolatile and volatile compounds that were detected east of the road that parallels Building A-824. The source and extent of soil contamination in this endangered species habitat is unknown. Therefore, additional investigation to determine the extent of this soil contamination is warranted. Soil COCs at this point consist of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, ideno(1,2,3-cd)pyrene, phenanthrene, pyrene, and xylene. All of these compounds are PAHs except xylene. Thus, additional sampling, sample analyses, and ecological risk assessment should focus on PAH contamination in soils within the area east of the road that parallels Building A-824.

4.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of the investigation at SWMU 7 were to identify the existing nature and extent of contamination (after interim remedial action) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

Metals were most commonly detected in soil and sediment throughout SWMU 7 and were less frequently detected in surface water and groundwater. Several VOCs and SVOCs were also detected in soil samples. Isolated areas of PCB contamination were detected in soil and sediment at SWMU 7. An IRA was conducted at SWMU 7 in 1996, removing PCB-contaminated soil from within the fenced area that was formerly used for transformer storage. The highest levels of PCBs were detected at the edges of the excavated area; however, the low concentrations detected in samples from the nearby pond and ditch indicate minimal areal extent and migration of PCBs.

The human health risk assessment at SWMU 7 indicates that contaminants are not present at sufficient concentrations to cause adverse noncarcinogenic effects under current exposure scenarios. Carcinogenic risks were calculated to be within the EPA's target risk range of 1E-04 to 1E-06 and exceed the FDEP target risk of 1E-06 under current exposure scenarios. The cancer risk for the future resident exposure scenario was estimated at levels exceeding the target risk range, and the hazard index for noncarcinogenic risk exceeded 1.0. Aroclor-1260 and arsenic are the main contributors to the carcinogenic risk, while arsenic and antimony are the main contributors to the noncarcinogenic risk.

The ecological risk assessment concludes that contaminants present at SWMU 7 do not pose significant environmental risks. Aquatic habitat at the site is of minimal areal extent and quality, resulting in minimal use of the site and vicinity by aquatic receptors. Foodchain modeling indicates relatively low potential risks from soil, sediment, and food ingestion.

The calculated risks to hypothetical future residents, trespassers, and occupational workers at SWMU 7 warrant the preparation of a CMS. Remedial actions that should be considered in the CMS should include no further action and monitoring.

Additional sampling was performed to the east of the road that runs parallel to Building A-824. Analytical results from these samples indicate soil contamination of PAHs that is consistent with fuel contamination. PCBs were not detected in any sample taken from east of the road, which indicates that this area is not associated with SWMU 7. Therefore, it is recommended that any additional investigation or remediation activities in the area east of the road be performed under the NAS Key West Underground Storage Tank program.

5.0 INSTALLATION RESTORATION SITE 1 (IR 1)

This chapter describes the site-specific evaluation of data for IR 1 (Truman Annex Refuse Disposal Area). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 5.8 presents a summary and conclusions with recommendations for IR 1.

5.1 UNIT DESCRIPTION

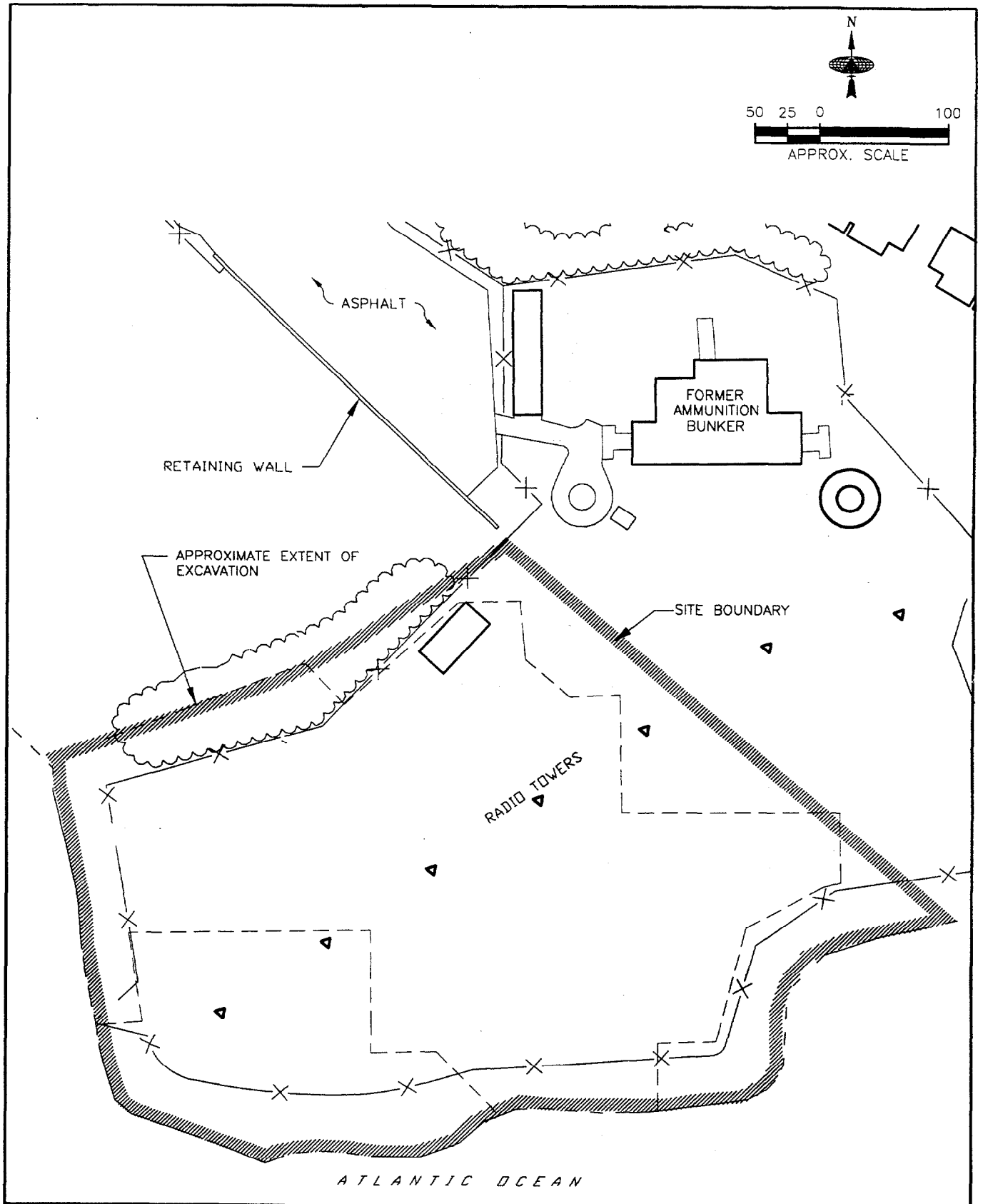
The Truman Annex Refuse Disposal Area (IR 1) is located along the southern shore of Truman Annex on Key West (Figure 5-1). The site covers an area of approximately 7 acres, including an antenna field and an area to the immediate north of the antenna field. A chain-link fence surrounds the site, and access to IR 1 is strictly controlled. The shoreline has erosion protection consisting of large concrete rubble and debris. The main sewer outfall line for Key West runs through the property. Treated sewage is pumped to the outfall point 3,600 feet southwest of IR 1. From 1952 until the mid-1960s the Truman Annex Refuse Disposal Area was used for general refuse disposal and open burning. No restrictions were placed on the types of wastes disposed at the site. General refuse, waste paint thinners, and solvents may have been disposed of at the site.

5.2 INVESTIGATION HISTORY

Several investigations have been performed at IR 1 since the mid-1980s to identify, confirm, or delineate contamination. The previous investigations are summarized in Section 5.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 5.2.2.

5.2.1 Previous Investigations

Geraghty and Miller conducted a preliminary investigation at the site in 1986. Four shallow monitoring wells were installed, and in December 1986, four soil samples were collected from excavated fill material contained within the site. Analytical results indicated that metals were present in the groundwater and soil, and that hydrocarbons were present in the groundwater.



SITE MANAGER: RCD	CHECKED BY: CB	Brown & Root Environmental	FIGURE 5-1
DRAWN BY: CLG	DRAWING DATE: 4/23/97		**SITE LOCATION MAP IR 1**
SURVEYED BY: TCB	SURVEY DATE: 9/18/96		NAVAL AIR STATION KEY WEST, FLORIDA
SCALE: AS SHOWN			
CAD DWG. NO.: 7046IR151	PROJ. NO.: HK7046		

Based on the results of the Geraghty and Miller (1987) investigation, a Preliminary RI was conducted by IT Corporation in 1990. Data gathered during the Preliminary RI indicated the presence of metals. Groundwater flow patterns at the site suggested that migration of metals toward the Atlantic Ocean could be occurring, and therefore, further investigation was recommended to determine the extent of contamination.

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 that the sediments surrounding the edge of the site have been contaminated with metals (e.g., cadmium, lead, mercury), certain pesticides, and PCBs, and groundwater was contaminated by metals and trace amounts of certain pesticides (IT Corporation, 1994). Metal contamination in the soil at the site appeared to be extensive. The Final RFI/RI report prepared by IT Corporation recommended installing soil boring and monitoring wells to determine the extent of contamination and identify site-specific background conditions, performing receptor identification and tissue analysis to confirm uptake of contaminants, performing a focused feasibility study and an IRA on the contaminated soils, and conducting a baseline human health risk assessment based on post-IRA sampling data.

Subsequent to the submittal of the draft Supplemental RFI/RI workplan (ABB, 1995), BEI began implementation of IRAs at some of the sites at NAS Key West. Delineation and characterization sampling focusing on metals was conducted at IR 1 to supplement the previous data, determine the extent of lead contaminated soil, and delineate the limits of the excavation. The preliminary IRA sampling data indicated the area to be excavated would be larger than initially anticipated. BEI then excavated lead contaminated soil to a depth of 12 to 18 inches at IR 1, removing 4,878 cubic yards of lead-contaminated soil for offsite treatment and disposal. The IRA reduced the highest lead concentration from 35,200 ppm to 680 ppm. Samples were collected from the excavation area to confirm removal of contaminated soil.

5.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at IR 1 and the scope of those field activities performed from August to October 1996. In addition to the results from the Supplemental RFI/RI, soil data was obtained from the confirmation sampling conducted after the interim remedial action. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 5-2 through 5-5 show the location of all soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as those from previous investigations.

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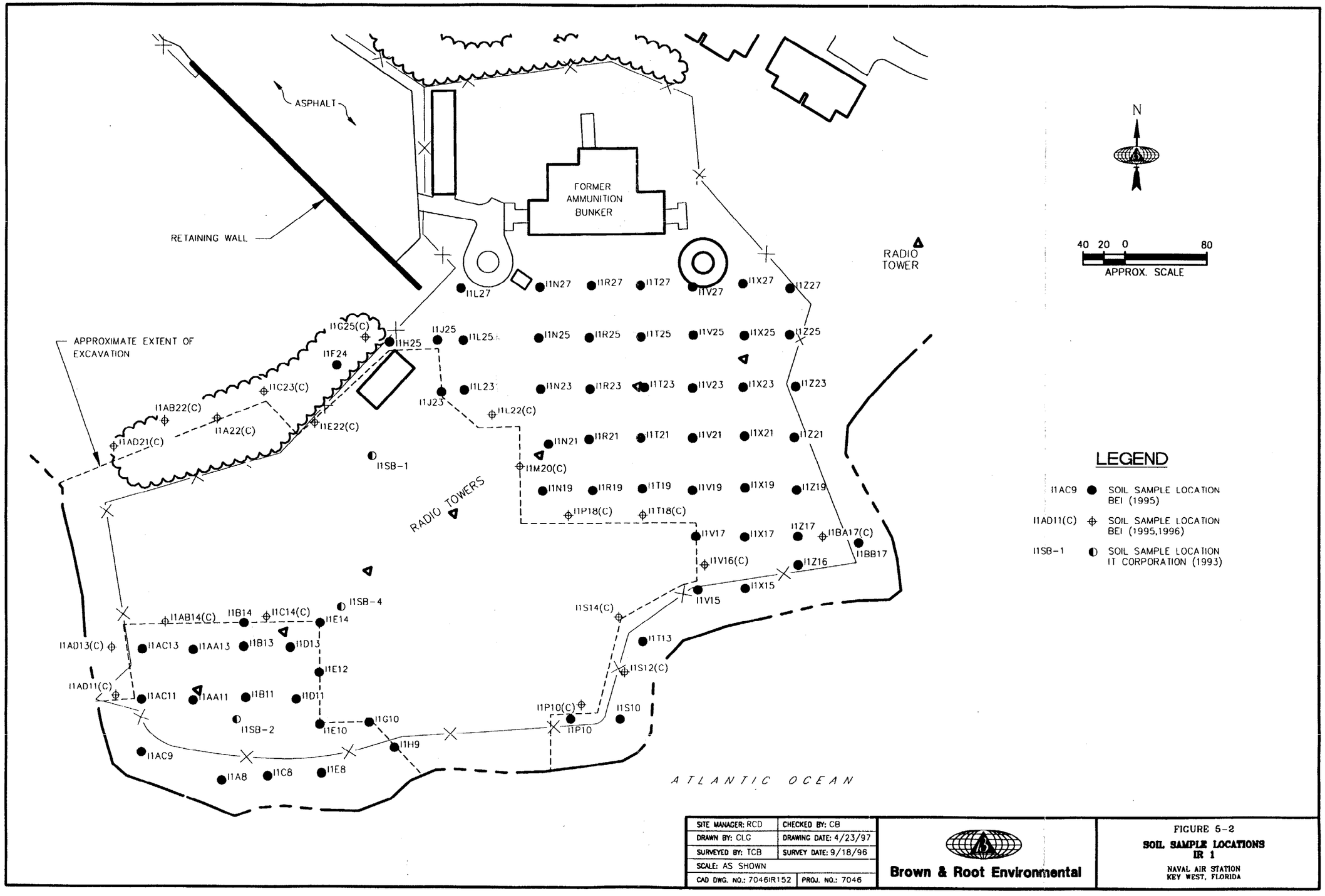

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CAD DWG. NO.: 7046IR152	PROJ. NO.: 7046

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FIGURE 5-2
SOIL SAMPLE LOCATIONS
IR 1
NAVAL AIR STATION
KEY WEST, FLORIDA

010FB197

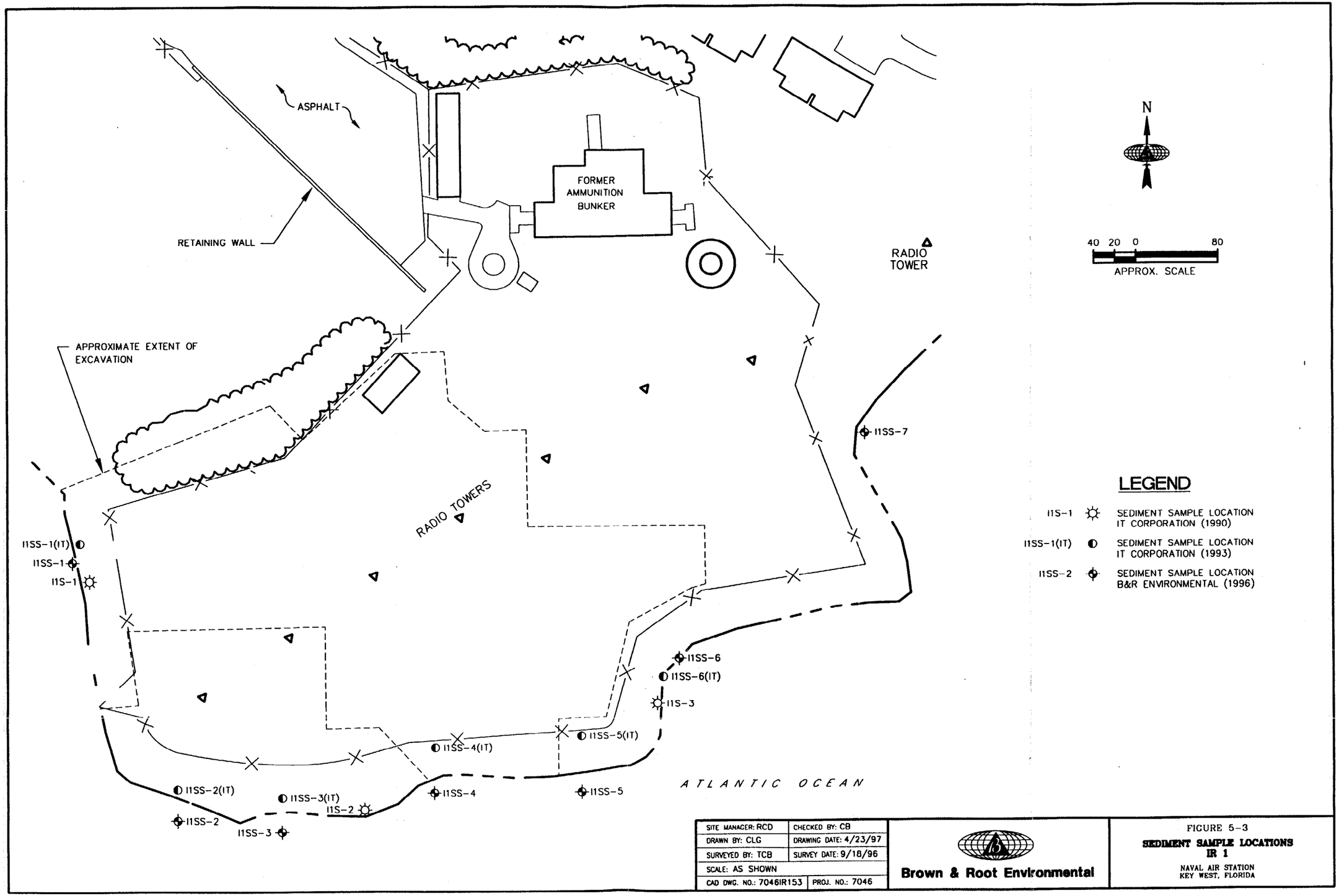

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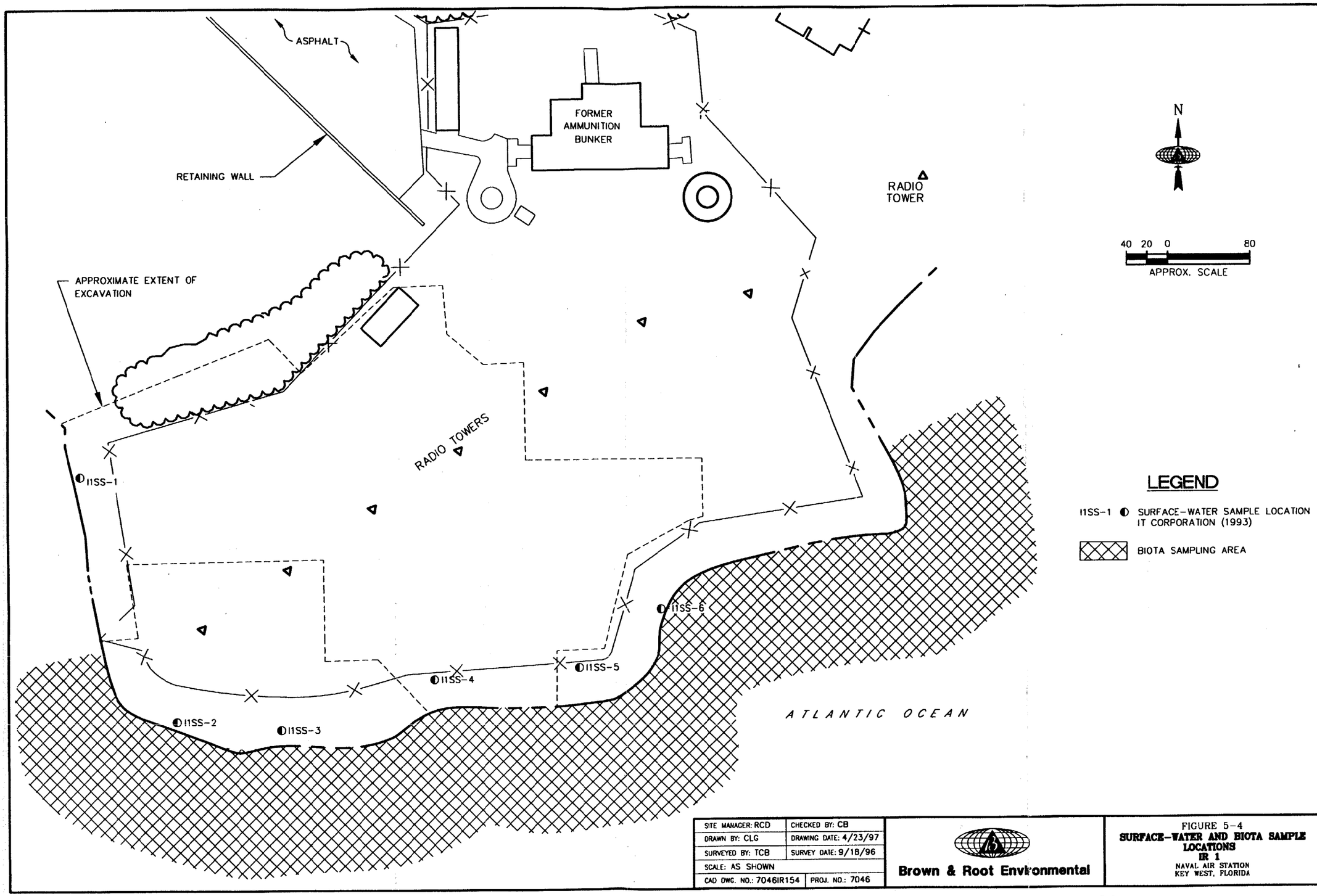
FIGURE 5-3
SEDIMENT SAMPLE LOCATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA



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SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR154	PROJ. NO.: 7046

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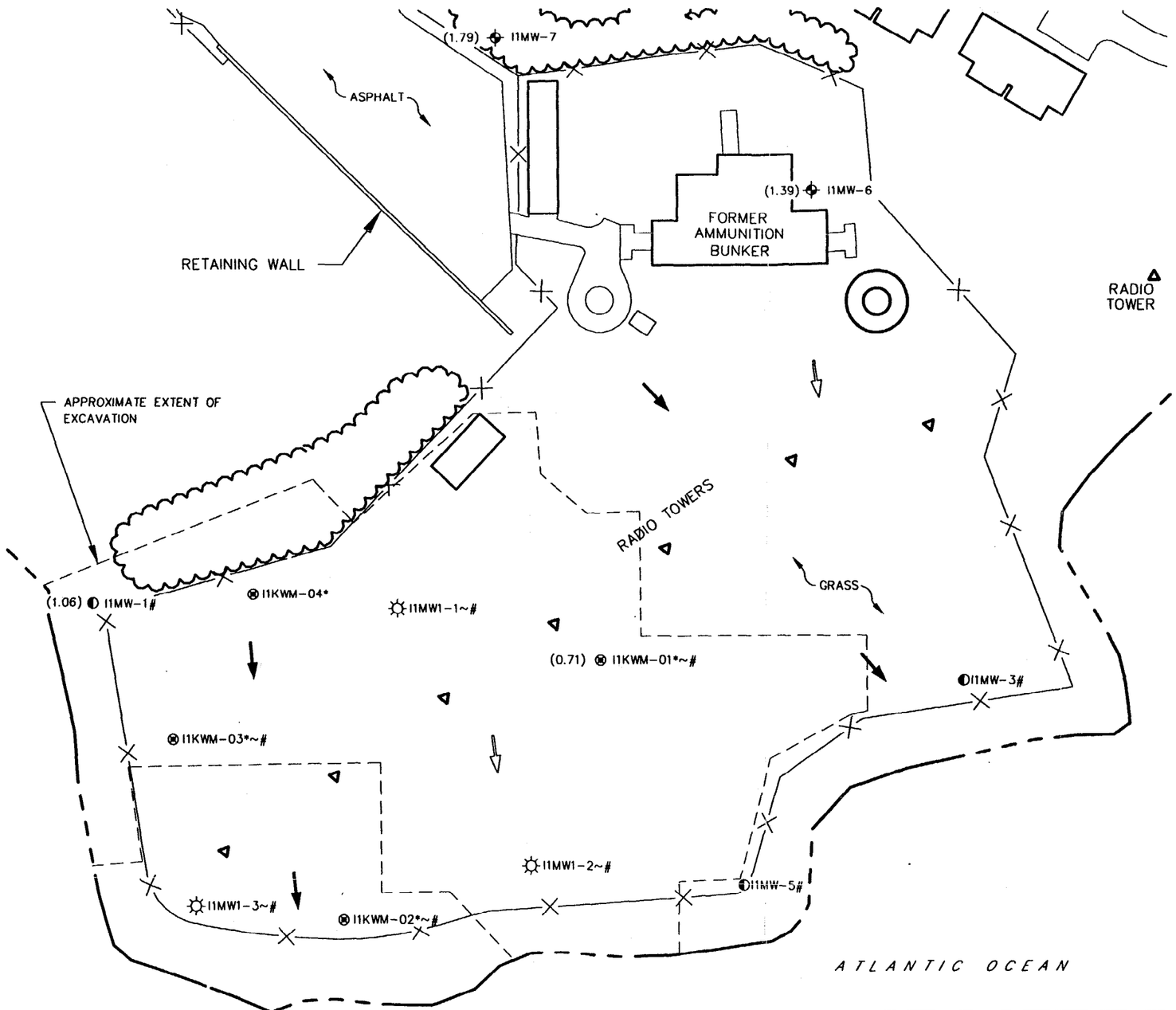
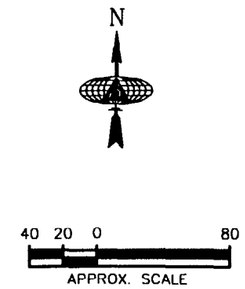
FIGURE 5-4
SURFACE-WATER AND BIOTA SAMPLE LOCATIONS
IR 1
NAVAL AIR STATION
KEY WEST, FLORIDA





NOTE: I1MW-6 AND I1MW-7 WERE GROUNDWATER BACKGROUND SAMPLING LOCATIONS.

LEGEND

- I1KWM-02 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)
- I1MW1-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)
- I1MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)
- I1MW-6 ⊕ MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)
- * ALSO SAMPLED BY IT CORPORATION IN 1990
- ~ ALSO SAMPLED BY IT CORPORATION IN 1993
- # ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996
- → GROUNDWATER FLOW DIRECTION OBSERVED BY IT CORPORATION (1993)
- ⇨ GROUNDWATER FLOW DIRECTION OBSERVED BY B&R ENVIRONMENTAL (1996)
- (0.71) GROUNDWATER ELEVATION (1996)

SITE MANAGER: RCD	CHECKED BY: CB
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SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR155	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-5
GROUNDWATER SAMPLE LOCATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA

5.2.2.1 Investigation Rationale

Additional sampling of sediment and groundwater was conducted at IR 1 to provide more information upon which appropriate risk assessments can be based. Resampling of sediments at IR 1 was performed to verify the presence or absence of contamination indicated in earlier findings. The additional data was also obtained to provide a statistically representative data set for the risk assessment. All of the existing monitoring wells were resampled to confirm previously-detected levels of contamination. Specifically, wells were sampled to verify previous concentrations of metals in groundwater that may have been influenced by turbidity.

5.2.2.2 Scope of Current Field Investigation

Supplemental field activities at IR 1 included the collection of sediment samples to confirm findings of earlier activities and monitoring well installation and groundwater sampling to confirm previously-detected levels of contamination.

5.2.2.2.1 Surface Soil

Previous sampling at IR 1 has sufficiently characterized surface soil after the IRA.

5.2.2.2.2 Surface Water and Sediment

Surface-water samples were not collected during Supplemental RFI/RI field activities. Sediment samples were collected near the original RFI /RI field locations to increase the number of data points in support of the risk assessment. All IR 1 sediment samples were analyzed for the following parameters:

- EPA Method 610 SVOCs
- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

5.2.2.2.3 Groundwater

Groundwater sampling was conducted to reassess the presence of pesticides, herbicides, metals, and cyanide in groundwater at IR 1. The focus of the groundwater sampling was on reducing the levels of turbidity that may have previously attributed to elevated concentrations of metals. Therefore, low-flow pumping methods were used to control the levels of turbidity. All IR 1 groundwater samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

5.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at NAS Key West is included in Section 1.4 (Base Environmental Setting) of this document. Applicable site-specific physical characteristics are discussed below.

5.3.1 Hydrogeology

Two additional monitoring wells were installed during the Supplemental RFI/RI, and these wells, as well as existing wells, were sampled. Monitoring well construction logs for the new wells are presented in Appendix E. The depth to groundwater during this monitoring event ranges from 5.39 feet to 9.45 feet bls. Groundwater elevations vary from 0.66 feet to 2.77 feet above msl. The primary hydrogeologic unit underlying the site is the surficial oolite limestone aquifer. Groundwater flow appears to be generally toward the south with a hydraulic gradient of 0.002 foot/foot. In 1993, IT Corporation observed that flow was from the west of the site to the east, towards the Atlantic Ocean, with a hydraulic gradient of 0.00133 foot/foot (IT Corporation, 1994). Since the site is bordered by the Atlantic Ocean, the hydraulic gradient driving the groundwater flow can be attributed to tidal influences. The direction of groundwater flow is indicated on Figure 5-5.

5.3.2 Soils

Geotechnical data were obtained from a composite soil sample collected from ground surface to 2 feet bls during the Preliminary RI conducted by IT Corporation in 1990. The data included grain size distribution, moisture content, soil pH, cation exchange capacity, total organic carbon content, and permeability. Grain size analysis indicated that the soil sample was a well graded sand. Total grain sizes ranged from cobbles to clay size fractions. The pH of the sample was 8.15 due to the abundance of carbonate soils and rock. The total organic content of 1.96 mg/kg indicated that organic matter present was minimal, and permeability of the soil sample was representative of a mixture of sand, silt, and clay.

5.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from soil, sediment, surface water, and groundwater in the vicinity of the Truman Annex Refuse Disposal Area (IR 1). The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various Federal agencies, state agencies, and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix I contains the analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI. Appendix H contains the full data set used for site characterization and assessment in this report.

5.4.1 Subsurface Soil

Data from the 1995 BEI Delineation Study and the 1993 IT RFI/RI were considered in the analysis of contamination in subsurface soil at IR 1. No other investigations tested for subsurface soil contamination at IR 1. Chemicals that were detected in subsurface soil samples are listed in Table 5-1. This table includes analytical results from historical sampling events only, as no subsurface samples were collected during the Supplemental RFI/RI investigation, as per the Sampling and Analysis Plan (ABB, 1995). The majority of the subsurface soil samples were collected during the Delineation Study. These samples were

TABLE 5-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT IR 1
NAS KEY WEST
PAGE 1 OF 3

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
I1SB-2	9	IT 1993	Aluminum	6,450	
I1G10	1	BEI(D) 1995	Aluminum	1,590	
I1E12	1	BEI(D) 1995	Aluminum	782	
I1D13	1	BEI(D) 1995	Aluminum	759	
I1E10	1	BEI(D) 1995	Aluminum	678	
I1D11	1	BEI(D) 1995	Aluminum	634	
I1E14	1	BEI(D) 1995	Aluminum	347	
I1B14	1	BEI(D) 1995	Aluminum	270	
I1SB-2	9	IT 1993	Antimony	49.7	
I1G10	1	BEI(D) 1995	Antimony	10.1	
I1D11	1	BEI(D) 1995	Antimony	4.7	
I1SB-1	10	IT 1993	Antimony	4.3	B
I1E12	1	BEI(D) 1995	Antimony	2.3	
I1E14	1	BEI(D) 1995	Antimony	2.1	
I1B14	1	BEI(D) 1995	Antimony	2	$B_3E_1N_1$
I1D13	1	BEI(D) 1995	Antimony	1.3	B_2
I1SB-2	9	IT 1993	Arsenic	38	B
I1G10	1	BEI(D) 1995	Arsenic	5.6	
I1B14	1	BEI(D) 1995	Arsenic	4	E_1
I1D11	1	BEI(D) 1995	Arsenic	3.1	
I1E12	1	BEI(D) 1995	Arsenic	2.7	
I1D13	1	BEI(D) 1995	Arsenic	2.4	
I1E14	1	BEI(D) 1995	Arsenic	1.4	B_2
I1E10	1	BEI(D) 1995	Arsenic	0.79	B_2
I1SB-1	10	IT 1993	Arsenic	0.33	B
I1SB-2	9	IT 1993	Barium	538	
I1G10	1	BEI(D) 1995	Barium	54.8	
I1E14	1	BEI(D) 1995	Barium	24.5	
I1D11	1	BEI(D) 1995	Barium	24.3	
I1E12	1	BEI(D) 1995	Barium	19.3	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1B14	1	BEI(D) 1995	Barium	16.6	B_3N_1
I1D13	1	BEI(D) 1995	Barium	15.5	
I1SB-1	10	IT 1993	Barium	10	B
I1E10	1	BEI(D) 1995	Barium	4.9	B_2
I1SB-2	9	IT 1993	Beryllium	0.23	B
I1B14	1	BEI(D) 1995	Beryllium	0.09	B_3
I1G10	1	BEI(D) 1995	Beryllium	0.08	B_2
I1D11	1	BEI(D) 1995	Beryllium	0.07	B_2
I1E10	1	BEI(D) 1995	Beryllium	0.06	B_2
I1E12	1	BEI(D) 1995	Beryllium	0.05	B_2
I1D13	1	BEI(D) 1995	Beryllium	0.05	B_2
I1E14	1	BEI(D) 1995	Beryllium	0.03	B_3
I1SB-2	9	IT 1993	Cadmium	15.6	
I1D13	1	BEI(D) 1995	Cadmium	0.89	B_3
I1G10	1	BEI(D) 1995	Cadmium	0.61	B_2
I1D11	1	BEI(D) 1995	Cadmium	0.53	B_2
I1B14	1	BEI(D) 1995	Cadmium	0.42	B_3N_1
I1SB-2	9	IT 1993	Chromium	104	
I1SB-1	10	IT 1993	Chromium	30.7	
I1D11	1	BEI(D) 1995	Chromium	22.2	
I1D13	1	BEI(D) 1995	Chromium	20.6	
I1G10	1	BEI(D) 1995	Chromium	20.4	
I1E12	1	BEI(D) 1995	Chromium	11.7	
I1B14	1	BEI(D) 1995	Chromium	7.6	E_1N_1
I1E14	1	BEI(D) 1995	Chromium	5.6	
I1E10	1	BEI(D) 1995	Chromium	3.6	B_2
I1SB-2	9	IT 1993	Cobalt	14.5	
I1G10	1	BEI(D) 1995	Cobalt	1.5	B_2
I1E12	1	BEI(D) 1995	Cobalt	1	B_2
I1D11	1	BEI(D) 1995	Cobalt	0.67	B_2
I1D13	1	BEI(D) 1995	Cobalt	0.6	B_2

TABLE 5-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT IR 1
NAS KEY WEST
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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1E14	1	BEI(D) 1995	Cobalt	0.46	B_2
I1B14	1	BEI(D) 1995	Cobalt	0.32	B_3E_1
I1SB-2	9	IT 1993	Copper	2,360	
I1D13	1	BEI(D) 1995	Copper	432	
I1D11	1	BEI(D) 1995	Copper	265	
I1G10	1	BEI(D) 1995	Copper	221	
I1E12	1	BEI(D) 1995	Copper	204	
I1B14	1	BEI(D) 1995	Copper	118	
I1E14	1	BEI(D) 1995	Copper	47.7	
I1SB-1	10	IT 1993	Copper	39.7	
I1SB-2	9	IT 1993	Iron	56,900	
I1G10	1	BEI(D) 1995	Iron	14,200	
I1D11	1	BEI(D) 1995	Iron	2,140	
I1D13	1	BEI(D) 1995	Iron	1,740	
I1E12	1	BEI(D) 1995	Iron	1,260	
I1B14	1	BEI(D) 1995	Iron	1,010	E_1
I1E14	1	BEI(D) 1995	Iron	762	
I1E10	1	BEI(D) 1995	Iron	343	
I1SB-2	9	IT 1993	Lead	3,700	
I1G10	1	BEI(D) 1995	Lead	382	
I1D13	1	BEI(D) 1995	Lead	187	
I1D11	1	BEI(D) 1995	Lead	173	
I1E14	1	BEI(D) 1995	Lead	105	
I1E12	1	BEI(D) 1995	Lead	73.1	
I1B14	1	BEI(D) 1995	Lead	68.4	E_1^*
I1SB-1	10	IT 1993	Lead	15.8	
I1SB-2	9	IT 1993	Manganese	874	
I1G10	1	BEI(D) 1995	Manganese	163	
I1D11	1	BEI(D) 1995	Manganese	80.1	
I1D13	1	BEI(D) 1995	Manganese	22.9	
I1E12	1	BEI(D) 1995	Manganese	19.5	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1B14	1	BEI(D) 1995	Manganese	16.6	E_1
I1E14	1	BEI(D) 1995	Manganese	11.7	
I1E10	1	BEI(D) 1995	Manganese	4.2	B_2
I1SB-2	9	IT 1993	Mercury	2	
I1D13	1	BEI(D) 1995	Mercury	1.2	
I1D11	1	BEI(D) 1995	Mercury	0.9	
I1E12	1	BEI(D) 1995	Mercury	0.63	
I1G10	1	BEI(D) 1995	Mercury	0.56	
I1B14	1	BEI(D) 1995	Mercury	0.37	N_1
I1E14	1	BEI(D) 1995	Mercury	0.1	
I1E10	1	BEI(D) 1995	Mercury	0.02	B_2
I1SB-2	9	IT 1993	Nickel	78.4	
I1G10	1	BEI(D) 1995	Nickel	14.8	
I1D11	1	BEI(D) 1995	Nickel	4.2	B_2
I1D13	1	BEI(D) 1995	Nickel	3.4	B_2
I1SB-2	10	IT 1993	Nickel	3.3	B
I1E12	1	BEI(D) 1995	Nickel	2.6	B_2
I1E14	1	BEI(D) 1995	Nickel	2.3	B_2
I1B14	1	BEI(D) 1995	Nickel	2	B_3E_1
I1E10	1	BEI(D) 1995	Nickel	0.89	B_2
I1SB-2	0	IT 1993	Selenium	0.4	B
I1G10	1	BEI(D) 1995	Thallium	0.45	B_2
I1SB-2	9	IT 1993	Tin	178	
I1SB-1	10	IT 1993	Tin	13.4	B
I1SB-2	9	IT 1993	Vanadium	34.9	
I1B14	1	BEI(D) 1995	Vanadium	2.7	B_3
I1G10	1	BEI(D) 1995	Zinc	1,050	
I1D11	1	BEI(D) 1995	Zinc	220	
I1D13	1	BEI(D) 1995	Zinc	198	
I1E12	1	BEI(D) 1995	Zinc	94.1	
I1B14	1	BEI(D) 1995	Zinc	84.8	

TABLE 5-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT IR 1
NAS KEY WEST
PAGE 3 OF 3

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1E14	1	BEI(D) 1995	Zinc	74.3	
I1SB-1		IT 1993	Zinc	28.8	
I1E10	1	BEI(D) 1995	Zinc	2.2	B_2
PESTICIDE/PCBs (µg/kg)					
I1SB-2	9	IT 1993	4,4'-DDD	92	DGJ
I1SB-2	9	IT 1993	4,4'-DDE	420	DG
I1SB-1	10	IT 1993	4,4'-DDE	3	C
I1SB-2	9	IT 1993	4,4'-DDT	150	DJXG
I1SB-2	9	IT 1993	Aldrin	26	XFG
I1SB-2	9	IT 1993	Aroclor-1254	3,900	DX
I1SB-2	9	IT 1993	Aroclor-1260	2,000	DJX
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
I1SB-2	9	IT 1993	Acenaphthene	740	J
I1SB-2	9	IT 1993	Benzo(a)anthracene	3,200	J
I1SB-2	9	IT 1993	Benzo(a)pyrene	4,300	J
I1SB-2	9	IT 1993	Benzo(b)fluoranthene	3,400	J
I1SB-2	9	IT 1993	Benzo(g,h,i)perylene	1,800	J
I1SB-2	9	IT 1993	Benzo(k)fluoranthene	3,400	J
I1SB-2	9	IT 1993	Biz(2-ethylhexyl)phthalate	1,800	J
I1SB-2	9	IT 1993	Chrysene	4,100	J
I1SB-2	9	IT 1993	Di-n-butylphthalate	500	J
I1SB-2	9	IT 1993	Dibenzo(a,h)anthracene	560	J
I1SB-2	9	IT 1993	Fluoranthene	4,600	J
I1SB-2	9	IT 1993	Fluorene	650	J
I1SB-2	9	IT 1993	Indeno(1,2,3-cd)pyrene	2,300	J
I1SB-2	9	IT 1993	Naphthalene	890	J
I1SB-2	9	IT 1993	Phenanthrene	2,700	J
I1SB-2	9	IT 1993	Pyrene	3,400	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
VOLATILE ORGANIC COMPOUNDS (µg/kg)					
I1SB-2	9	IT 1993	2-butanone	2	J
I1SB-2	9	IT 1993	Carbon disulfide	3	J
I1SB-2	9	IT 1993	Ethylbenzene	2	J
I1SB-2	9	IT 1993	Methylene chloride	30	B
I1SB-2	9	IT 1993	Toluene	2	J

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

1 Depths are in feet and represent top of sampling interval.

2 Data Sources:
BEI(D) 1995- Delineation Study (BEI, 1995) conducted in 1995 by BEI

3 Qualifier (Qual.) codes:
B_3 - Qualifier definition not available
E_1 - Qualifier definition not available
N_1 - Qualifier definition not available
B_2 - Analyte was found in the blank as well as the sample

all collected near the southwest corner of the area that was later excavated, were collected from the subsurface interval beginning at a depth of 1 foot, and were tested only for metals. IT Corporation collected three subsurface soil samples within the perimeter of the area that was later excavated, but below the depth of the excavation. Two of these samples were tested for organic and inorganic compounds, while the third sample was tested for organics only. Metals were detected in all subsurface compounds that underwent testing for inorganic parameters, and several of the detections exceeded screening values. A number of organic parameters were also detected in subsurface soil, but with the exception of one pesticide compound, all organic detections were limited to a single sample. Figure 5-6 shows the occurrence of analytes that exceeded screening values and indicated possible subsurface soil contamination.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of subsurface soil samples.

5.4.1.1 Volatile Organic Compounds

Three subsurface soil samples were tested for VOCs. Five VOCs were detected at low levels in one of these samples. None of the detected concentrations exceeded screening values.

5.4.1.2 Semivolatile Organic Compounds

Of the two subsurface soil samples that were analyzed for SVOCs, I1SB-2 exhibited a number of detections, many in excess of screening values, while no SVOCs were detected at I1SB-1. In all, 16 SVOCs were detected at I1SB-2. Fourteen of these detections exceeded screening values. This included acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

5.4.1.3 Pesticides

In the two subsurface soil samples from IR 1 that underwent pesticide analysis, four pesticide compounds were detected. Three of these compounds (4,4'-DDD, 4,4'-DDT, and aldrin) were detected only at I1SB-2,

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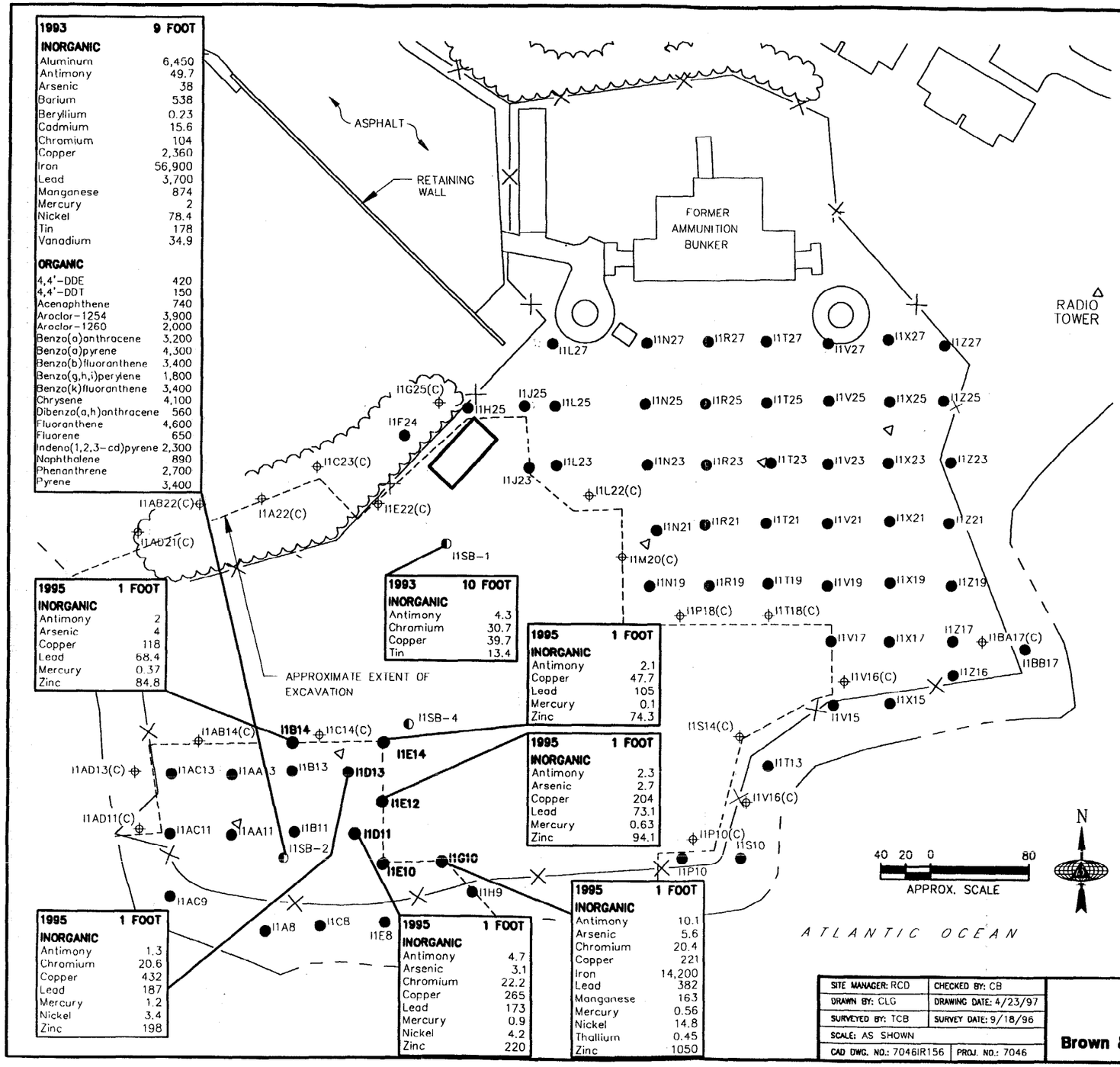

PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	3800
Antimony	0.79
Arsenic	2.6
Barium	440
Beryllium	0.15
Cadmium	2.5
Chromium	12
Copper	15
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Silver	9.8E-06
Vanadium	7.9
Zinc	30
ORGANIC	
4,4'-DDE	150
4,4'-DDT	110
Acenaphthene	100
Aroclor-1254	90
Aroclor-1260	96
Benzo(a)anthracene	100
Benzo(a)pyrene	88
Benzo(b)fluoranthene	100
Benzo(g,h,i)perylene	100
Benzo(k)fluoranthene	100
Chrysene	100
Dibenzo(a,h)anthracene	500
Fluoranthene	100
Fluorene	100
Indeno(1,2,3-cd)pyrene	100
Naphthalene	100
Phenanthrene	100
Pyrene	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

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

NOTE: ALL SUBSURFACE SOIL SAMPLE LOCATIONS ARE BOLD.

NOTE: ONLY SUBSURFACE SOIL SAMPLES COLLECTED BY IT CORPORATION IN 1993 WERE ANALYZED FOR ORGANIC PARAMETERS.

LEGEND

I1AC9 ● SOIL SAMPLE LOCATION BEI (1995)

I1AD11(C) ⊕ SOIL SAMPLE LOCATION BEI (1995,1996)

I1SB-1 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR156	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-6
SUBSURFACE SOIL CHEMICAL CONCENTRATIONS
IR 1
NAVAL AIR STATION
KEY WEST, FLORIDA

while the fourth compound (4,4'-DDE) was detected at both I1SB-1 and I1SB-2. Only two of the detections, both occurring at I1SB-2, exceeded screening values (4,4'-DDE, 420 µg/kg; 4,4'-DDT, 150 µg/kg).

5.4.1.4 Polychlorinated Biphenyls

Two subsurface soil samples were tested for PCBs. Two PCBs were detected in one of the two samples. Both aroclor-1254 and aroclor-1260 were detected and exceeded screening values at I1SB-2. Detected concentrations were 3,900 µg/kg and 2,000 µg/kg, respectively.

5.4.1.5 Inorganics

Inorganic compounds were detected in all nine of the subsurface samples that underwent inorganic analyses. Compounds were most frequently detected and were most frequently in excess of screening values at I1SB-2, collected in the southwest corner of the site from 10 to 12 feet below land surface. Seventeen of the nineteen inorganic compounds detected at IR 1 occurred at I1SB-2. Fifteen of these compounds exceeded screening values and were detected at their maximum concentration at I1SB-2. This includes aluminum (5,450 mg/kg), antimony (49.7 mg/kg), arsenic (38 mg/kg), barium (538 mg/kg), beryllium (0.23 mg/kg), cadmium (15.6 mg/kg), chromium (104 mg/kg), copper (2,360 mg/kg), iron (56,900 mg/kg), lead (3,700 mg/kg), manganese (874 mg/kg), mercury (2 mg/kg), nickel (78.4 mg/kg), tin (178 mg/kg), and vanadium (34.9 mg/kg). The single detection of selenium in subsurface soil also occurred at this location, although it did not exceed the 1.8 mg/kg screening value. The highest concentration of cobalt occurred at I1SB-2 as well, although the associated screening value was not exceeded.

Considering only the shallower subsurface samples collected by BEI during the 1995 Delineation Investigation, I1G10, the southeastern-most sample, generally demonstrated the highest and most frequent detections of inorganic compounds. Both zinc (1,050 mg/kg) and thallium (0.45 mg/kg) were detected at their maximum concentrations at I1G10.

The most frequently detected metals at IR 1 included arsenic, barium, chromium, and nickel. All were detected in every subsurface soil sample that underwent inorganic analysis. The compounds most frequently detected in excess of screening values included antimony and copper which exceeded screening values in 8 samples, lead and mercury which exceeded screening values in 7 samples, zinc which exceeded screening values in 6 samples, and arsenic and chromium which exceeded screening values in 5 of the 9 samples.

5.4.2 Surface Soil

Data from the 1995 BEI Delineation Study and the 1996 BEI Confirmatory Study were considered in the analysis of surface soil contamination at IR 1. No other investigations tested surface soil for contamination at IR 1. Chemicals that were detected in surface soil samples are listed in Table 5-2. This table includes analytical results from historical sampling events only, as no surface samples were collected during the Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995). The samples were tested only for metals. Of the 85 surface soil samples collected, 48 were tested for arsenic and lead only, and two were tested for lead only. In almost all samples, concentrations of at least one metal exceeded screening values. Exceptions were in the northern part of the site, just south of the ammunition bunker and near the northeast radio towers. Figures 5-7 through 5-9 show the occurrence of analytes that exceeded screening values and indicate possible surface soil contamination.

Screening values were obtained from a variety of sources including: ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

TABLE 5-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 1
NAS KEY WEST
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Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
I1P10(C)	BEI(C) 1995-96	Aluminum	12,200	
I1S12(C)	BEI(C) 1995-96	Aluminum	2,050	
I1E22(C)	BEI(C) 1995-96	Aluminum	1,880	
I1C23(C)	BEI(C) 1995-96	Aluminum	1,700	E*
I1G25(C)	BEI(C) 1995-96	Aluminum	1,690	E*
I1AB22(C)	BEI(C) 1995-96	Aluminum	1,670	E*
I1AD21(C)	BEI(C) 1995-96	Aluminum	1,355	E*
I1J23	BEI(D) 1995	Aluminum	1,350	
I1V16(C)	BEI(C) 1995-96	Aluminum	1,310	
I1P18(C)	BEI(C) 1995-96	Aluminum	1,280	
I1A22(C)	BEI(C) 1995-96	Aluminum	1,190	E*
I1T13	BEI(D) 1995	Aluminum	1,090	
I1E10	BEI(D) 1995	Aluminum	1,080	
I1T18(C)	BEI(C) 1995-96	Aluminum	1,030	
I1S14(C)	BEI(C) 1995-96	Aluminum	1,000	
I1M20(C)	BEI(C) 1995-96	Aluminum	885	
I1Z17	BEI(D) 1995	Aluminum	882	
I1E12	BEI(D) 1995	Aluminum	851	
I1E14	BEI(D) 1995	Aluminum	776	
I1AB14(C)	BEI(C) 1995-96	Aluminum	740	
I1G10	BEI(D) 1995	Aluminum	737	
I1V27	BEI(D) 1995	Aluminum	736	
I1B14	BEI(D) 1995	Aluminum	733	
I1AD13(C)	BEI(C) 1995-96	Aluminum	721	E*
I1D11	BEI(D) 1995	Aluminum	670	
I1AC9	BEI(D) 1995	Aluminum	669	
I1D13	BEI(D) 1995	Aluminum	647	
I1L25	BEI(D) 1995	Aluminum	603	
I1V23	BEI(D) 1995	Aluminum	559	
I1AA13	BEI(D) 1995	Aluminum	551	
I1V19	BEI(D) 1995	Aluminum	496.5	

Location	Source[1]	Parameter	Result	Qual.[2]
I1C14(C)	BEI(C) 1995-96	Aluminum	435	
I1R25	BEI(D) 1995	Aluminum	393	
I1AD11(C)	BEI(C) 1995-96	Aluminum	344	E*
I1L22(C)	BEI(C) 1995-96	Aluminum	247	
I1S12(C)	BEI(C) 1995-96	Antimony	203	N
I1E22(C)	BEI(C) 1995-96	Antimony	63.2	N
I1J23	BEI(D) 1995	Antimony	37.7	
I1AD21(C)	BEI(C) 1995-96	Antimony	32.8	E*
I1G25(C)	BEI(C) 1995-96	Antimony	25.7	E_1N_1
I1AB22(C)	BEI(C) 1995-96	Antimony	21.6	E*
I1B14	BEI(D) 1995	Antimony	11	E_1N_1
I1A22(C)	BEI(C) 1995-96	Antimony	8.3	EN
I1AD13(C)	BEI(C) 1995-96	Antimony	7.8	EN
I1P10(C)	BEI(C) 1995-96	Antimony	7.6	N
I1M20(C)	BEI(C) 1995-96	Antimony	7.6	N
I1C23(C)	BEI(C) 1995-96	Antimony	6.7	EN
I1AA13	BEI(D) 1995	Antimony	6.7	
I1G10	BEI(D) 1995	Antimony	6.1	
I1E14	BEI(D) 1995	Antimony	5.6	
I1D13	BEI(D) 1995	Antimony	5.2	
I1E12	BEI(D) 1995	Antimony	5.1	
I1AB14(C)	BEI(C) 1995-96	Antimony	4.5	N
I1T18(C)	BEI(C) 1995-96	Antimony	3.9	N
I1C14(C)	BEI(C) 1995-96	Antimony	3	N
I1Z17	BEI(D) 1995	Antimony	3	
I1AD11(C)	BEI(C) 1995-96	Antimony	2.7	EN
I1V16(C)	BEI(C) 1995-96	Antimony	2.1	N
I1S14(C)	BEI(C) 1995-96	Antimony	2	N
I1P18(C)	BEI(C) 1995-96	Antimony	1.4	N
I1L22(C)	BEI(C) 1995-96	Antimony	1.1	N
I1D11	BEI(D) 1995	Antimony	1	B_2
I1V19	BEI(D) 1995	Antimony	0.83	

TABLE 5-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 1
NAS KEY WEST
PAGE 2 OF 11

Location	Source[1]	Parameter	Result	Qual.[2]
I1R25	BEI(D) 1995	Antimony	0.76	
I1E10	BEI(D) 1995	Antimony	0.59	B_2
I1L25	BEI(D) 1995	Antimony	0.51	B_2
I1T13	BEI(D) 1995	Antimony	0.47	B_2
I1V27	BEI(D) 1995	Antimony	0.39	B_2
I1V23	BEI(D) 1995	Antimony	0.26	B_2
I1AC9	BEI(D) 1995	Antimony	0.17	B_2
I1E8	BEI(D) 1995	Arsenic	44.7	
I1E22(C)	BEI(C) 1995-96	Arsenic	10	
I1G25(C)	BEI(C) 1995-96	Arsenic	9.4	E
I1V25	BEI(D) 1995	Arsenic	7.8	
I1S12(C)	BEI(C) 1995-96	Arsenic	7.5	
I1AD13(C)	BEI(C) 1995-96	Arsenic	6.8	E
I1M20(C)	BEI(C) 1995-96	Arsenic	6.8	
I1B11	BEI(D) 1995	Arsenic	6.1	
I1V19	BEI(D) 1995	Arsenic	6.1	
I1H9	BEI(D) 1995	Arsenic	5.3	
I1T18(C)	BEI(C) 1995-96	Arsenic	4.4	
I1P10	BEI(D) 1995	Arsenic	4.2	
I1AA11	BEI(D) 1995	Arsenic	4.1	
I1V16(C)	BEI(C) 1995-96	Arsenic	4	
I1B13	BEI(D) 1995	Arsenic	3.9	
I1C8	BEI(D) 1995	Arsenic	3.8	
I1AD21(C)	BEI(C) 1995-96	Arsenic	3.7	E
I1A8	BEI(D) 1995	Arsenic	3.6	
I1V15	BEI(D) 1995	Arsenic	3.5	
I1S14(C)	BEI(C) 1995-96	Arsenic	3.5	
I1AA13	BEI(D) 1995	Arsenic	3.3	
I1V17	BEI(D) 1995	Arsenic	3.1	
I1B14	BEI(D) 1995	Arsenic	3	E_1
I1N21	BEI(D) 1995	Arsenic	3	
I1AC11	BEI(D) 1995	Arsenic	2.9	
I1L23	BEI(D) 1995	Arsenic	2.7	
I1AB14(C)	BEI(C) 1995-96	Arsenic	2.7	
I1AC13	BEI(D) 1995	Arsenic	2.6	
I1X23	BEI(D) 1995	Arsenic	2.6	
I1L22(C)	BEI(C) 1995-96	Arsenic	2.6	
I1T19	BEI(D) 1995	Arsenic	2.5	
I1AB22(C)	BEI(C) 1995-96	Arsenic	2.5	E
I1E12	BEI(D) 1995	Arsenic	2.4	
I1D13	BEI(D) 1995	Arsenic	2.3	
I1Z17	BEI(D) 1995	Arsenic	2.3	
I1J23	BEI(D) 1995	Arsenic	2.3	
I1S10	BEI(D) 1995	Arsenic	2.3	
I1J25	BEI(D) 1995	Arsenic	2.3	
I1C23(C)	BEI(C) 1995-96	Arsenic	2.3	E
I1Z21	BEI(D) 1995	Arsenic	2.2	
I1P10(C)	BEI(C) 1995-96	Arsenic	2.2	
I1AD11(C)	BEI(C) 1995-96	Arsenic	2.2	E
I1E14	BEI(D) 1995	Arsenic	2.1	
I1X17	BEI(D) 1995	Arsenic	2	
I1R21	BEI(D) 1995	Arsenic	2	
I1G10	BEI(D) 1995	Arsenic	1.9	B_2
I1C14(C)	BEI(C) 1995-96	Arsenic	1.9	
I1X15	BEI(D) 1995	Arsenic	1.8	
I1Z19	BEI(D) 1995	Arsenic	1.8	
I1Z16	BEI(D) 1995	Arsenic	1.8	
I1X19	BEI(D) 1995	Arsenic	1.8	
I1BB17	BEI(D) 1995	Arsenic	1.7	
I1N23	BEI(D) 1995	Arsenic	1.7	
I1A22(C)	BEI(C) 1995-96	Arsenic	1.6	E
I1N27	BEI(D) 1995	Arsenic	1.6	
I1P18(C)	BEI(C) 1995-96	Arsenic	1.6	
I1F24	BEI(D) 1995	Arsenic	1.5	

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Location	Source[1]	Parameter	Result	Qual.[2]
I1R23	BEI(D) 1995	Arsenic	1.5	
I1X21	BEI(D) 1995	Arsenic	1.5	
I1T13	BEI(D) 1995	Arsenic	1.4	
I1T25	BEI(D) 1995	Arsenic	1.4	
I1L27	BEI(D) 1995	Arsenic	1.3	
I1R27	BEI(D) 1995	Arsenic	1.3	
I1N19	BEI(D) 1995	Arsenic	1.3	
I1H25	BEI(D) 1995	Arsenic	1.3	
I1Z23	BEI(D) 1995	Arsenic	1.3	
I1Z25	BEI(D) 1995	Arsenic	1.3	
I1X25	BEI(D) 1995	Arsenic	1.2	
I1Z27	BEI(D) 1995	Arsenic	1.2	
I1T27	BEI(D) 1995	Arsenic	1.2	
I1AC9	BEI(D) 1995	Arsenic	1.2	
I1V21	BEI(D) 1995	Arsenic	1.2	
I1N25	BEI(D) 1995	Arsenic	1.1	
I1V23	BEI(D) 1995	Arsenic	1.1	
I1E10	BEI(D) 1995	Arsenic	1.1	B_2
I1R19	BEI(D) 1995	Arsenic	1	
I1D11	BEI(D) 1995	Arsenic	0.99	B_2
I1L25	BEI(D) 1995	Arsenic	0.98	
I1T23	BEI(D) 1995	Arsenic	0.96	
I1R25	BEI(D) 1995	Arsenic	0.92	
I1X27	BEI(D) 1995	Arsenic	0.91	
I1V27	BEI(D) 1995	Arsenic	0.9	
I1T21	BEI(D) 1995	Arsenic	0.81	
I1E22(C)	BEI(C) 1995-96	Barium	163	N
I1J23	BEI(D) 1995	Barium	118	
I1G25(C)	BEI(C) 1995-96	Barium	111	E
I1AD21(C)	BEI(C) 1995-96	Barium	69	E
I1E14	BEI(D) 1995	Barium	67.3	
I1S12(C)	BEI(C) 1995-96	Barium	59.2	N

Location	Source[1]	Parameter	Result	Qual.[2]
I1S14(C)	BEI(C) 1995-96	Barium	58	N
I1C23(C)	BEI(C) 1995-96	Barium	45.5	E
I1AB22(C)	BEI(C) 1995-96	Barium	41.2	E
I1M20(C)	BEI(C) 1995-96	Barium	40.6	N
I1E12	BEI(D) 1995	Barium	38.7	
I1B14	BEI(D) 1995	Barium	38.3	N_1
I1T18(C)	BEI(C) 1995-96	Barium	35	N
I1G10	BEI(D) 1995	Barium	32.7	
I1D13	BEI(D) 1995	Barium	31.5	
I1P10(C)	BEI(C) 1995-96	Barium	31	N
I1AA13	BEI(D) 1995	Barium	29.7	
I1Z17	BEI(D) 1995	Barium	29	
I1V16(C)	BEI(C) 1995-96	Barium	27.8	N
I1P18(C)	BEI(C) 1995-96	Barium	27.6	N
I1AD13(C)	BEI(C) 1995-96	Barium	25.3	E
I1A22(C)	BEI(C) 1995-96	Barium	23.7	E
I1AB14(C)	BEI(C) 1995-96	Barium	22.9	N
I1V27	BEI(D) 1995	Barium	22.5	
I1C14(C)	BEI(C) 1995-96	Barium	20.4	N
I1AD11(C)	BEI(C) 1995-96	Barium	17.6	E
I1AC9	BEI(D) 1995	Barium	16.9	
I1T13	BEI(D) 1995	Barium	15.5	
I1L22(C)	BEI(C) 1995-96	Barium	13.7	N
I1L25	BEI(D) 1995	Barium	13.2	
I1R25	BEI(D) 1995	Barium	12.4	
I1V23	BEI(D) 1995	Barium	10.4	
I1D11	BEI(D) 1995	Barium	8.8	
I1V19	BEI(D) 1995	Barium	8	
I1E10	BEI(D) 1995	Barium	7.1	
I1C23(C)	BEI(C) 1995-96	Beryllium	0.26	B_2
I1E12	BEI(D) 1995	Beryllium	0.19	B_2
I1P10(C)	BEI(C) 1995-96	Beryllium	0.17	B_2

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Location	Source[1]	Parameter	Result	Qual.[2]
I1B14	BEI(D) 1995	Beryllium	0.11	B_3
I1AD21(C)	BEI(C) 1995-96	Beryllium	0.105	B_2
I1M20(C)	BEI(C) 1995-96	Beryllium	0.1	B_2N
I1E10	BEI(D) 1995	Beryllium	0.07	B_2
I1G10	BEI(D) 1995	Beryllium	0.07	B_2
I1S12(C)	BEI(C) 1995-96	Beryllium	0.07	B_2
I1V16(C)	BEI(C) 1995-96	Beryllium	0.06	B_2
I1D11	BEI(D) 1995	Beryllium	0.06	B_2
I1S14(C)	BEI(C) 1995-96	Beryllium	0.05	B_2
I1T13	BEI(D) 1995	Beryllium	0.05	B_2
I1AB22(C)	BEI(C) 1995-96	Beryllium	0.05	B_2
I1D13	BEI(D) 1995	Beryllium	0.05	B_2
I1J23	BEI(D) 1995	Beryllium	0.04	B_2
I1E14	BEI(D) 1995	Beryllium	0.04	B_2
I1T18(C)	BEI(C) 1995-96	Beryllium	0.04	B_2
I1E22(C)	BEI(C) 1995-96	Beryllium	0.04	B_2
I1P18(C)	BEI(C) 1995-96	Beryllium	0.04	B_2N
I1G25(C)	BEI(C) 1995-96	Beryllium	0.03	B_2
I1A22(C)	BEI(C) 1995-96	Beryllium	0.03	B_2
I1AD13(C)	BEI(C) 1995-96	Beryllium	0.03	B_2
I1Z17	BEI(D) 1995	Beryllium	0.03	B_2
I1AB14(C)	BEI(C) 1995-96	Beryllium	0.025	B_2
I1L25	BEI(D) 1995	Beryllium	0.02	B_2
I1AA13	BEI(D) 1995	Beryllium	0.02	B_2
I1AC9	BEI(D) 1995	Beryllium	0.02	B_2
I1R25	BEI(D) 1995	Beryllium	0.01	B_2
I1V19	BEI(D) 1995	Beryllium	0.01	B_2
I1V27	BEI(D) 1995	Beryllium	0.01	B_2
I1V23	BEI(D) 1995	Beryllium	0.01	B_2
I1J23	BEI(D) 1995	Cadmium	3.6	
I1AB22(C)	BEI(C) 1995-96	Cadmium	2.1	E
I1E22(C)	BEI(C) 1995-96	Cadmium	2.1	

Location	Source[1]	Parameter	Result	Qual.[2]
I1G25(C)	BEI(C) 1995-96	Cadmium	2	EN
I1AD21(C)	BEI(C) 1995-96	Cadmium	1.7	E
I1S12(C)	BEI(C) 1995-96	Cadmium	1.4	
I1AA13	BEI(D) 1995	Cadmium	1.4	
I1P10(C)	BEI(C) 1995-96	Cadmium	1.3	
I1B14	BEI(D) 1995	Cadmium	0.89	N_1
I1C23(C)	BEI(C) 1995-96	Cadmium	0.82	EN
I1AD13(C)	BEI(C) 1995-96	Cadmium	0.8	EN
I1T18(C)	BEI(C) 1995-96	Cadmium	0.78	
I1S14(C)	BEI(C) 1995-96	Cadmium	0.74	
I1E12	BEI(D) 1995	Cadmium	0.7	B_2
I1E14	BEI(D) 1995	Cadmium	0.68	B_2
I1Z17	BEI(D) 1995	Cadmium	0.64	
I1A22(C)	BEI(C) 1995-96	Cadmium	0.62	EN
I1C14(C)	BEI(C) 1995-96	Cadmium	0.6	
I1M20(C)	BEI(C) 1995-96	Cadmium	0.57	N
I1AB14(C)	BEI(C) 1995-96	Cadmium	0.525	B_2
I1G10	BEI(D) 1995	Cadmium	0.48	B_2
I1T13	BEI(D) 1995	Cadmium	0.45	
I1D13	BEI(D) 1995	Cadmium	0.44	B_2
I1V16(C)	BEI(C) 1995-96	Cadmium	0.43	B_2
I1AD11(C)	BEI(C) 1995-96	Cadmium	0.35	EN
I1P18(C)	BEI(C) 1995-96	Cadmium	0.24	B_2N
I1V19	BEI(D) 1995	Cadmium	0.19	B_2
I1V27	BEI(D) 1995	Cadmium	0.17	
I1L22(C)	BEI(C) 1995-96	Cadmium	0.17	B_2N
I1AC9	BEI(D) 1995	Cadmium	0.16	B_2
I1R25	BEI(D) 1995	Cadmium	0.16	B_2
I1L25	BEI(D) 1995	Cadmium	0.14	B_2
I1V23	BEI(D) 1995	Cadmium	0.11	B_2
I1S14(C)	BEI(C) 1995-96	Chromium	153	*
I1T18(C)	BEI(C) 1995-96	Chromium	64.8	*

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Location	Source[1]	Parameter	Result	Qual.[2]
I1AB14(C)	BEI(C) 1995-96	Chromium	47.4	*
I1G25(C)	BEI(C) 1995-96	Chromium	41	E
I1E22(C)	BEI(C) 1995-96	Chromium	40.2	*
I1S12(C)	BEI(C) 1995-96	Chromium	39.7	*
I1Z17	BEI(D) 1995	Chromium	36	
I1P10(C)	BEI(C) 1995-96	Chromium	35.5	*
I1M20(C)	BEI(C) 1995-96	Chromium	34.7	EN
I1AD13(C)	BEI(C) 1995-96	Chromium	34.5	E
I1V16(C)	BEI(C) 1995-96	Chromium	31.2	*
I1AD21(C)	BEI(C) 1995-96	Chromium	28.4	EN*
I1AB22(C)	BEI(C) 1995-96	Chromium	28.3	EN*
I1E12	BEI(D) 1995	Chromium	25.8	
I1C23(C)	BEI(C) 1995-96	Chromium	24.5	E
I1A22(C)	BEI(C) 1995-96	Chromium	18.8	E
I1R25	BEI(D) 1995	Chromium	16.6	
I1G10	BEI(D) 1995	Chromium	14.9	
I1P18(C)	BEI(C) 1995-96	Chromium	14.1	EN
I1B14	BEI(D) 1995	Chromium	13.5	E_1N_1
I1J23	BEI(D) 1995	Chromium	13.2	
I1V19	BEI(D) 1995	Chromium	12.6	
I1AD11(C)	BEI(C) 1995-96	Chromium	12.4	E
I1E14	BEI(D) 1995	Chromium	12.2	
I1AA13	BEI(D) 1995	Chromium	11.4	
I1T13	BEI(D) 1995	Chromium	11	
I1D13	BEI(D) 1995	Chromium	10.4	
I1C14(C)	BEI(C) 1995-96	Chromium	9.3	*
I1D11	BEI(D) 1995	Chromium	6.7	
I1AC9	BEI(D) 1995	Chromium	5	
I1E10	BEI(D) 1995	Chromium	4.4	B
I1L22(C)	BEI(C) 1995-96	Chromium	4.3	EN
I1V23	BEI(D) 1995	Chromium	4.3	
I1L25	BEI(D) 1995	Chromium	4.1	

Location	Source[1]	Parameter	Result	Qual.[2]
I1V27	BEI(D) 1995	Chromium	3.6	
I1M20(C)	BEI(C) 1995-96	Cobalt	5.5	EN
I1E22(C)	BEI(C) 1995-96	Cobalt	5.3	
I1S12(C)	BEI(C) 1995-96	Cobalt	1.7	
I1G25(C)	BEI(C) 1995-96	Cobalt	1.7	E
I1S14(C)	BEI(C) 1995-96	Cobalt	1.6	
I1AD21(C)	BEI(C) 1995-96	Cobalt	1.5	E
I1V16(C)	BEI(C) 1995-96	Cobalt	1.4	
I1T18(C)	BEI(C) 1995-96	Cobalt	1.2	
I1J23	BEI(D) 1995	Cobalt	1.2	
I1E12	BEI(D) 1995	Cobalt	1.2	B_2
I1P18(C)	BEI(C) 1995-96	Cobalt	1.1	EN
I1AB22(C)	BEI(C) 1995-96	Cobalt	1	E
I1C23(C)	BEI(C) 1995-96	Cobalt	0.95	E
I1G10	BEI(D) 1995	Cobalt	0.84	B_2
I1P10(C)	BEI(C) 1995-96	Cobalt	0.79	B_2
I1B14	BEI(D) 1995	Cobalt	0.77	B_3E_1
I1Z17	BEI(D) 1995	Cobalt	0.76	
I1AB14(C)	BEI(C) 1995-96	Cobalt	0.735	B_2
I1AD13(C)	BEI(C) 1995-96	Cobalt	0.685	E
I1D13	BEI(D) 1995	Cobalt	0.65	B_2
I1A22(C)	BEI(C) 1995-96	Cobalt	0.61	E
I1E14	BEI(D) 1995	Cobalt	0.6	B_2
I1T13	BEI(D) 1995	Cobalt	0.55	
I1AA13	BEI(D) 1995	Cobalt	0.49	B_2
I1D11	BEI(D) 1995	Cobalt	0.46	B_2
I1C14(C)	BEI(C) 1995-96	Cobalt	0.44	B_2
I1AD11(C)	BEI(C) 1995-96	Cobalt	0.35	B_2E
I1V19	BEI(D) 1995	Cobalt	0.24	B_2
I1L25	BEI(D) 1995	Cobalt	0.19	B_2
I1V27	BEI(D) 1995	Cobalt	0.17	
I1L22(C)	BEI(C) 1995-96	Cobalt	0.17	B_2EN

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Location	Source[1]	Parameter	Result	Qual.[2]
I1R25	BEI(D) 1995	Cobalt	0.16	B_2
I1AC9	BEI(D) 1995	Cobalt	0.12	B_2
I1V23	BEI(D) 1995	Cobalt	0.06	B_2
I1S14(C)	BEI(C) 1995-96	Copper	2,250	*
I1S12(C)	BEI(C) 1995-96	Copper	2,240	*
I1Z17	BEI(D) 1995	Copper	1,490	
I1AD13(C)	BEI(C) 1995-96	Copper	1,375	*
I1E12	BEI(D) 1995	Copper	1,180	
I1T18(C)	BEI(C) 1995-96	Copper	1,160	*
I1AB14(C)	BEI(C) 1995-96	Copper	796.5	*
I1P10(C)	BEI(C) 1995-96	Copper	763	*
I1E22(C)	BEI(C) 1995-96	Copper	662	*
I1G25(C)	BEI(C) 1995-96	Copper	530	*
I1AD21(C)	BEI(C) 1995-96	Copper	469.5	E
I1V16(C)	BEI(C) 1995-96	Copper	467	*
I1D13	BEI(D) 1995	Copper	441	
I1AB22(C)	BEI(C) 1995-96	Copper	334	E
I1M20(C)	BEI(C) 1995-96	Copper	263	N
I1J23	BEI(D) 1995	Copper	237	
I1C23(C)	BEI(C) 1995-96	Copper	230	*
I1T13	BEI(D) 1995	Copper	229	
I1A22(C)	BEI(C) 1995-96	Copper	214	*
I1B14	BEI(D) 1995	Copper	189	
I1AA13	BEI(D) 1995	Copper	167	
I1P18(C)	BEI(C) 1995-96	Copper	140	N
I1C14(C)	BEI(C) 1995-96	Copper	139	*
I1V19	BEI(D) 1995	Copper	118.5	
I1E14	BEI(D) 1995	Copper	118	
I1AD11(C)	BEI(C) 1995-96	Copper	110	*
I1G10	BEI(D) 1995	Copper	79	
I1L25	BEI(D) 1995	Copper	60.6	
I1D11	BEI(D) 1995	Copper	35.9	

Location	Source[1]	Parameter	Result	Qual.[2]
I1L22(C)	BEI(C) 1995-96	Copper	25.3	N
I1V27	BEI(D) 1995	Copper	16.1	
I1R25	BEI(D) 1995	Copper	16	
I1V23	BEI(D) 1995	Copper	12.3	
I1AC9	BEI(D) 1995	Copper	10.4	
I1E10	BEI(D) 1995	Copper	5.5	B_2
I1E22(C)	BEI(C) 1995-96	Iron	45,200	
I1P10(C)	BEI(C) 1995-96	Iron	10,500	
I1M20(C)	BEI(C) 1995-96	Iron	8,110	E
I1Z17	BEI(D) 1995	Iron	7,200	
I1G25(C)	BEI(C) 1995-96	Iron	6,970	E*
I1S12(C)	BEI(C) 1995-96	Iron	6,670	
I1AB14(C)	BEI(C) 1995-96	Iron	6,165	
I1AD21(C)	BEI(C) 1995-96	Iron	5,980	E*
I1V16(C)	BEI(C) 1995-96	Iron	5,310	
I1J23	BEI(D) 1995	Iron	4,890	
I1S14(C)	BEI(C) 1995-96	Iron	4,410	
I1AD13(C)	BEI(C) 1995-96	Iron	3,765	E*
I1AB22(C)	BEI(C) 1995-96	Iron	3,760	E*
I1T18(C)	BEI(C) 1995-96	Iron	3,640	
I1B14	BEI(D) 1995	Iron	3,100	E_1
I1E12	BEI(D) 1995	Iron	3,070	
I1P18(C)	BEI(C) 1995-96	Iron	2,790	E
I1A22(C)	BEI(C) 1995-96	Iron	2,660	E*
I1T13	BEI(D) 1995	Iron	2,650	
I1AA13	BEI(D) 1995	Iron	2,560	
I1C23(C)	BEI(C) 1995-96	Iron	2,310	E*
I1D13	BEI(D) 1995	Iron	2,310	
I1C14(C)	BEI(C) 1995-96	Iron	2,210	
I1G10	BEI(D) 1995	Iron	2,020	
I1E14	BEI(D) 1995	Iron	1,990	
I1D11	BEI(D) 1995	Iron	1,550	

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Location	Source[1]	Parameter	Result	Qual.[2]
I1V19	BEI(D) 1995	Iron	985.5	
I1E10	BEI(D) 1995	Iron	944	
I1AD11(C)	BEI(C) 1995-96	Iron	926	E*
I1L22(C)	BEI(C) 1995-96	Iron	828	E
I1L25	BEI(D) 1995	Iron	810	
I1V27	BEI(D) 1995	Iron	733	
I1R25	BEI(D) 1995	Iron	710	
I1AC9	BEI(D) 1995	Iron	641	
I1V23	BEI(D) 1995	Iron	524	
I1G25(C)	BEI(C) 1995-96	Lead	680	E*
I1S14(C)	BEI(C) 1995-96	Lead	567	N
I1AD21(C)	BEI(C) 1995-96	Lead	553.5	*
I1E22(C)	BEI(C) 1995-96	Lead	520	N
I1Z16	BEI(D) 1995	Lead	514	
I1T18(C)	BEI(C) 1995-96	Lead	506	N
I1A22(C)	BEI(C) 1995-96	Lead	458	E*
I1Z17	BEI(D) 1995	Lead	454	
I1AB22(C)	BEI(C) 1995-96	Lead	417	*
I1S12(C)	BEI(C) 1995-96	Lead	383	N
I1M20(C)	BEI(C) 1995-96	Lead	371	EN
I1E12	BEI(D) 1995	Lead	370	
I1H9	BEI(D) 1995	Lead	367	
I1V15	BEI(D) 1995	Lead	360	
I1AD13(C)	BEI(C) 1995-96	Lead	356.5	E*
I1S10	BEI(D) 1995	Lead	345	
I1P10	BEI(D) 1995	Lead	319	
I1E8	BEI(D) 1995	Lead	298	
I1AB14(C)	BEI(C) 1995-96	Lead	268.5	N
I1B14	BEI(D) 1995	Lead	264	E_1*[1]
I1X17	BEI(D) 1995	Lead	262	
I1H25	BEI(D) 1995	Lead	259	
I1J25	BEI(D) 1995	Lead	257	

Location	Source[1]	Parameter	Result	Qual.[2]
I1C8	BEI(D) 1995	Lead	255	
I1J23	BEI(D) 1995	Lead	227	
I1AA11	BEI(D) 1995	Lead	217	
I1BB17	BEI(D) 1995	Lead	200	
I1A8	BEI(D) 1995	Lead	198	
I1N19	BEI(D) 1995	Lead	197	
I1C23(C)	BEI(C) 1995-96	Lead	185	E*
I1V16(C)	BEI(C) 1995-96	Lead	183	N
I1V25	BEI(D) 1995	Lead	182	
I1BA17(C)	BEI(C) 1995-96	Lead	180	EN
I1AC11	BEI(D) 1995	Lead	177	
I1V17	BEI(D) 1995	Lead	170	
I1P18(C)	BEI(C) 1995-96	Lead	165	EN
I1P10(C)	BEI(C) 1995-96	Lead	162	N
I1G10	BEI(D) 1995	Lead	155	
I1AA13	BEI(D) 1995	Lead	155	
I1X15	BEI(D) 1995	Lead	145	
I1L27	BEI(D) 1995	Lead	144	
I1AC13	BEI(D) 1995	Lead	141	
I1B13	BEI(D) 1995	Lead	138	
I1D13	BEI(D) 1995	Lead	136	
I1E14	BEI(D) 1995	Lead	131	
I1AD11(C)	BEI(C) 1995-96	Lead	121	E*
I1B11	BEI(D) 1995	Lead	108	
I1X19	BEI(D) 1995	Lead	98.4	
I1G25(C)	BEI(C) 1995-96	Lead	94.8	EN
I1R25	BEI(D) 1995	Lead	93.4	
I1R19	BEI(D) 1995	Lead	92.7	
I1T19	BEI(D) 1995	Lead	90.9	
I1C14(C)	BEI(C) 1995-96	Lead	89.5	N
I1N23	BEI(D) 1995	Lead	84.7	
I1T13	BEI(D) 1995	Lead	63.6	

TABLE 5-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 1
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Location	Source[1]	Parameter	Result	Qual.[2]
I1Z21	BEI(D) 1995	Lead	53.3	
I1N21	BEI(D) 1995	Lead	52.5	
I1V19	BEI(D) 1995	Lead	50.4	
I1N25	BEI(D) 1995	Lead	49.9	
I1Z25	BEI(D) 1995	Lead	41.8	
I1L22(C)	BEI(C) 1995-96	Lead	41.1	EN
I1AC9	BEI(D) 1995	Lead	40.5	
I1Z23	BEI(D) 1995	Lead	40.2	
I1F24	BEI(D) 1995	Lead	40.1	
I1T25	BEI(D) 1995	Lead	40	
I1X23	BEI(D) 1995	Lead	39.7	
I1R23	BEI(D) 1995	Lead	36.8	
I1V27	BEI(D) 1995	Lead	34.3	
I1X21	BEI(D) 1995	Lead	31.9	
I1T21	BEI(D) 1995	Lead	31.2	
I1L23	BEI(D) 1995	Lead	29.7	
I1R27	BEI(D) 1995	Lead	26.7	
I1Z19	BEI(D) 1995	Lead	25.9	
I1R21	BEI(D) 1995	Lead	23	
I1D11	BEI(D) 1995	Lead	22.3	
I1T27	BEI(D) 1995	Lead	21.9	
I1V21	BEI(D) 1995	Lead	19.9	
I1N27	BEI(D) 1995	Lead	19.5	
I1X25	BEI(D) 1995	Lead	17.3	
I1L25	BEI(D) 1995	Lead	17.2	
I1T23	BEI(D) 1995	Lead	16	
I1Z27	BEI(D) 1995	Lead	15.5	
I1E10	BEI(D) 1995	Lead	11.9	
I1V23	BEI(D) 1995	Lead	11.7	
I1X27	BEI(D) 1995	Lead	8.2	
I1E22(C)	BEI(C) 1995-96	Manganese	372	
I1G25(C)	BEI(C) 1995-96	Manganese	191	EN*

Location	Source[1]	Parameter	Result	Qual.[2]
I1P10(C)	BEI(C) 1995-96	Manganese	132	
I1S12(C)	BEI(C) 1995-96	Manganese	120	
I1C23(C)	BEI(C) 1995-96	Manganese	116	EN*
I1V16(C)	BEI(C) 1995-96	Manganese	116	
I1S14(C)	BEI(C) 1995-96	Manganese	93.2	
I1AD21(C)	BEI(C) 1995-96	Manganese	93.2	E
I1AB22(C)	BEI(C) 1995-96	Manganese	72.8	E
I1J23	BEI(D) 1995	Manganese	63.6	
I1B14	BEI(D) 1995	Manganese	56.7	E_1
I1AB14(C)	BEI(C) 1995-96	Manganese	49	
I1P18(C)	BEI(C) 1995-96	Manganese	46.8	N
I1AD13(C)	BEI(C) 1995-96	Manganese	45.8	EN*
I1Z17	BEI(D) 1995	Manganese	45.1	
I1M20(C)	BEI(C) 1995-96	Manganese	45	N
I1T13	BEI(D) 1995	Manganese	44.3	
I1L25	BEI(D) 1995	Manganese	41.6	
I1AA13	BEI(D) 1995	Manganese	39.3	
I1V27	BEI(D) 1995	Manganese	38.2	
I1E14	BEI(D) 1995	Manganese	36.9	
I1T18(C)	BEI(C) 1995-96	Manganese	35.9	
I1G10	BEI(D) 1995	Manganese	33.8	
I1A22(C)	BEI(C) 1995-96	Manganese	32.2	EN*
I1E12	BEI(D) 1995	Manganese	32.1	
I1D13	BEI(D) 1995	Manganese	30.7	
I1C14(C)	BEI(C) 1995-96	Manganese	23.3	
I1R25	BEI(D) 1995	Manganese	18.8	
I1AD11(C)	BEI(C) 1995-96	Manganese	18.6	EN*
I1AC9	BEI(D) 1995	Manganese	17.3	
I1D11	BEI(D) 1995	Manganese	16.7	
I1V19	BEI(D) 1995	Manganese	15.3	
I1L22(C)	BEI(C) 1995-96	Manganese	11.2	N
I1V23	BEI(D) 1995	Manganese	9.5	

TABLE 5-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 1
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Location	Source[1]	Parameter	Result	Qual.[2]
I1E10	BEI(D) 1995	Manganese	9.3	
I1E12	BEI(D) 1995	Mercury	9.3	X
I1S14(C)	BEI(C) 1995-96	Mercury	7	ND
I1V16(C)	BEI(C) 1995-96	Mercury	5.1	ND
I1T18(C)	BEI(C) 1995-96	Mercury	3.1	ND
I1AB14(C)	BEI(C) 1995-96	Mercury	3.1	ND
I1Z17	BEI(D) 1995	Mercury	2.3	D
I1AD13(C)	BEI(C) 1995-96	Mercury	2.2	
I1M20(C)	BEI(C) 1995-96	Mercury	1.3	
I1AB22(C)	BEI(C) 1995-96	Mercury	1.2	
I1V19	BEI(D) 1995	Mercury	1.1	
I1G25(C)	BEI(C) 1995-96	Mercury	0.85	
I1D13	BEI(D) 1995	Mercury	0.81	
I1S12(C)	BEI(C) 1995-96	Mercury	0.73	N
I1E22(C)	BEI(C) 1995-96	Mercury	0.71	N
I1P18(C)	BEI(C) 1995-96	Mercury	0.66	
I1AD21(C)	BEI(C) 1995-96	Mercury	0.64	
I1P10(C)	BEI(C) 1995-96	Mercury	0.61	N
I1AA13	BEI(D) 1995	Mercury	0.48	
I1B14	BEI(D) 1995	Mercury	0.47	N
I1AD11(C)	BEI(C) 1995-96	Mercury	0.45	
I1J23	BEI(D) 1995	Mercury	0.42	
I1C23(C)	BEI(C) 1995-96	Mercury	0.39	
I1C14(C)	BEI(C) 1995-96	Mercury	0.38	ND
I1T13	BEI(D) 1995	Mercury	0.31	
I1A22(C)	BEI(C) 1995-96	Mercury	0.24	
I1G10	BEI(D) 1995	Mercury	0.21	
I1L22(C)	BEI(C) 1995-96	Mercury	0.2	
I1E14	BEI(D) 1995	Mercury	0.12	
I1V27	BEI(D) 1995	Mercury	0.07	
I1R25	BEI(D) 1995	Mercury	0.06	
I1L25	BEI(D) 1995	Mercury	0.06	

Location	Source[1]	Parameter	Result	Qual.[2]
I1AC9	BEI(D) 1995	Mercury	0.05	
I1E10	BEI(D) 1995	Mercury	0.04	
I1V23	BEI(D) 1995	Mercury	0.03	
I1D11	BEI(D) 1995	Mercury	0.02	B_2
I1E22(C)	BEI(C) 1995-96	Nickel	49.1	
I1G25(C)	BEI(C) 1995-96	Nickel	27.5	EN*
I1AD21(C)	BEI(C) 1995-96	Nickel	20.1	EN*
I1M20(C)	BEI(C) 1995-96	Nickel	19.7	EN
I1P10(C)	BEI(C) 1995-96	Nickel	16.9	
I1S12(C)	BEI(C) 1995-96	Nickel	12.7	
I1T18(C)	BEI(C) 1995-96	Nickel	11.4	
I1AB22(C)	BEI(C) 1995-96	Nickel	11	EN*
I1E12	BEI(D) 1995	Nickel	9.8	
I1AB14(C)	BEI(C) 1995-96	Nickel	7.8	
I1J23	BEI(D) 1995	Nickel	7.6	
I1AD13(C)	BEI(C) 1995-96	Nickel	7.5	EN*
I1B14	BEI(D) 1995	Nickel	6.9	E_1
I1Z17	BEI(D) 1995	Nickel	6.9	
I1S14(C)	BEI(C) 1995-96	Nickel	6.2	
I1A22(C)	BEI(C) 1995-96	Nickel	6	EN*
I1AD11(C)	BEI(C) 1995-96	Nickel	5.6	EN*
I1E14	BEI(D) 1995	Nickel	5.4	
I1V16(C)	BEI(C) 1995-96	Nickel	5.3	
I1G10	BEI(D) 1995	Nickel	5.2	
I1AA13	BEI(D) 1995	Nickel	5	
I1C23(C)	BEI(C) 1995-96	Nickel	4.7	EN*
I1P18(C)	BEI(C) 1995-96	Nickel	3.8	EN
I1D11	BEI(D) 1995	Nickel	3.6	B_2
I1D13	BEI(D) 1995	Nickel	3.5	B_2
I1C14(C)	BEI(C) 1995-96	Nickel	2.9	
I1T13	BEI(D) 1995	Nickel	2.7	
I1L25	BEI(D) 1995	Nickel	2.3	

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CHEMICALS DETECTED IN SURFACE SOIL AT IR 1
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Location	Source[1]	Parameter	Result	Qual.[2]
I1E10	BEI(D) 1995	Nickel	1.7	B_2
I1V19	BEI(D) 1995	Nickel	1.5	
I1AC9	BEI(D) 1995	Nickel	1.4	
I1V23	BEI(D) 1995	Nickel	1.3	
I1V27	BEI(D) 1995	Nickel	1.2	
I1R25	BEI(D) 1995	Nickel	1.1	
I1L22(C)	BEI(C) 1995-96	Nickel	1	EN
I1D13	BEI(D) 1995	Selenium	0.53	B_2
I1Z17	BEI(D) 1995	Selenium	0.38	
I1AC9	BEI(D) 1995	Selenium	0.29	B_2
I1C14(C)	BEI(C) 1995-96	Selenium	0.27	B_2
I1V27	BEI(D) 1995	Selenium	0.25	B_2
I1V23	BEI(D) 1995	Selenium	0.23	B_2
I1L25	BEI(D) 1995	Selenium	0.21	B_2
I1J23	BEI(D) 1995	Selenium	0.16	B_2
I1M20(C)	BEI(C) 1995-96	Selenium	0.12	B_2N
I1T13	BEI(D) 1995	Selenium	0.12	B_2
I1V19	BEI(D) 1995	Selenium	0.115	B_2
I1G25(C)	BEI(C) 1995-96	Selenium	0.11	B_2
I1AA13	BEI(D) 1995	Selenium	0.09	B_2
I1C23(C)	BEI(C) 1995-96	Selenium	0.09	B_2
I1AD11(C)	BEI(C) 1995-96	Selenium	0.08	B_2
I1E22(C)	BEI(C) 1995-96	Silver	5.1	
I1G25(C)	BEI(C) 1995-96	Silver	2.4	
I1AD21(C)	BEI(C) 1995-96	Silver	1.8	
I1S12(C)	BEI(C) 1995-96	Silver	1.3	
I1AB22(C)	BEI(C) 1995-96	Silver	1.2	
I1P10(C)	BEI(C) 1995-96	Silver	0.82	B_2
I1J23	BEI(D) 1995	Silver	0.75	
I1C23(C)	BEI(C) 1995-96	Silver	0.66	
I1B14	BEI(D) 1995	Silver	0.43	B_3
I1M20(C)	BEI(C) 1995-96	Silver	0.4	B_2

Location	Source[1]	Parameter	Result	Qual.[2]
I1AD13(C)	BEI(C) 1995-96	Silver	0.32	B_2
I1AA13	BEI(D) 1995	Silver	0.3	B_2
I1V27	BEI(D) 1995	Silver	0.26	B_2
I1C14(C)	BEI(C) 1995-96	Silver	0.25	B_2
I1A22(C)	BEI(C) 1995-96	Silver	0.24	B_2
I1AB14(C)	BEI(C) 1995-96	Silver	0.2	B_2
I1AD11(C)	BEI(C) 1995-96	Silver	0.16	B_2
I1G25(C)	BEI(C) 1995-96	Vanadium	20.2	EN
I1AD21(C)	BEI(C) 1995-96	Vanadium	12.6	EN*
I1S12(C)	BEI(C) 1995-96	Vanadium	10.1	
I1E22(C)	BEI(C) 1995-96	Vanadium	8.6	
I1P10(C)	BEI(C) 1995-96	Vanadium	8.2	
I1AB22(C)	BEI(C) 1995-96	Vanadium	8.1	EN*
I1AD13(C)	BEI(C) 1995-96	Vanadium	8	EN
I1T18(C)	BEI(C) 1995-96	Vanadium	6.8	
I1J23	BEI(D) 1995	Vanadium	5.5	
I1Z17	BEI(D) 1995	Vanadium	5.1	
I1B14	BEI(D) 1995	Vanadium	5	
I1A22(C)	BEI(C) 1995-96	Vanadium	5	EN
I1AB14(C)	BEI(C) 1995-96	Vanadium	4.6	
I1V16(C)	BEI(C) 1995-96	Vanadium	4.4	
I1C23(C)	BEI(C) 1995-96	Vanadium	4.4	EN
I1V23	BEI(D) 1995	Vanadium	4.2	
I1P18(C)	BEI(C) 1995-96	Vanadium	4.1	N
I1S14(C)	BEI(C) 1995-96	Vanadium	4	
I1V19	BEI(D) 1995	Vanadium	4	
I1T13	BEI(D) 1995	Vanadium	3.9	
I1AA13	BEI(D) 1995	Vanadium	3.9	
I1M20(C)	BEI(C) 1995-96	Vanadium	3.8	N
I1AC9	BEI(D) 1995	Vanadium	3.4	
I1AD11(C)	BEI(C) 1995-96	Vanadium	3.2	EN
I1C14(C)	BEI(C) 1995-96	Vanadium	3	

TABLE 5-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 1
NAS KEY WEST
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Location	Source[1]	Parameter	Result	Qual.[2]
I1L22(C)	BEI(C) 1995-96	Vanadium	2.7	N
I1L25	BEI(D) 1995	Vanadium	2.6	
I1V27	BEI(D) 1995	Vanadium	2.5	
I1R25	BEI(D) 1995	Vanadium	2	
I1AB22(C)	BEI(C) 1995-96	Zinc	3,240	*
I1E22(C)	BEI(C) 1995-96	Zinc	1,430	*D
I1G25(C)	BEI(C) 1995-96	Zinc	1,280	
I1Z17	BEI(D) 1995	Zinc	955	D
I1S12(C)	BEI(C) 1995-96	Zinc	820	*D
I1AD21(C)	BEI(C) 1995-96	Zinc	810	*
I1S14(C)	BEI(C) 1995-96	Zinc	693	*D
I1J23	BEI(D) 1995	Zinc	607	D
I1M20(C)	BEI(C) 1995-96	Zinc	505	N
I1C23(C)	BEI(C) 1995-96	Zinc	437	
I1E12	BEI(D) 1995	Zinc	421	
I1T18(C)	BEI(C) 1995-96	Zinc	405	*
I1AD13(C)	BEI(C) 1995-96	Zinc	390	
I1B14	BEI(D) 1995	Zinc	373	
I1AB14(C)	BEI(C) 1995-96	Zinc	353.5	*
I1A22(C)	BEI(C) 1995-96	Zinc	347	
I1P10(C)	BEI(C) 1995-96	Zinc	284	*
I1V16(C)	BEI(C) 1995-96	Zinc	268	*
I1E14	BEI(D) 1995	Zinc	227	
I1G10	BEI(D) 1995	Zinc	204	
I1AA13	BEI(D) 1995	Zinc	193	
I1D13	BEI(D) 1995	Zinc	191	
I1AD11(C)	BEI(C) 1995-96	Zinc	186	
I1C14(C)	BEI(C) 1995-96	Zinc	143	*
I1P18(C)	BEI(C) 1995-96	Zinc	125	N
I1T13	BEI(D) 1995	Zinc	104	
I1V19	BEI(D) 1995	Zinc	87.7	D
I1D11	BEI(D) 1995	Zinc	84.8	
I1L25	BEI(D) 1995	Zinc	58.2	
I1V27	BEI(D) 1995	Zinc	49.4	
I1R25	BEI(D) 1995	Zinc	45.6	
I1L22(C)	BEI(C) 1995-96	Zinc	39.4	N
I1AC9	BEI(D) 1995	Zinc	24.4	
I1E10	BEI(D) 1995	Zinc	20.7	
I1V23	BEI(D) 1995	Zinc	12.6	

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

1 Data Sources:
BEI(D) 1995 - Delineation Study (BEI, 1995) conducted in 1995 by BEI
BEI(C) 1995-96 - Confirmation Study (BEI, 1997) conducted in 1995 and 1996 by BEI

2 Qualifier (Qual.) codes:
- E - Identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis
- * - Duplicate analysis not within control limit
- N - Presumptive evidence based upon a mass spectral library search to make a tentative identification of the analyte
- E_1 - Qualifier definition not available
- N_1 - Qualifier definition not available
- B_2 - Analyte was found in the blank as well as the sample
- B_3 - Qualifier definition not available
- *1 - Qualifier definition not available
- x - Qualifier definition not available
- D - Analyte(s) quantified in an analysis performed at a secondary dilution factor

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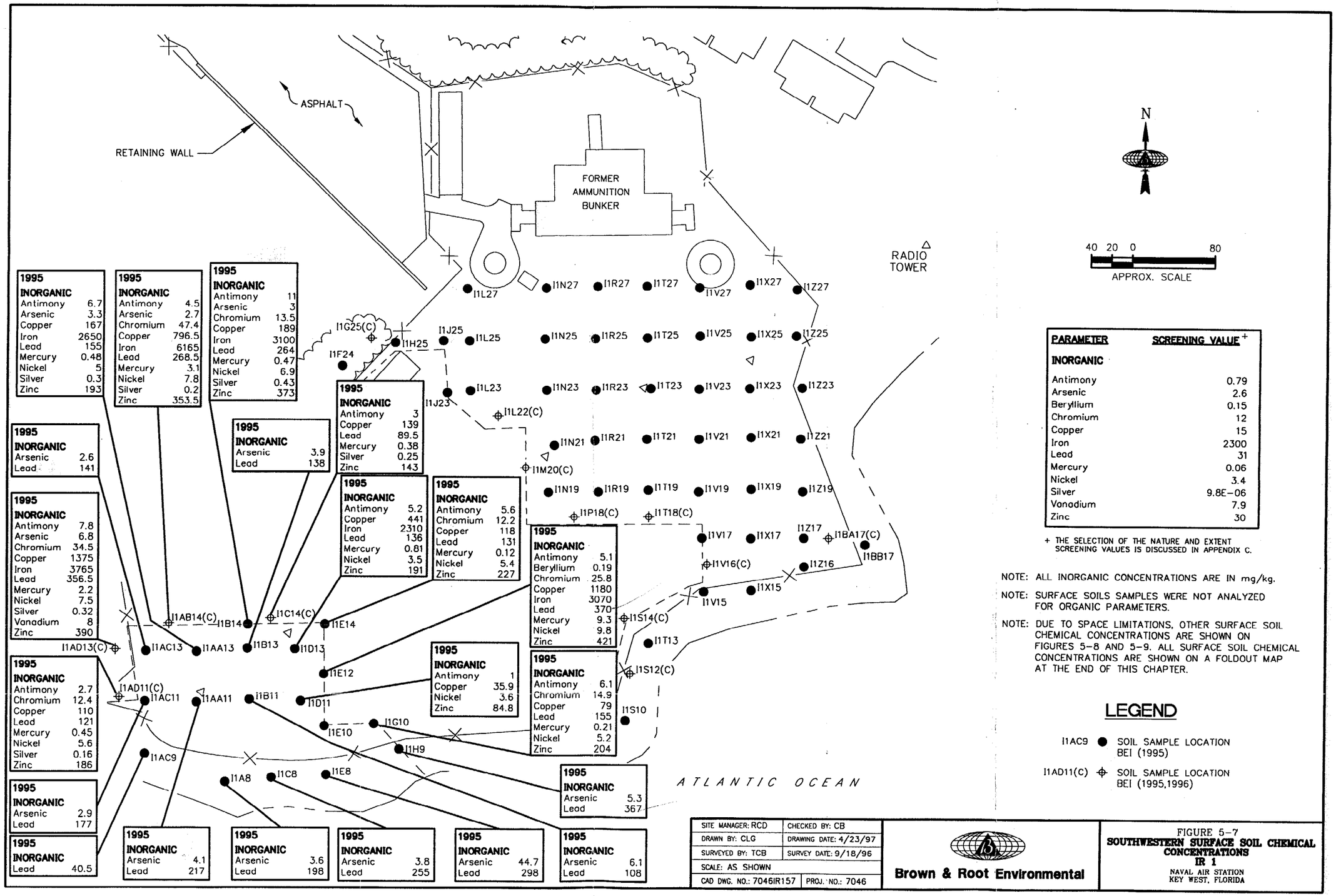


PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Chromium	12
Copper	15
Iron	2300
Lead	31
Mercury	0.06
Nickel	3.4
Silver	9.8E−06
Vanadium	7.9
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: SURFACE SOILS SAMPLES WERE NOT ANALYZED FOR ORGANIC PARAMETERS.

NOTE: DUE TO SPACE LIMITATIONS, OTHER SURFACE SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON FIGURES 5-8 AND 5-9. ALL SURFACE SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON A FOLDOUT MAP AT THE END OF THIS CHAPTER.

LEGEND

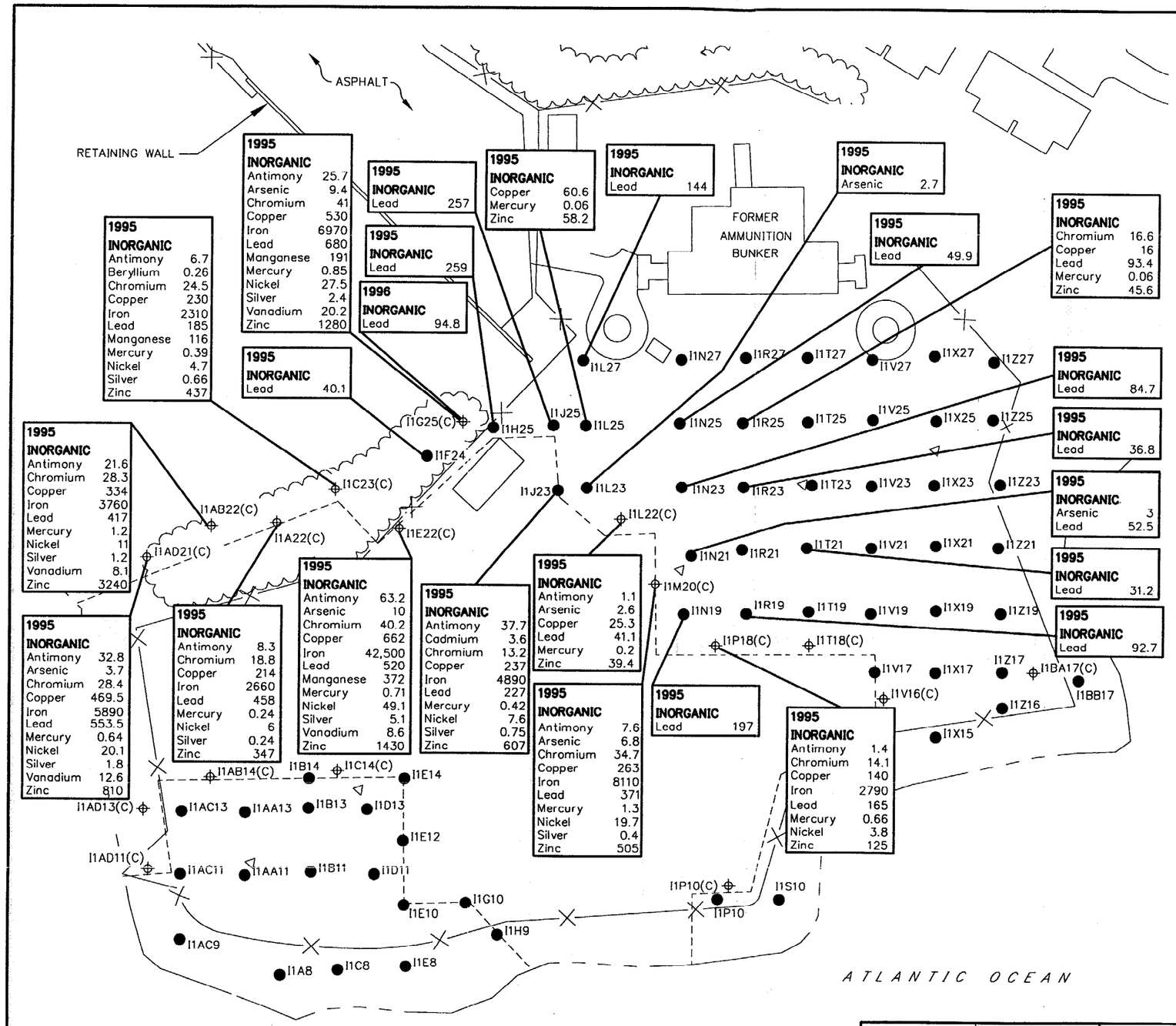
I1AC9 ● SOIL SAMPLE LOCATION BEI (1995)

I1AD11(C) ⊕ SOIL SAMPLE LOCATION BEI (1995,1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR157	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-7
SOUTHWESTERN SURFACE SOIL CHEMICAL CONCENTRATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Cadmium	2.5
Chromium	12
Copper	15
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Silver	9.8E-06
Vanadium	7.9
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: SURFACE SOIL SAMPLES WERE NOT ANALYZED FOR ORGANIC PARAMETERS.

NOTE: I1G25(C) WAS SAMPLED AND ANALYZED FOR LEAD TWICE DURING THE BEI CONFIRMATION STUDY.

NOTE: DUE TO SPACE LIMITATIONS, OTHER SURFACE SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON FIGURES 5-7 AND 5-9. ALL SURFACE SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON A FOLDOUT MAP AT THE END OF THIS CHAPTER.

LEGEND

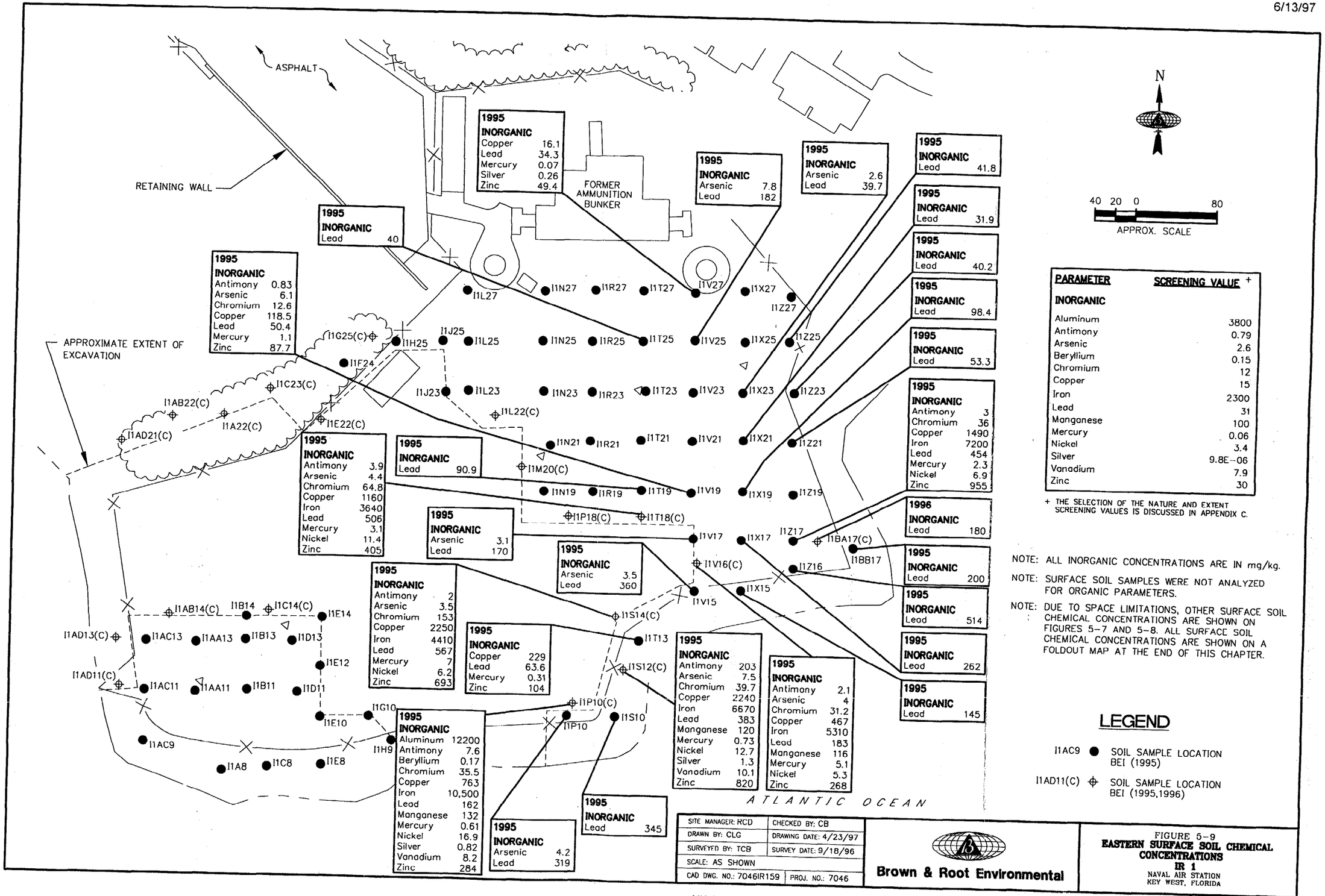
I1AC9 ● SOIL SAMPLE LOCATION BEI (1995)

I1AD11(C) ⊕ SOIL SAMPLE LOCATION BEI (1995,1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR158	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-8
NORTHWESTERN SURFACE SOIL CHEMICAL CONCENTRATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	3800
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Chromium	12
Copper	15
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Silver	9.8E-06
Vanadium	7.9
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: SURFACE SOIL SAMPLES WERE NOT ANALYZED FOR ORGANIC PARAMETERS.

NOTE: DUE TO SPACE LIMITATIONS, OTHER SURFACE SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON FIGURES 5-7 AND 5-8. ALL SURFACE SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON A FOLDOUT MAP AT THE END OF THIS CHAPTER.

LEGEND

I1AC9 ● SOIL SAMPLE LOCATION BEI (1995)

I1AD11(C) ⌖ SOIL SAMPLE LOCATION BEI (1995,1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR159	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-9
EASTERN SURFACE SOIL CHEMICAL CONCENTRATIONS
IR 1
NAVAL AIR STATION
KEY WEST, FLORIDA

5.4.2.1 Volatile Organic Compounds

Surface soil samples at IR 1 were not analyzed for VOCs.

5.4.2.2 Semivolatile Organic Compounds

Surface soil samples at IR 1 were not analyzed for SVOCs.

5.4.2.3 Pesticides

Surface soil samples at IR 1 were not analyzed for pesticides.

5.4.2.4 Polychlorinated Biphenyls

Surface soil samples at IR 1 were not analyzed for PCBs.

5.4.2.5 Inorganics

A number of metals were detected in surface soil at IR 1. Aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, vanadium, and zinc all exceeded soil screening values, while barium, cobalt, and selenium were consistently detected below the levels used for screening. High metal concentrations were commonly detected to the northwest at I1G25(C) and I1E22(C), and to the southeast at I1S12(C) and I1S14(C), although contamination was certainly not limited to these areas. Due to the large number of surface soil samples collected and the extent of metal contamination at IR 1, each detected metal is discussed individually below.

Aluminum was detected at 35 of 39 sampling locations, predominantly around the perimeter of the excavation area. Of those 35 samples, only one sample at location I1P10(C) (12,200 mg/kg) exceeded the screening value (3,800 mg/kg).

Antimony was detected at 35 of 39 sampling locations, predominantly around the perimeter of the excavation area. Of those 35 detections, 28 exceeded the screening value (0.79 mg/kg). Maximum

concentrations were detected at I1S12(C) (203 mg/kg) and I1E22(C) (63.2 mg/kg). Concentrations at other sampling locations where there were exceedances were generally much lower (between 0.83 mg/kg and 37.7 mg/kg).

Arsenic was detected at 83 of 89 sampling locations. Of those 83 detections, 30 exceeded the screening value (2.6 mg/kg). Maximum concentrations were detected at I1E8 (44.7 mg/kg) and I1E22(C) (10 mg/kg). Concentrations at all other sampling locations were less than 10 mg/kg.

Beryllium was detected at 32 of 39 sampling locations. In those 32 samples, 3 exceeded the selected screening values (0.15 mg/kg). These maximum concentrations were detected at sampling locations I1C23(C) (0.26 mg/kg), I1E12 (0.19 mg/kg), and I1P10(C) (0.17 mg/kg).

Cadmium was detected at 33 of 39 sampling locations. One sample exceeded the selected screening value (2.5 mg/kg). This exceedance occurred at 1J23 (3.6 mg/kg). Concentrations at other sampling locations were consistently less than 2.1 mg/kg.

Chromium was detected at 35 of 39 sampling locations. In those 35 samples, 24 exceeded the 12-mg/kg screening value. Maximum concentrations were detected at I1S14(C) (153 mg/kg) and I1T18(C) (64.8 mg/kg). Chromium concentrations were less than 50 mg/kg at all other sampling locations.

Copper was detected at 35 of 39 sampling locations. In those 35 samples, 32 copper detections exceeded the 15-mg/kg screening value. The maximum copper concentration was detected at I1S14(C) at 2,250 mg/kg and was 150 times the screening value. Other high concentrations of copper were detected at I1S12(C) (2,240 mg/kg), I1Z17 (1,490 mg/kg), I1AD13(C) (1,375 mg/kg), I1E12 (1,180 mg/kg), I1T18(C) (1,160 mg/kg), I1AB14(C) (796.5 mg/kg), I1P10(C) (763 mg/kg), I1E22(C) (662 mg/kg), and I1G25(C) (530 mg/kg). Concentrations were less than 35 times the screening value (525 mg/kg) at all other sampling locations.

Iron was detected in 35 of 39 sampling locations. In those 35 sample, 22 detections exceeded iron's 2,300-mg/kg screening value. The maximum concentration was detected at I1E22(C) (42,500 mg/kg).

Lead was detected at all 85 surface soil sampling locations, predominantly around the perimeter of the excavation area. Sixty-nine samples contained lead concentrations in excess of the 31 mg/kg screening value. Maximum concentrations were detected at I1G25(C) (680 mg/kg), I1S14(C) (567 mg/kg), I1AD21(C) (553.5 mg/kg), I1E22(C) (520 mg/kg), I1Z16 (514 mg/kg), and I1T18(C) (506 mg/kg). Concentrations were less than 15 times the screening value at all other sampling locations.

Manganese was detected at 35 of 39 sampling locations. Of those 35, six exceeded the selected screening value (100 mg/kg). Maximum concentrations were detected at I1E22(C) (372 mg/kg) and I1G25(C) (191 mg/kg). Concentrations at the other four sampling locations where manganese exceeded the ORNL BTV screening value ranged between 116 and 132 mg/kg.

Mercury was detected at 35 of 39 sampling locations. Of those 35 samples, 31 exhibited concentrations in excess of the 0.06-mg/kg screening value. Maximum concentrations were detected at I1E12 (9.3 mg/kg), I1S14(C) (7 mg/kg), I1V16(C) (5.1 mg/kg), I1T18(C) (3.1 mg/kg), I1AB14(C) (3.05 mg/kg), I1Z17 (2.3 mg/kg), and I1AD13(C) (2.2 mg/kg). Concentrations were less than 22 times background at other sampling locations where there were exceedances.

Nickel was detected at 35 of 39 sampling locations. Of those 35 detections, 25 exceeded the 3.4 mg/kg screening value. Maximum concentrations were detected at I1E22(C) (49.1 mg/kg), I1G25(C) (27.5 mg/kg), and I1AD21(C) (20.1 mg/kg). Concentrations were less than 20 mg/kg at all other sampling locations.

Silver was detected at 17 of 39 sampling locations, all of which exceeded the selected screening level (9.8E-06 mg/kg). Maximum concentrations were detected at I1E22(C) (5.1 mg/kg) and I1G25(C) (2.4 mg/kg). Concentrations were less than 2.0 mg/kg at all other sampling locations.

Vanadium was detected at 29 of 39 sampling locations. Only seven detections exceeded the 7.9-mg/kg screening value. Maximum concentrations were detected at I1G25(C) (20.2 mg/kg), I1AD21(C) (12.6 mg/kg), and I1S12(C) (10.1 mg/kg). Concentrations were less than 9 mg/kg at all other sampling locations.

Zinc was detected at 35 of 39 sampling locations. Of those 35 samples, 32 exceeded the 30-mg/kg screening value. The maximum concentration was approximately 100 times the screening value and was detected at I1AB22(C) (3,240 mg/kg). Other high concentrations were detected at I1E22(C) (1,430 mg/kg) and I1G25(C) (1,280 mg/kg). Concentrations were less than 1,000 mg/kg at all other sampling locations.

Barium, selenium, and cobalt were detected at levels less than screening values. Barium and cobalt were most frequently detected, at 35 and 34 of 39 sample locations, respectively.

5.4.3 Sediment

Data from a number of sampling efforts including the 1990 IT Corporation RI, the 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of sediment contamination at IR 1. Chemicals that were detected in sediment samples are listed in Table 5-3. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. The majority of the sediment samples were surface samples. The 1993 IT Corporation RFI/RI sediment samples were taken at a depth of 6 inches. Due to the shallow depth of the subsurface sediment samples, results for surface and subsurface sediment samples will be discussed together in this section. Figure 5-10 shows the occurrence of analytes that exceeded screening values and indicate possible sediment contamination. In general, metals were the most frequently detected parameters, although the pesticides 4,4'-DDT and 4,4'-DDE were also detected at nearly all sample locations.

Screening values were obtained from a variety of sources including FDEP SQAGs, EPA Region IV Screening Values, EPA SQCs for Marine and Freshwater Sediments, ER-L Criteria, ER-M Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples.

5.4.3.1 Volatile Organic Compounds

Acetone was the only VOC at IR 1 with concentrations in excess of its screening value. Sediment at sampling locations I1SS-4(IT) (150 µg/kg) and I1SS-6(IT) (130 µg/kg) (both on the south central shoreline) contained acetone at approximately twice the screening value. Other VOCs including 1,2-dichloroethene, 2-butanone, methylene chloride, toluene, and xylene were detected in sediment, but were well below their screening values. Methylene chloride, found in all five samples tested for VOCs, was detected with the greatest frequency. 1,2-dichlorethene and 2-butanone were limited to the 1993 samples, while toluene and xylene were only detected in 1990. B&R Environmental did not test for VOCs in the 1996 Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995).

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. 2-butanone was identified as an ecological COPC (Section 5.7.1.4.2)

TABLE 5-3

CHEMICALS DETECTED IN SEDIMENT AT IR 1
NAS KEY WEST
PAGE 1 OF 6

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
I1S-2	0	IT 1990	Aluminum	6,170	
I1S-3	0	IT 1990	Aluminum	1,960	
I1SS-3	0	B&RE 1996	Aluminum	925	
I1SS-4	0	B&RE 1996	Aluminum	615	
I1SS-6	0	B&RE 1996	Aluminum	560	
I1S-1	0	IT 1990	Aluminum	546	
I1SS-1	0	B&RE 1996	Aluminum	515.5	
I1SS-5	0	B&RE 1996	Aluminum	387	
I1SS-2	0	B&RE 1996	Aluminum	326	
I1SS-4(IT)	0.5	IT 1993	Aluminum	277	
I1SS-6(IT)	0.5	IT 1993	Aluminum	179	
I1SS-7	0	B&RE 1996	Aluminum	72.4	
I1SS-2(IT)	0.5	IT 1993	Antimony	6.8	B_1
I1SS-4	0	B&RE 1996	Arsenic	12.1	
I1SS-6	0	B&RE 1996	Arsenic	10.8	
I1SS-2(IT)	0.5	IT 1993	Arsenic	9	
I1SS-1	0	B&RE 1996	Arsenic	4.4	
I1SS-4(IT)	0.5	IT 1993	Arsenic	4.1	
I1SS-3	0	B&RE 1996	Arsenic	4.1	
I1SS-6(IT)	0.5	IT 1993	Arsenic	4	
I1S-1	0	IT 1990	Arsenic	4	
I1S-2	0	IT 1990	Arsenic	3.9	
I1SS-2	0	B&RE 1996	Arsenic	3	
I1SS-5	0	B&RE 1996	Arsenic	2.7	
I1SS-5(IT)	0.5	IT 1993	Arsenic	2.6	
I1SS-3(IT)	0.5	IT 1993	Arsenic	1.7	
I1SS-1(IT)	0.5	IT 1993	Arsenic	1.6	
I1SS-7	0	B&RE 1996	Arsenic	0.92	
I1S-2	0	IT 1990	Barium	40.5	
I1S-1	0	IT 1990	Barium	16.7	B_1

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1S-3	0	IT 1990	Barium	20.1	B_1
I1SS-6	0	B&RE 1996	Barium	11.8	J
I1SS-1	0	B&RE 1996	Barium	10.8	J
I1SS-2	0	B&RE 1996	Barium	8.6	J
I1SS-7	0	B&RE 1996	Barium	7.8	J
I1SS-4	0	B&RE 1996	Barium	7.5	J
I1SS-3	0	B&RE 1996	Barium	7.4	J
I1SS-2(IT)	0.5	IT 1993	Barium	7.2	B_1
I1SS-5	0	B&RE 1996	Barium	7	J
I1SS-1(IT)	0.5	IT 1993	Barium	6.1	B_1
I1SS-5(IT)	0.5	IT 1993	Barium	4.6	B_1
I1SS-3(IT)	0.5	IT 1993	Barium	4.2	B_1
I1SS-4(IT)	0.5	IT 1993	Barium	4.1	B_1
I1SS-6(IT)	0.5	IT 1993	Barium	3.3	B_1
I1S-2	0	IT 1990	Beryllium	0.14	B_1
I1S-1	0	IT 1990	Cadmium	1.1	
I1SS-4	0	B&RE 1996	Chromium	17.2	
I1SS-6	0	B&RE 1996	Chromium	12.9	
I1SS-1	0	B&RE 1996	Chromium	12.1	
I1S-3	0	IT 1990	Chromium	9	
I1S-1	0	IT 1990	Chromium	8	
I1SS-5(IT)	0.5	IT 1993	Chromium	6.3	
I1S-2	0	IT 1990	Chromium	6.1	
I1SS-3	0	B&RE 1996	Chromium	5.5	
I1SS-1(IT)	0.5	IT 1993	Chromium	5	
I1SS-2(IT)	0.5	IT 1993	Chromium	5	
I1SS-4(IT)	0.5	IT 1993	Chromium	4.5	
I1SS-6(IT)	0.5	IT 1993	Chromium	4.4	
I1SS-3(IT)	0.5	IT 1993	Chromium	4.2	
I1SS-2(IT)	0.5	IT 1993	Cobalt	5.3	B_1
I1SS-6	0	B&RE 1996	Cobalt	3.1	

TABLE 5-3

CHEMICALS DETECTED IN SEDIMENT AT IR 1
NAS KEY WEST
PAGE 2 OF 6

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1SS-4	0	B&RE 1996	Cobalt	2.4	
I1SS-1	0	B&RE 1996	Cobalt	1.4	
I1S-1	0	IT 1990	Copper	132	
I1S-3	0	IT 1990	Copper	72.5	
I1SS-6	0	B&RE 1996	Copper	64.4	
I1SS-1	0	B&RE 1996	Copper	51.6	
I1SS-4	0	B&RE 1996	Copper	40.3	
I1SS-6(IT)	0.5	IT 1993	Copper	29.6	
I1SS-2	0	B&RE 1996	Copper	22.7	
I1SS-5	0	B&RE 1996	Copper	21.8	
I1SS-3	0	B&RE 1996	Copper	21.6	
I1SS-2(IT)	0.5	IT 1993	Copper	18.7	
I1S-2	0	IT 1990	Copper	18.3	
I1SS-4(IT)	0.5	IT 1993	Copper	17.1	
I1SS-7	0	B&RE 1996	Copper	15.2	
I1SS-5(IT)	0.5	IT 1993	Copper	9.7	
I1SS-1(IT)	0.5	IT 1993	Copper	9.6	B_1
I1SS-3(IT)	0.5	IT 1993	Copper	9.4	
I1SS-4(IT)	0.5	IT 1993	Cyanide	13	
I1SS-4	0	B&RE 1996	Iron	32,600	
I1SS-6	0	B&RE 1996	Iron	27,700	
I1SS-1	0	B&RE 1996	Iron	13,800	
I1SS-6(IT)	0.5	IT 1993	Iron	5,340	
I1S-2	0	IT 1990	Iron	4,480	
I1SS-4(IT)	0.5	IT 1993	Iron	4,270	
I1SS-2	0	B&RE 1996	Iron	3,380	
I1SS-3	0	B&RE 1996	Iron	3,090	
I1SS-5	0	B&RE 1996	Iron	2,820	
I1S-3	0	IT 1990	Iron	1,860	
I1S-1	0	IT 1990	Iron	1,790	
I1SS-7	0	B&RE 1996	Iron	387	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1SS-5	0	B&RE 1996	Lead	226	
I1S-1	0	IT 1990	Lead	134	
I1SS-1	0	B&RE 1996	Lead	127.6	
I1SS-4	0	B&RE 1996	Lead	112	
I1SS-6	0	B&RE 1996	Lead	96.3	
I1SS-6(IT)	0.5	IT 1993	Lead	75.5	
I1SS-4(IT)	0.5	IT 1993	Lead	55.5	
I1SS-3	0	B&RE 1996	Lead	46.8	
I1S-3	0	IT 1990	Lead	43.1	
I1SS-2	0	B&RE 1996	Lead	42.9	
I1SS-1(IT)	0.5	IT 1993	Lead	41.4	
I1SS-2(IT)	0.5	IT 1993	Lead	38.9	
I1S-2	0	IT 1990	Lead	30.1	
I1SS-5(IT)	0.5	IT 1993	Lead	29.9	
I1SS-7	0	B&RE 1996	Lead	19	
I1SS-3(IT)	0.5	IT 1993	Lead	15.3	
I1S-2	0	IT 1990	Manganese	295	
I1S-3	0	IT 1990	Manganese	146	
I1SS-6	0	B&RE 1996	Manganese	118	
I1SS-4	0	B&RE 1996	Manganese	105	
I1SS-1	0	B&RE 1996	Manganese	70.4	
I1SS-5	0	B&RE 1996	Manganese	29.6	
I1S-1	0	IT 1990	Manganese	24.9	
I1SS-4(IT)	0.5	IT 1993	Manganese	22.3	
I1SS-2	0	B&RE 1996	Manganese	21.7	
I1SS-6(IT)	0.5	IT 1993	Manganese	20.6	
I1SS-3	0	B&RE 1996	Manganese	18.1	
I1SS-7	0	B&RE 1996	Manganese	7.3	
I1S-3	0	IT 1990	Mercury	0.15	
I1SS-6(IT)	0.5	IT 1993	Mercury	0.12	
I1SS-4	0	B&RE 1996	Mercury	0.11	

TABLE 5-3

CHEMICALS DETECTED IN SEDIMENT AT IR 1
NAS KEY WEST
PAGE 3 OF 6

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1SS-5	0	B&RE 1996	Mercury	0.09	
I1S-1	0	IT 1990	Mercury	0.09	
I1SS-4(IT)	0.5	IT 1993	Mercury	0.07	
I1SS-6	0	B&RE 1996	Mercury	0.06	
I1SS-5(IT)	0.5	IT 1993	Mercury	0.06	
I1SS-1	0	B&RE 1996	Mercury	0.06	
I1S-2	0	IT 1990	Mercury	0.06	
I1SS-3(IT)	0.5	IT 1993	Mercury	0.06	
I1SS-2(IT)	0.5	IT 1993	Mercury	0.05	
I1SS-2	0	B&RE 1996	Mercury	0.04	
I1SS-3	0	B&RE 1996	Mercury	0.04	
I1SS-1(IT)	0.5	IT 1993	Mercury	0.04	
I1SS-4	0	B&RE 1996	Nickel	12	
I1SS-6	0	B&RE 1996	Nickel	12	
I1SS-1	0	B&RE 1996	Nickel	5.8	
I1SS-2(IT)	0.5	IT 1993	Nickel	5.2	
I1S-2	0	IT 1990	Nickel	4.7	
I1SS-4(IT)	0.5	IT 1993	Nickel	2.8	B_1
I1SS-3	0	B&RE 1996	Nickel	2.4	
I1SS-2	0	B&RE 1996	Nickel	1.8	
I1SS-5	0	B&RE 1996	Nickel	1.2	
I1SS-7	0	B&RE 1996	Nickel	1	
I1SS-6	0	B&RE 1996	Silver	0.33	
I1SS-2(IT)	0.5	IT 1993	Tin	64.1	
I1SS-5(IT)	0.5	IT 1993	Tin	16.2	B_1
I1SS-6(IT)	0.5	IT 1993	Tin	14.4	B_1
I1SS-3(IT)	0.5	IT 1993	Tin	9.3	B_1
I1S-2	0	IT 1990	Vanadium	14	
I1SS-4	0	B&RE 1996	Vanadium	10.2	
I1SS-2(IT)	0.5	IT 1993	Vanadium	9.6	
I1SS-3	0	B&RE 1996	Vanadium	7.6	J
I1SS-6	0	B&RE 1996	Vanadium	7.2	
I1S-1	0	IT 1990	Vanadium	6.7	
I1SS-1	0	B&RE 1996	Vanadium	5.7	J
I1SS-2	0	B&RE 1996	Vanadium	5.1	J
I1S-3	0	IT 1990	Vanadium	4.3	B_1
I1SS-5	0	B&RE 1996	Vanadium	3.9	J
I1SS-6(IT)	0.5	IT 1993	Vanadium	2.5	B_1
I1SS-4(IT)	0.5	IT 1993	Vanadium	2.2	B_1
I1SS-7	0	B&RE 1996	Vanadium	0.73	J
I1SS-6	0	B&RE 1996	Zinc	484	
I1SS-4	0	B&RE 1996	Zinc	163	
I1SS-6(IT)	0.5	IT 1993	Zinc	150	
I1SS-2(IT)	0.5	IT 1993	Zinc	148	
I1SS-1	0	B&RE 1996	Zinc	136.5	
I1S-1	0	IT 1990	Zinc	131	
I1SS-4(IT)	0.5	IT 1993	Zinc	91.8	
I1SS-5(IT)	0.5	IT 1993	Zinc	73	
I1S-3	0	IT 1990	Zinc	45.9	
I1SS-5	0	B&RE 1996	Zinc	43.1	
I1SS-3	0	B&RE 1996	Zinc	39	
I1SS-1(IT)	0.5	IT 1993	Zinc	30.1	
I1SS-2	0	B&RE 1996	Zinc	28.4	
I1S-2	0	IT 1990	Zinc	24.1	
I1SS-3(IT)	0.5	IT 1993	Zinc	18.3	
I1SS-7	0	B&RE 1996	Zinc	1.1	
PESTICIDES/PCBs (µg/kg)					
I1SS-7	0	B&RE 1996	2,4-D	21.4	J
I1SS-2	0	B&RE 1996	4,4'-DDD	29.4	
I1SS-6	0	B&RE 1996	4,4'-DDD	4.6	J
I1SS-5	0	B&RE 1996	4,4'-DDD	3.1	J
I1SS-7	0	B&RE 1996	4,4'-DDD	2.5	

TABLE 5-3

CHEMICALS DETECTED IN SEDIMENT AT IR 1
NAS KEY WEST
PAGE 4 OF 6

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1SS-3	0	B&RE 1996	4,4'-DDD	2.5	
I1SS-1	0	B&RE 1996	4,4'-DDE	296	J
I1SS-2	0	B&RE 1996	4,4'-DDE	75.8	
I1S-1	0	IT 1990	4,4'-DDE	44	D
I1SS-6(IT)	0.5	IT 1993	4,4'-DDE	37	X_1
I1S-2	0	IT 1990	4,4'-DDE	37	DJ
I1S-3	0	IT 1990	4,4'-DDE	32	
I1SS-4	0	B&RE 1996	4,4'-DDE	26.6	
I1SS-2(IT)	0.5	IT 1993	4,4'-DDE	20	C
I1SS-3(IT)	0.5	IT 1993	4,4'-DDE	15	C
I1SS-5(IT)	0.5	IT 1993	4,4'-DDE	13	C
I1SS-6	0	B&RE 1996	4,4'-DDE	9.5	
I1SS-5	0	B&RE 1996	4,4'-DDE	5.9	J
I1SS-3	0	B&RE 1996	4,4'-DDE	4.2	
I1SS-1(IT)	0.5	IT 1993	4,4'-DDE	3.9	C
I1SS-7	0	B&RE 1996	4,4'-DDE	3.2	J
I1SS-1	0	B&RE 1996	4,4'-DDT	711	J
I1SS-4	0	B&RE 1996	4,4'-DDT	118	J
I1SS-3(IT)	0.5	IT 1993	4,4'-DDT	110	NC**
I1SS-1(IT)	0.5	IT 1993	4,4'-DDT	75	NC**
I1S-1	0	IT 1990	4,4'-DDT	51	
I1S-2	0	IT 1990	4,4'-DDT	39	
I1SS-6(IT)	0.5	IT 1993	4,4'-DDT	32	X
I1S-3	0	IT 1990	4,4'-DDT	14	J
I1SS-5	0	B&RE 1996	4,4'-DDT	13.1	
I1SS-7	0	B&RE 1996	4,4'-DDT	7.8	
I1SS-6	0	B&RE 1996	4,4'-DDT	6.5	J
I1SS-3	0	B&RE 1996	4,4'-DDT	4.6	
I1SS-7	0	B&RE 1996	alpha-BHC	0.85	J
I1SS-1(IT)	0.5	IT 1993	Aroclor-1248	120	+
I1SS-2	0	B&RE 1996	Aroclor-1254	669	J

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1S-1	0	IT 1990	Aroclor-1254	220	DJ
I1SS-1	0	B&RE 1996	Aroclor-1260	18,260	
I1SS-2(IT)	0.5	IT 1993	Aroclor-1260	10,000	+
I1S-2	0	IT 1990	Aroclor-1260	2,400	D
I1SS-4	0	B&RE 1996	Aroclor-1260	2,290	
I1SS-3(IT)	0.5	IT 1993	Aroclor-1260	1,800	+
I1SS-2	0	B&RE 1996	Aroclor-1260	905	
I1SS-1(IT)	0.5	IT 1993	Aroclor-1260	760	+
I1SS-4(IT)	0.5	IT 1993	Aroclor-1260	420	X
I1SS-5(IT)	0.5	IT 1993	Aroclor-1260	250	+
I1S-1	0	IT 1990	Aroclor-1260	170	DJ
I1SS-5	0	B&RE 1996	Aroclor-1260	79.8	J
I1SS-6	0	B&RE 1996	Aroclor-1260	66.6	
I1SS-7	0	B&RE 1996	Aroclor-1260	38.6	J
I1SS-3	0	B&RE 1996	Aroclor-1260	24.1	J
I1S-2	0	IT 1990	beta-BHC	20	Z
I1SS-6	0	B&RE 1996	delta-BHC	1	
I1SS-4	0	B&RE 1996	Dieldrin	13.6	J
I1SS-1(IT)	0.5	IT 1993	Dieldrin	12	C
I1SS-7	0	B&RE 1996	Dieldrin	3	J
I1SS-6	0	B&RE 1996	Dieldrin	2.4	J
I1SS-1	0	B&RE 1996	Endosulfan I	256	J
I1SS-2	0	B&RE 1996	Endosulfan I	25.2	
I1SS-4	0	B&RE 1996	Endosulfan I	21.9	
I1SS-3	0	B&RE 1996	Endosulfan I	2.7	
I1SS-7	0	B&RE 1996	Endosulfan I	2.3	J
I1SS-5	0	B&RE 1996	Endosulfan I	2.2	J
I1SS-6	0	B&RE 1996	Endosulfan I	1.7	J
I1S-2	0	IT 1990	Endosulfan II	83	ZF
I1SS-1	0	B&RE 1996	Endosulfan sulfate	341	
I1SS-6	0	B&RE 1996	Endosulfan sulfate	0.84	J

TABLE 5-3

CHEMICALS DETECTED IN SEDIMENT AT IR 1
NAS KEY WEST
PAGE 5 OF 6

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1SS-1	0	B&RE 1996	Endrin	1,462	J
I1SS-2	0	B&RE 1996	Endrin	59.5	
I1S-2	0	IT 1990	Endrin	39	Z
I1SS-5	0	B&RE 1996	Endrin	6.5	
I1SS-6	0	B&RE 1996	Endrin	3.3	
I1SS-7	0	B&RE 1996	Endrin	2.8	J
I1SS-3	0	B&RE 1996	Endrin	1.2	J
I1SS-1	0	B&RE 1996	Endrin aldehyde	380.5	J
I1SS-3(IT)	0.5	IT 1993	Endrin aldehyde	89	NC**
I1SS-5	0	B&RE 1996	gamma-BHC (lindane)	3.3	J
I1SS-3	0	B&RE 1996	gamma-BHC (lindane)	2	
I1SS-7	0	B&RE 1996	gamma-BHC (lindane)	1.7	J
I1SS-6	0	B&RE 1996	gamma-BHC (lindane)	0.78	J
I1SS-2	0	B&RE 1996	Heptachlor	18.9	J
I1SS-4	0	B&RE 1996	Heptachlor	7.8	J
I1SS-5	0	B&RE 1996	Heptachlor	2	J
I1SS-3	0	B&RE 1996	Heptachlor	1.2	
I1SS-7	0	B&RE 1996	Heptachlor	0.76	J
I1SS-3	0	B&RE 1996	Heptachlor epoxide	1.5	J
I1SS-7	0	B&RE 1996	Heptachlor epoxide	1.2	

SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)

I1S-3	0	IT 1990	Acenaphthylene	75	J
I1S-1	0	IT 1990	Benzo(a)anthracene	230	J
I1S-2	0	IT 1990	Benzo(a)anthracene	170	J
I1S-3	0	IT 1990	Benzo(a)anthracene	120	J
I1S-2	0	IT 1990	Benzo(a)pyrene	180	J
I1S-3	0	IT 1990	Benzo(a)pyrene	130	J
I1S-2	0	IT 1990	Benzo(b)fluoranthene	200	J
I1S-1	0	IT 1990	Benzo(b)fluoranthene	180	J
I1S-3	0	IT 1990	Benzo(b)fluoranthene	160	J
I1S-2	0	IT 1990	Benzo(k)fluoranthene	200	J
I1S-1	0	IT 1990	Benzo(k)fluoranthene	190	J
I1S-3	0	IT 1990	Benzo(k)fluoranthene	160	J
I1S-2	0	IT 1990	Bis(2-ethylhexyl)phthalate	480	J
I1S-3	0	IT 1990	Bis(2-ethylhexyl)phthalate	430	J
I1S-1	0	IT 1990	Bis(2-ethylhexyl)phthalate	390	J
I1S-1	0	IT 1990	Chrysene	300	J
I1S-2	0	IT 1990	Chrysene	250	J
I1S-3	0	IT 1990	Chrysene	190	J
I1S-1	0	IT 1990	Fluoranthene	400	J
I1S-2	0	IT 1990	Fluoranthene	350	J
I1SS-2	0	B&RE 1996	Fluoranthene	289	J
I1S-3	0	IT 1990	Fluoranthene	250	J
I1S-1	0	IT 1990	Phenanthrene	220	J
I1S-2	0	IT 1990	Phenanthrene	160	J
I1S-3	0	IT 1990	Phenanthrene	110	J
I1S-1	0	IT 1990	Pyrene	400	J
I1SS-2	0	B&RE 1996	Pyrene	326	J
I1S-2	0	IT 1990	Pyrene	320	J
I1S-3	0	IT 1990	Pyrene	250	J

VOLATILE ORGANIC COMPOUNDS (µg/kg)

I1SS-6(IT)	0.5	IT 1993	1,2-dichloroethene	3	J
I1SS-4(IT)	0.5	IT 1993	1,2-dichloroethene	2	J
I1SS-4(IT)	0.5	IT 1993	2-butanone	16	
I1SS-6(IT)	0.5	IT 1993	2-butanone	14	
I1SS-4(IT)	0.5	IT 1993	Acetone	150	B_2
I1SS-6(IT)	0.5	IT 1993	Acetone	130	B_2
I1SS-4(IT)	0.5	IT 1993	Methylene chloride	11	B_2
I1SS-6(IT)	0.5	IT 1993	Methylene chloride	11	B_2
I1S-1	0	IT 1990	Methylene chloride	3	J
I1S-3	0	IT 1990	Methylene chloride	3	J
I1S-2	0	IT 1990	Methylene chloride	2	J

TABLE 5-3

CHEMICALS DETECTED IN SEDIMENT AT IR 1
NAS KEY WEST
PAGE 6 OF 6

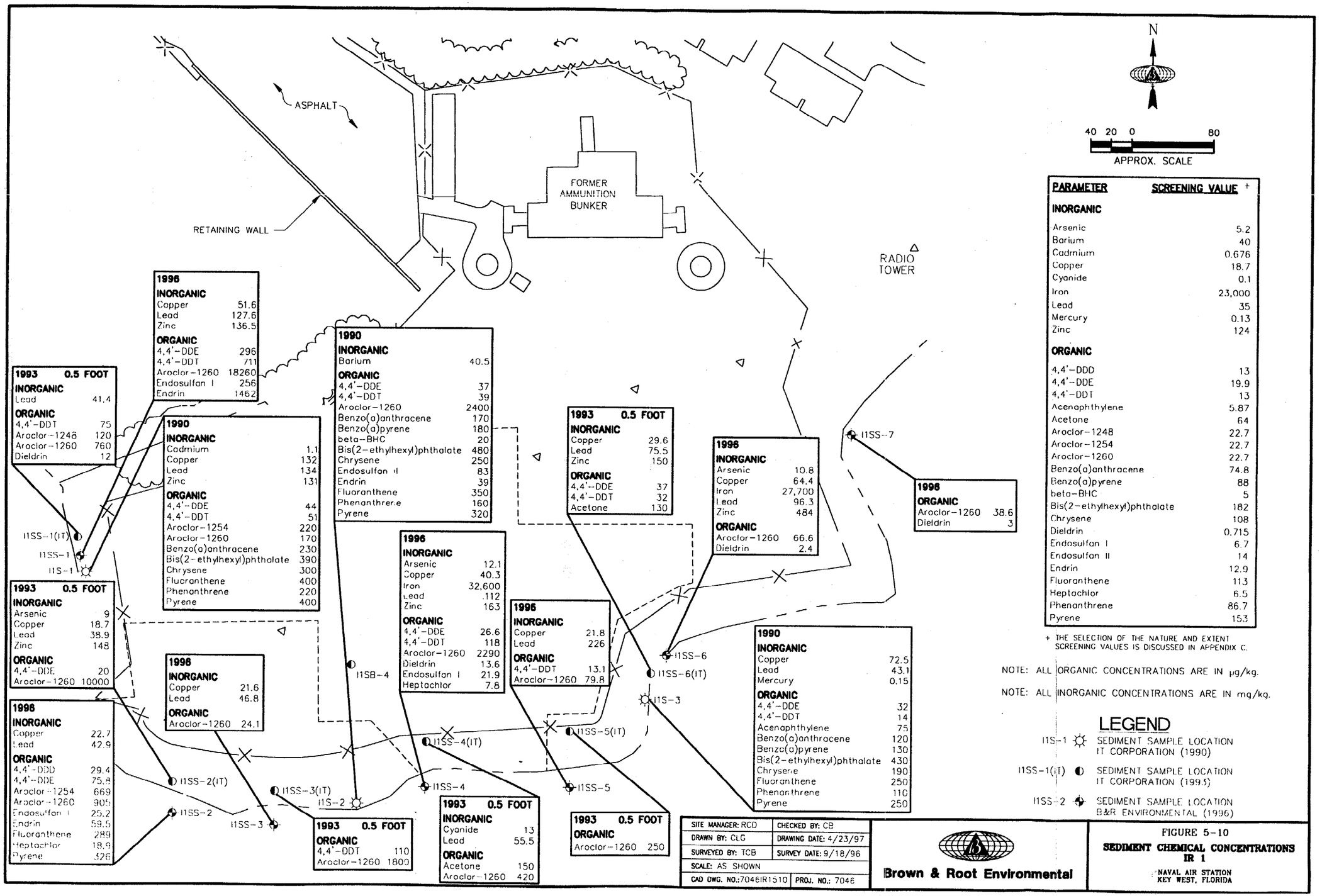
Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
I1S-1	0	IT 1990	Toluene	4	J
I1S-3	0	IT 1990	Toluene	2	J
I1S-1	0	IT 1990	Xylenes, total	3	J

Shading indicates a concentration in excess of the screening values (See Table C.3-2).

1 Depths are in feet.

2 Data Sources:
IT 1990 - RI (IT Corporation, 1991) conducted in 1990 by IT Corporation
IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

3 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
D - Compound analyzed at the secondary dilution factor
X_1 - A flag that FORMASTER III inserts when the data were entered manually
C - Confirmed
NC - Not confirmed
** - Elevated detection limit due to the presence of a pesticide, and/or PCB
+ - Altered pattern
Z - Elevated CRQL reported due to matrix interferences obscuring the compound of interest
F - Peak offscale and therefore out of linear range



PARAMETER	SCREENING VALUE +
INORGANIC	
Arsenic	5.2
Barium	40
Cadmium	0.676
Copper	18.7
Cyanide	0.1
Iron	23,000
Lead	35
Mercury	0.13
Zinc	124
ORGANIC	
4,4'-DDD	13
4,4'-DDE	19.9
4,4'-DDT	13
Acenaphthylene	5.87
Acetone	64
Aroclor-1248	22.7
Aroclor-1254	22.7
Aroclor-1260	22.7
Benzo(a)anthracene	74.8
Benzo(a)pyrene	88
beta-BHC	5
Bis(2-ethylhexyl)phthalate	182
Chrysene	108
Dieldrin	0.715
Endosulfan I	6.7
Endosulfan II	14
Endrin	12.9
Fluoranthene	113
Heptachlor	6.5
Phenanthrene	86.7
Pyrene	153

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

LEGEND

I1S-1 SEDIMENT SAMPLE LOCATION IT CORPORATION (1990)

I1SS-1(IT) SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)

I1SS-2 SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.:7046IR1510	PROJ. NO.: 7046

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FIGURE 5-10
SEDIMENT CHEMICAL CONCENTRATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA

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because it has no ecological threshold; however, 2-butanone concentrations did not exceed Residential Soil RBCs selected for nature and extent screening.

5.4.3.2 Semivolatile Organic Compounds

Several SVOCs exceeded their screening values in sediment samples collected from the southern shoreline.

Benzo(a)anthracene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, phenanthrene, and pyrene were detected at all three IT Corporation 1990 sampling locations. Of the compounds detected at all three sample locations, all the maximum concentrations of these SVOCs were consistently detected at I1S-1 with the exception of bis(2-ethylhexyl)phthalate, which had its maximum concentration at I1S-2. Acenaphthylene was detected only in a single sample (I1S-3), while benzo(a)pyrene exceeded the 88 µg/kg screening value in two samples, with the maximum occurring at I1S-2. Benzo(b)fluoranthene and benzo(k)fluoranthene were detected in all three 1990 samples, but were consistently below the screening values. Only two SVOCs were detected in sediment during the B&R Environmental 1996 investigation. Fluoranthene and pyrene were both detected in a single sample (I1SS-2). Both detections were in excess of screening values. The 289 µg/kg concentration of fluoranthene was slightly less than the 350 µg/kg concentration detected nearby at I1S-2 in 1990. At 326 µg/kg, the 1996 pyrene concentration was slightly greater than the 1990 level (320 mg/kg) detected at I1S-2.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Benzo(b)fluoranthene and benzo(k)fluoranthene were identified as COPCs (Section 5.6.2.2) in the human health risk assessment because they are from the same family as other COPCs although they do not have their own RBCs. The concentrations of benzo(b)fluoranthene and benzo(k)fluoranthene in sediment at IR 1 were less than the Residential Soil Risk-Based Concentrations selected for nature and extent screening.

5.4.3.3 Pesticides

A number of pesticide compounds were detected in sediment in excess of their screening values at IR 1. Most maximum concentrations were detected at I1SS-1, along the western shore, including 4,4'-DDE (296 µg/kg), 4,4'-DDT (711 µg/kg), endosulfan I (256 µg/kg), and endrin (1,462 µg/kg). The maximum concentrations of dieldrin and heptachlor were detected to the southeast along the sore at I1SS-2 (18.9 µg/kg) and I1SS-4 (13.6 mg/kg), respectively. 4,4'-DDD, beta-BHC, and endosulfan II were

detected in excess of screening criteria at one sample location each, either I1SS-2 or I1SS-2. 4,4'-DDE and 4,4'-DDT were detected in excess of screening criteria most frequently, in 11 and 9 of 16 samples, respectively. Other pesticides detected at levels below screening criteria included 2,4-D, alpha-BHC, delta-BHC, endosulfan sulfate, endrin aldehyde, gamma-BHC (lindane), and heptachlor epoxide. Overall detection frequency was highest for 4,4'-DDE and 4,4-DDT detected in 15 and 12 of 16 samples, respectively.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Delta-BHC was identified as a COPC (see Section 5.6.2.2) in the human health risk assessment based on a qualitative evaluation since it does not have an RBC. The concentration of delta-BHC in sediment at RI 1 was less than the Hull and Sutter (1994) screening value selected for nature and extent screening. 2,4-D was selected as an ecological COPC (see Section 5.7.4.1.2) because it had no ecological threshold; however, the 2,4-D concentration in sediment at IR 1 was less than the RCRA AL selected for nature and extent screening. Endosulfan sulfate, endrin aldehyde, and gamma BHC (lindane) were selected as ecological COPCs (see Section 5.7.4.1.2) based on the fact that their hazard quotients were greater than one. However, endosulfan sulfate and endrin aldehyde had no applicable nature and extent screening values and gamma-BHC (lindane) did not exceed twice the background average used as a nature and extent screening value.

5.4.3.4 Polychlorinated Biphenyls

Three PCBs were detected in sediment at IR 1. All detections were in excess of the 22.7 µg/kg sediment screening value. Aroclor-1248 was detected in a single sample [I1SS-1(IT), 120 µg/kg] during the 1993 investigation. Aroclor-1254 was detected in two samples. The lower concentration (220 µg/kg) was detected in 1990 at I1S-1, while the higher concentration (669 µg/kg) was detected farther to the south at I1SS-2 in 1996. Aroclor-1260 was detected in 14 of the 16 sediment samples tested for PCBs. It was detected in all three investigations and was not limited to a particular part of the shoreline, although the samples from the western and southwestern part of the site generally contained lower concentrations. The maximum concentration was over 800 times the screening value and was detected at I1SS-1 (18,260 µg/kg).

5.4.3.5 Inorganics

A number of inorganics were detected in excess of sediment screening values at IR 1. However, several of these parameters were either detected only a single time (cadmium, 1.1 mg/kg; cyanide, 13 mg/kg) or

were detected only once at a value that exceeded screening levels (beryllium, 20.1 mg/kg; mercury, 0.15 mg/kg). None of these exceedances occurred during the 1996 Supplemental RFI/RI, although barium and mercury were detected at lower concentrations in 1996 samples. Copper, lead, and zinc were all detected in each of the 16 sediment samples at IR 1. Of these three parameters, lead (12 samples) was most frequently in excess of the screening values, followed by copper (10 samples), and zinc (6 samples). These exceedances were divided among 1996 samples and samples from previous investigations, although the maximum concentrations of lead (I1SS-5, 226 mg/kg) and zinc (I1SS-6, 484 mg/kg) were detected in 1996 samples, while the maximum copper concentration (I1S-1, 132 mg/kg) occurred in a 1990 sample. Arsenic was detected in 15 samples, although only three of these concentrations were in excess of the 5.2-mg/kg screening value. Two of these exceedances were from the 1996 Supplemental RFI/RI (I1SS-4, 12.1 mg/kg and I1SS-6, 10.8 mg/kg), and one was from the 1993 RFI/RI [I1SS-2(IT), 9 mg/kg]. Iron was detected in excess of its 23,000 mg/kg screening value at two 1996 sample locations (I1SS-4, 32,600 mg/kg; I1SS-6, 27,700 mg/kg). Several inorganics, including aluminum, antimony, barium, chromium, cobalt, manganese, nickel, silver, tin, and vanadium were detected at the site but were consistently below sediment screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Antimony and manganese were identified as COPCs (see Section 5.6.2.2) in the human health risk assessment, but did not exceed the selected nature and extent screening level due to the conservative non-cancer hazard index applied to the EPA RBCs during the risk assessment process. Aluminum, beryllium, tin, and vanadium were selected as ecological COPCs (see Section 4.7.4.1.2) based on a comparison with twice the average background concentration, because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels, and were higher than twice the average background concentrations.

5.4.4 Surface Water

Data from the 1993 IT Corporation RFI/RI were considered in the analysis of contamination surface water at IR 1. No other investigations tested for surface-water contamination at IR 1. Chemicals that were detected in surface-water samples are listed in Table 5-4. This table includes analytical results from historical sampling events only, as no surface-water samples were collected during the Supplemental RFI/RI, at IR 1 because the surface water is open ocean water (see Appendix D, Section 7). Figure 5-11 shows the occurrence of analytes that exceeded screening values and indicated possible surface-water contamination.

TABLE 5-4

CHEMICALS DETECTED IN SURFACE WATER AT IR 1

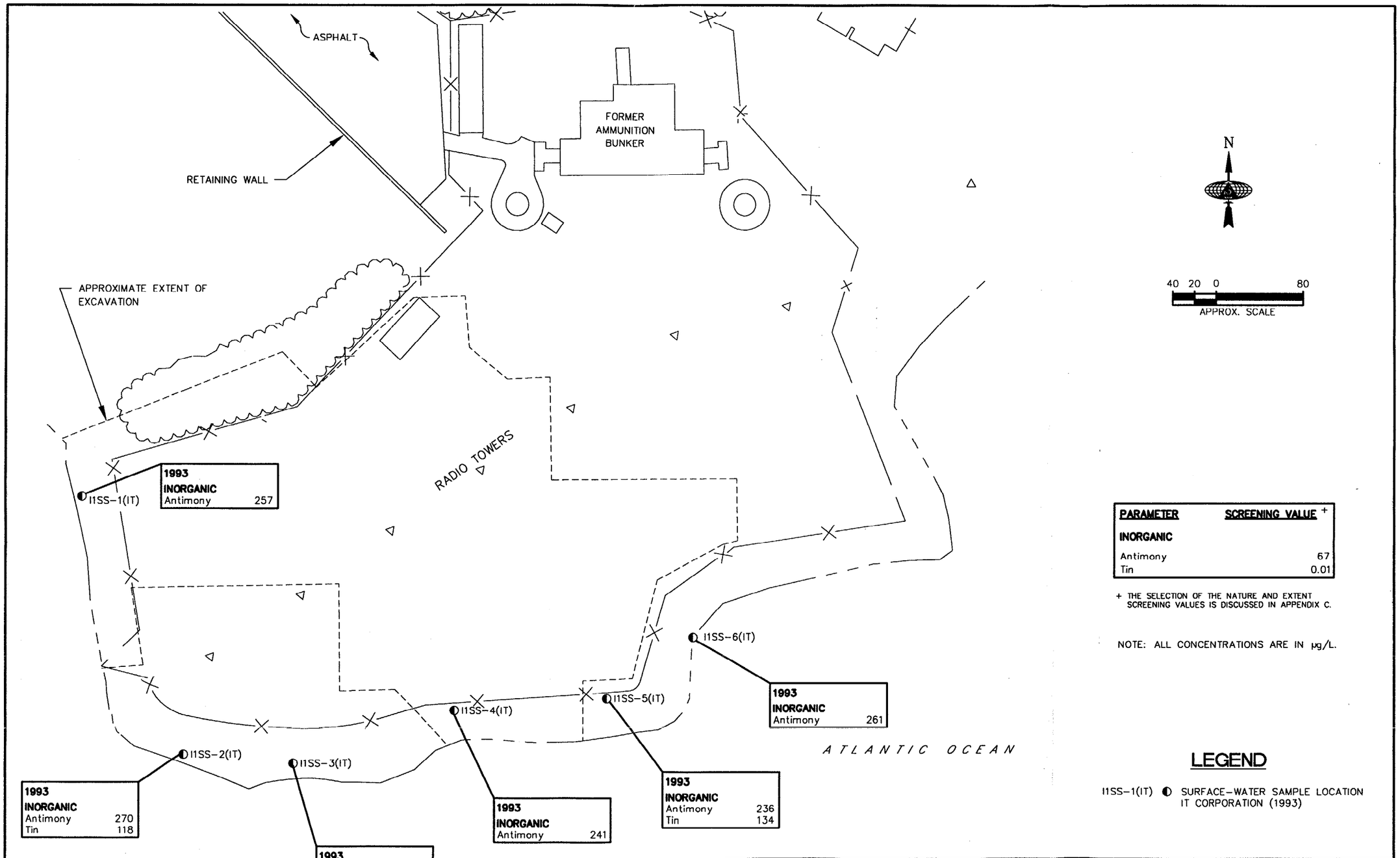
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
I1SS-6(IT)	IT 1993	Aluminum	47.1	B_1
I1SS-2(IT)	IT 1993	Antimony	270	
I1SS-6(IT)	IT 1993	Antimony	261	
I1SS-1(IT)	IT 1993	Antimony	257	
I1SS-3(IT)	IT 1993	Antimony	251	
I1SS-4(IT)	IT 1993	Antimony	241	
I1SS-5(IT)	IT 1993	Antimony	236	
I1SS-2(IT)	IT 1993	Barium	6	B_1
I1SS-1(IT)	IT 1993	Barium	5.9	B_1
I1SS-5(IT)	IT 1993	Barium	5.8	B_1
I1SS-6(IT)	IT 1993	Barium	5.8	B_1
I1SS-3(IT)	IT 1993	Barium	5.6	B_1
I1SS-4(IT)	IT 1993	Barium	5.4	B_1
I1SS-4(IT)	IT 1993	Iron	37.8	B_1
I1SS-6(IT)	IT 1993	Iron	27.5	B_1
I1SS-5(IT)	IT 1993	Tin	134	B_1
I1SS-2(IT)	IT 1993	Tin	118	B_1
I1SS-6(IT)	IT 1993	Zinc	9.4	B_1
I1SS-1(IT)	IT 1993	Zinc	7.6	B_1
I1SS-5(IT)	IT 1993	Zinc	6.8	B_1
I1SS-2(IT)	IT 1993	Zinc	6	B_1
I1SS-3(IT)	IT 1993	Zinc	5	B_1
VOLATILE ORGANIC COMPOUNDS (µg/L)				
I1SS-4(IT)	IT 1993	Acetone	8	J
I1SS-4(IT)	IT 1993	Methylene chloride	1	B_1J

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

1 Data Sources:
IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation

2 Qualifier (Qual.) codes:
B_1 - Value greater than instrumentation detection limit, but less than contract required quantitation limit.
J - The associated value is an estimated quantity.



SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR1511	PROJ. NO.: 7046

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FIGURE 5-11
SURFACE-WATER CHEMICAL CONCENTRATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA

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Metals and VOCs were the only contaminants detected in surface water at IR 1. VOC contamination was isolated in a single sample and was consistently below the screening values. Two metals, antimony and tin, exceeded screening values; and only antimony did so uniformly at every sample location.

Screening values were obtained from a variety of sources including FDEP SWQSs, EPA Region IV Freshwater and Marine Screening Values, EPA AWQCs for Fresh and Marine Waters, Proposed RCRA ALs, EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples.

5.4.4.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the surface-water samples. Acetone and methylene chloride were detected at low levels at I1SS-4(IT).

5.4.4.2 Semivolatile Organic Compounds

No SVOCs were detected in surface water at IR 1.

5.4.4.3 Pesticides

No pesticides were detected in surface water at IR 1.

5.4.4.4 Polychlorinated Biphenyls

No PCBs were detected in surface water at IR 1.

5.4.4.5 Inorganics

Antimony was detected in excess of its 67 µg/L screening value at all six of the sampling locations. Concentrations detected were relatively consistent, ranging from 270 µg/kg at I1SS-2(IT) to 236 µg/kg at I1SS-5(IT). Tin was detected in excess of its 0.01 µg/L screening value at 2 of 6 sampling locations. These concentrations were detected at I1SS-5(IT) (134 µg/L) and I1SS-2(IT) (118 µg/L). Other

inorganics, including aluminum, barium, iron, and zinc were detected in surface water at IR 1, but were below their respective screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Aluminum, barium, iron, and zinc were identified as COPCs (see Section 5.6.2.2) in the human health risk assessment based on a qualitative evaluation since they do not have RBCs. Aluminum, barium, iron, and zinc concentrations in surface water at IR 1 were less than their nature and extent screening criteria selected from twice the background average concentration, proposed RCRA ALs, Florida Surface Water Quality Standards, and EPA Region III Marine BTAG Surface Water Screening Levels, respectively.

5.4.5 Groundwater

Data from a number of sampling efforts including the 1986 Geraghty and Miller Verification Study, the 1990 IT Corporation RI, the 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of groundwater contamination at IR 1. Chemicals that were detected in groundwater samples are listed in Table 5-5. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. The 1986 Geraghty and Miller and the 1990 IT Corporation RI samples were tested for VOCs, SVOCs, pesticides, PCBs, and inorganics. The 1993 IT Corporation RFI/RI and this Supplemental RFI/RI samples were tested for pesticides, PCBs, and inorganics in all samples. A single 1993 sample was tested for VOCs and SVOCs. Figures 5-12 through 5-15 show the occurrence of analytes that exceeded screening values and indicate possible groundwater contamination.

Inorganics were the most frequently detected chemical fraction, followed by pesticides. Inorganics were detected in samples from all investigations, but both extent and degree of inorganic contamination appeared to be reduced in the 1996 samples. The opposite was true of pesticide contamination. A limited amount of pesticide contamination was detected in previous sampling investigations. Most of the detected pesticides were found in 1996 samples.

Screening values were obtained from a variety of sources including SDWA MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1,

TABLE 5-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 1
NAS KEY WEST
PAGE 1 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
I1MW1-3	IT 1990	Aluminum	46,500	
I1MW1-2	IT 1990	Aluminum	34,900	
I1KWM-02	IT 1990	Aluminum	12,800	
I1MW1-1	IT 1990	Aluminum	5,870	
I1KWM-04	IT 1990	Aluminum	3,865	
I1KWM-03	IT 1990	Aluminum	2,120	
I1MW1-2	IT 1993	Aluminum	376	
I1KWM-01	IT 1990	Aluminum	162	B_1
I1MW-5	IT 1993	Antimony	563	
I1MW1-2	IT 1990	Antimony	557	
I1KWM-02	IT 1990	Antimony	427	
I1MW1-3	IT 1990	Antimony	313	
I1MW-3	IT 1993	Antimony	199	
I1KWM-02	IT 1993	Antimony	190	
I1MW1-2	IT 1993	Antimony	173	
I1KWM-03	IT 1993	Antimony	170	
I1MW1-3	IT 1993	Antimony	151	
I1MW-1	IT 1993	Antimony	103	
I1KWM-03	IT 1990	Antimony	95.2	
I1MW1-1	IT 1993	Antimony	71.9	
I1MW1-1	B&RE 1996	Antimony	44.3	
I1MW-1	B&RE 1996	Antimony	22.2	
I1KWM-01	B&RE 1996	Antimony	10.3	J
I1MW1-3	B&RE 1996	Antimony	9.1	
I1MW-3	B&RE 1996	Antimony	5.6	
I1MW1-2	IT 1990	Arsenic	62.2	
I1MW-5	IT 1993	Arsenic	61.2	
I1MW1-3	IT 1990	Arsenic	46.6	
I1MW-3	IT 1993	Arsenic	17.2	
I1MW1-2	IT 1993	Arsenic	9.1	B_1

Location	Source[1]	Parameter	Result	Qual.[2]
I1KWM-02	G&M 1986	Arsenic	7	
I1KWM-03	G&M 1986	Arsenic	7	
I1KWM-01	G&M 1986	Arsenic	6	
I1KWM-04	G&M 1986	Arsenic	6	
I1MW-1	IT 1993	Arsenic	5.8	B_1
I1KWM-03	IT 1993	Arsenic	4.9	B_1
I1KWM-02	IT 1993	Arsenic	3.6	B_1
I1MW1-2	IT 1990	Barium	1,380	E
I1MW1-3	IT 1990	Barium	1,310	E
I1KWM-02	IT 1990	Barium	566	
I1MW-5	IT 1993	Barium	496	
I1MW-3	IT 1993	Barium	277	
I1MW1-1	IT 1990	Barium	227	E
I1MW1-1	IT 1993	Barium	147	B_1
I1KMW-04	IT 1990	Barium	93.5	B_1
I1MW-1	IT 1993	Barium	75.4	B_1
I1KWM-03	IT 1990	Barium	73.8	B_1
I1MW1-3	IT 1993	Barium	69.9	B_1
I1MW1-3	B&RE 1996	Barium	64.6	
I1MW1-2	IT 1993	Barium	64.3	B_1
I1KWM-02	IT 1993	Barium	63.2	B_1
I1MW1-2	B&RE 1996	Barium	50.4	
I1KWM-01	IT 1990	Barium	45.1	B_1
I1MW-1	B&RE 1996	Barium	43.2	
I1KWM-01	B&RE 1996	Barium	41.5	J
I1MW-3	B&RE 1996	Barium	40.3	
I1KWM-02	B&RE 1996	Barium	38.2	
I1KWM-03	IT 1993	Barium	37	B_1
I1MW-5	B&RE 1996	Barium	36.3	
I1MW1-1	B&RE 1996	Barium	14.6	
I1KWM-03	B&RE 1996	Barium	12.1	

TABLE 5-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 1
NAS KEY WEST
PAGE 2 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I1MW-3	IT 1993	Beryllium	1.2	B_1
I1MW1-1	IT 1993	Beryllium	1.2	B_1
I1MW1-2	IT 1990	Cadmium	54.5	
I1MW-5	IT 1993	Cadmium	42.3	
I1MW1-3	IT 1990	Cadmium	33.2	
I1KWM-02	IT 1990	Cadmium	22.2	
I1MW1-3	IT 1990	Chromium	657	
I1MW-5	IT 1993	Chromium	394	
I1MW1-2	IT 1990	Chromium	351	
I1KWM-02	IT 1990	Chromium	142	
I1MW-3	IT 1993	Chromium	113	
I1MW1-1	IT 1990	Chromium	92.2	
I1MW1-1	IT 1993	Chromium	75.7	
I1KWM-04	IT 1990	Chromium	61.2	
I1MW-1	IT 1993	Chromium	51.3	
I1KWM-03	IT 1990	Chromium	33.2	
I1KWM-03	IT 1993	Chromium	21.7	
I1MW-3	B&RE 1996	Chromium	12.6	
I1MW1-3	IT 1993	Chromium	11.4	
I1MW-5	IT 1993	Cobalt	48.1	B_1
I1MW1-2	IT 1990	Cobalt	43.7	B_1
I1MW1-3	IT 1990	Cobalt	31.9	B_1
I1KWM-01	B&RE 1996	Cobalt	2.9	
I1MW1-3	IT 1990	Copper	10,200	
I1MW1-2	IT 1990	Copper	9,520	
I1MW-5	IT 1993	Copper	3,570	
I1KWM-02	IT 1990	Copper	3,360	
I1MW-3	IT 1993	Copper	714	
I1MW1-3	IT 1993	Copper	462	
I1MW-1	IT 1993	Copper	332	
I1MW1-2	IT 1993	Copper	208	

Location	Source[1]	Parameter	Result	Qual.[2]
I1KWM-03	IT 1990	Copper	136	
I1MW1-3	B&RE 1996	Copper	88.4	
I1MW1-1	IT 1990	Copper	64.5	
I1MW-1	B&RE 1996	Copper	60.5	
I1KWM-01	IT 1990	Copper	48.8	
I1KWM-04	IT 1990	Copper	54.2	B_1
I1KWM-03	G&M 1986	Copper	40	
I1KWM-02	G&M 1986	Copper	40	
I1KWM-01	G&M 1986	Copper	40	
I1KWM-03	IT 1993	Copper	37.1	
I1KWM-02	IT 1993	Copper	27.2	
I1MW1-1	IT 1993	Copper	26.2	
I1KWM-04	G&M 1986	Copper	20	
I1KWM-01	B&RE 1996	Copper	11.5	J
I1MW1-2	IT 1990	Iron	155,000	E
I1KWM-02	IT 1990	Iron	89,500	E_2
I1MW1-3	IT 1990	Iron	81,000	E
I1MW1-2	IT 1993	Iron	9,210	
I1MW1-1	IT 1990	Iron	5,100	E
I1KWM-03	IT 1990	Iron	3,790	E_2
I1KWM-04	IT 1990	Iron	1,916.5	E_2
I1MW1-3	B&RE 1996	Iron	391	
I1KWM-01	IT 1990	Iron	258	E_2
I1MW-1	B&RE 1996	Iron	184.1	
I1KWM-03	B&RE 1996	Iron	80.5	
I1MW1-2	B&RE 1996	Iron	62.4	
I1MW-3	B&RE 1996	Iron	51.4	
I1MW1-2	IT 1990	Lead	5,700	
I1MW1-3	IT 1990	Lead	4,360	
I1KWM-02	IT 1990	Lead	4,140	
I1MW-5	IT 1993	Lead	2,170	

TABLE 5-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 1
NAS KEY WEST
PAGE 3 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I1MW-3	IT 1993	Lead	774	
I1MW-1	IT 1993	Lead	300	
I1MW1-2	IT 1993	Lead	282	
I1KWM-03	IT 1990	Lead	219	
I1MW1-1	IT 1993	Lead	142	
I1KWM-03	IT 1993	Lead	98.6	
I1MW1-3	IT 1993	Lead	90.1	
I1MW1-1	IT 1990	Lead	57.1	
I1KWM-04	IT 1990	Lead	50.1	
I1KWM-01	IT 1990	Lead	47.2	
I1MW1-3	B&RE 1996	Lead	18.9	
I1KWM-02	IT 1993	Lead	13.2	
I1MW1-2	IT 1990	Manganese	2,940	
I1KWM-02	IT 1990	Manganese	1,360	
I1MW1-3	IT 1990	Manganese	921	
I1MW1-2	IT 1993	Manganese	657	
I1MW-3	B&RE 1996	Manganese	137	
I1MW1-1	IT 1990	Manganese	134	
I1KWM-04	IT 1990	Manganese	53.1	
I1KWM-03	IT 1990	Manganese	41.7	
I1KWM-02	B&RE 1996	Manganese	31.3	
I1MW1-1	B&RE 1996	Manganese	28.7	
I1MW-5	B&RE 1996	Manganese	25.7	
I1KWM-01	B&RE 1996	Manganese	8.8	J
I1KWM-01	IT 1990	Manganese	8.4	B_1
I1MW1-2	B&RE 1996	Manganese	5.5	
I1KWM-03	B&RE 1996	Manganese	3.4	
I1KWM-02	G&M 1986	Mercury	640	
I1KWM-03	G&M 1986	Mercury	120	
I1KWM-01	G&M 1986	Mercury	55	
I1KWM-04	G&M 1986	Mercury	46	

Location	Source[1]	Parameter	Result	Qual.[2]
I1MW1-2	IT 1990	Mercury	16.2	
I1MW-5	IT 1993	Mercury	14.6	
I1MW1-3	IT 1990	Mercury	11.1	
I1MW-3	IT 1993	Mercury	4.1	
I1MW-1	IT 1993	Mercury	2.4	
I1KWM-02	IT 1990	Mercury	2.4	
I1KWM-03	IT 1990	Mercury	0.95	
I1MW1-3	IT 1993	Mercury	0.58	
I1MW1-3	B&RE 1996	Mercury	0.43	
I1MW1-2	IT 1993	Mercury	0.34	
I1KWM-03	IT 1993	Mercury	0.24	
I1MW1-1	IT 1993	Mercury	0.21	
I1KWM-01	B&RE 1996	Mercury	0.14	
I1MW1-2	IT 1990	Nickel	303	
I1MW1-3	IT 1990	Nickel	277	
I1MW-5	IT 1993	Nickel	196	
I1KWM-02	IT 1990	Nickel	88.2	
I1KWM-03	IT 1990	Nickel	25.9	B_1
I1MW1-3	B&RE 1996	Nickel	10.2	
I1MW-1	B&RE 1996	Nickel	7	
I1MW1-1	B&RE 1996	Selenium	54.6	
I1MW1-2	B&RE 1996	Selenium	4.7	
I1MW-5	IT 1993	Silver	22	
I1MW-5	IT 1993	Tin	340	
I1MW-3	IT 1993	Tin	30	
I1MW1-2	IT 1990	Vanadium	116	
I1MW1-3	IT 1990	Vanadium	114	
I1MW-5	IT 1993	Vanadium	100	
I1KWM-02	IT 1990	Vanadium	96.8	
I1MW-3	IT 1993	Vanadium	67.9	
I1KWM-03	IT 1990	Vanadium	63.3	

TABLE 5-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 1
NAS KEY WEST
PAGE 4 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I1MW1-1	IT 1990	Vanadium	55.4	
I1KWM-04	IT 1990	Vanadium	40.8	B_1
I1MW1-1	IT 1993	Vanadium	29.5	B_1
I1KWM-03	IT 1993	Vanadium	24.4	B_1
I1MW-1	IT 1993	Vanadium	16.2	B_1
I1KWM-03	B&RE 1996	Vanadium	15.7	
I1MW1-1	B&RE 1996	Vanadium	9.3	
I1KWM-01	B&RE 1996	Vanadium	4.1	J
I1MW-1	B&RE 1996	Vanadium	2.3	
I1MW-3	B&RE 1996	Vanadium	2	
I1MW1-2	IT 1990	Zinc	15,200	
I1MW-5	IT 1993	Zinc	11,300	
I1MW1-3	IT 1990	Zinc	10,400	
I1KWM-02	IT 1990	Zinc	7,320	
I1MW1-2	IT 1993	Zinc	606	
I1MW-3	IT 1993	Zinc	525	
I1KWM-03	IT 1990	Zinc	432	
I1MW-1	IT 1993	Zinc	424	
I1MW1-3	IT 1993	Zinc	324	
I1MW1-1	IT 1990	Zinc	171	
I1KWM-04	IT 1990	Zinc	136.6	
I1KWM-03	IT 1993	Zinc	120	
I1MW1-3	B&RE 1996	Zinc	96.2	
I1MW1-1	IT 1993	Zinc	74.2	
I1MW-1	B&RE 1996	Zinc	56.2	
I1MW1-2	B&RE 1996	Zinc	52.2	
I1KWM-01	IT 1990	Zinc	26.9	
I1KWM-02	IT 1993	Zinc	12.8	B_1

PESTICIDES/PCBs (µg/L)

I1MW1-2	B&RE 1996	4,4'-DDD	1.3	J
I1MW1-2	IT 1993	4,4'-DDE	0.11	

Location	Source[1]	Parameter	Result	Qual.[2]
I1MW1-3	B&RE 1996	alpha-BHC	0.015	J
I1MW-1	B&RE 1996	alpha-BHC	0.013	J
I1MW1-2	IT 1993	alpha-chlordane	2.1	DJ
I1MW1-2	IT 1990	alpha-chlordane	0.98	DJ
I1MW1-2	IT 1993	beta-BHC	1.4	D
I1MW1-2	B&RE 1996	Chlordane	57.9	
I1MW-5	B&RE 1996	Dieldrin	0.023	J
I1MW1-1	B&RE 1996	Dieldrin	0.022	J
I1MW-1	B&RE 1996	Dieldrin	0.022	J
I1KWM-01	B&RE 1996	Dieldrin	0.011	J
I1MW1-2	B&RE 1996	Endosulfan I	5.9	J
I1MW-5	B&RE 1996	Endosulfan I	0.02	J
I1MW-1	B&RE 1996	Endosulfan I	0.015	J
I1KWM-02	B&RE 1996	Endosulfan I	0.013	J
I1MW-3	B&RE 1996	Endosulfan I	0.013	J
I1MW1-3	B&RE 1996	Endosulfan I	0.011	J
I1MW1-1	B&RE 1996	Endosulfan sulfate	0.027	J
I1MW-5	B&RE 1996	gamma-BHC (lindane)	0.16	J
I1KWM-02	B&RE 1996	gamma-BHC (lindane)	0.087	J
I1MW1-3	B&RE 1996	gamma-BHC (lindane)	0.024	
I1KWM-03	B&RE 1996	gamma-BHC (lindane)	0.015	J
I1MW1-2	IT 1993	gamma-chlordane	1.3	DJ
I1MW1-2	IT 1990	gamma-chlordane	1.1	DJ
I1MW1-2	B&RE 1996	Heptachlor	1	
I1MW1-2	IT 1993	Heptachlor epoxide	0.65	D

SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)

I1KWM-02	G&M 1986	Acenaphthene	7.4	
I1KWM-02	G&M 1986	Anthracene	1.1	
I1KWM-02	G&M 1986	Fluoranthene	2.4	
I1KWM-02	G&M 1986	Fluorene	7.5	
I1KWM-02	G&M 1986	Phenanthrene	14	

TABLE 5-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 1
NAS KEY WEST
PAGE 5 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I1KWM-02	G&M 1986	Pyrene	1	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
I1MW1-2	IT 1990	Acetone	4	J
I1MW1-3	IT 1990	Acetone	2	J
I1KWM-02	G&M 1986	Benzene	1.6	
I1MW1-3	IT 1990	Carbon disulfide	1	B_1J
I1KWM-02	G&M 1986	Ethylbenzene	1.6	
I1KWM-03	G&M 1986	Methylene chloride	5.2	BG*
I1KWM-01	G&M 1986	Methylene chloride	3.9	BG*
I1KWM-04	G&M 1986	Methylene chloride	3.6	BG*
I1KWM-02	G&M 1986	Methylene chloride	3.3	BG*
I1KWM-01	IT 1990	Methylene chloride	2	B_2J
I1MW1-1	IT 1990	Methylene chloride	2	B_2J
I1MW1-2	IT 1993	Methylene chloride	2	B_2J
I1MW1-2	IT 1990	Methylene chloride	2	B_2J
I1KWM-02	IT 1990	Methylene chloride	1	B_2J
I1MW1-3	IT 1990	Methylene chloride	1	B_2J
I1KWM-04	IT 1990	Methylene chloride	1	B_2J
I1KWM-02	G&M 1986	Toluene	4.3	
I1KWM-04	G&M 1986	Trans-1,2-dichloroethene	18	
I1KWM-04	G&M 1986	Trichloroethene	14	
I1KWM-04	IT 1990	Trichloroethene	1	J
I1KWM-02	G&M 1986	Xylenes, total	7.2	

Shading indicates a concentration in excess of the screening values (See Table C.3-4).

1 Data Sources:
G&M 1986 - Verification Study (Geraghty and Miller, 1987) conducted in 1986 by Geraghty and Miller
IT 1990 - RI conducted in 1990 by IT Corporation (1991)
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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
E - Compound exceeded calibration range of instrument
E_2 - The reported value is estimated because of the presence of interference
D - Compound analyzed at a secondary dilution
BG*- Qualifier definition not available
B_2 - Analyte was found in the blank as well as the sample

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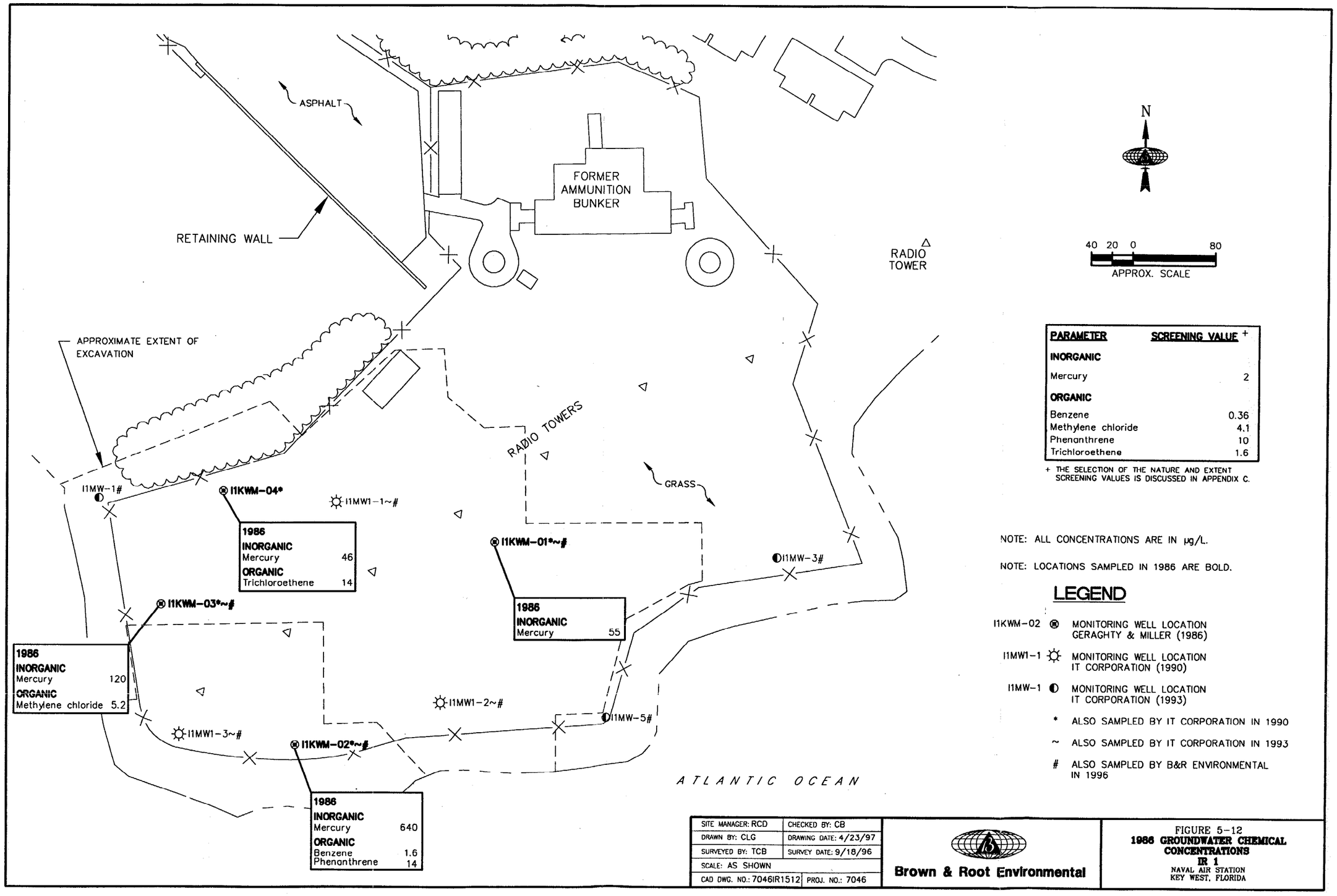


PARAMETER	SCREENING VALUE +
INORGANIC	
Mercury	2
ORGANIC	
Benzene	0.36
Methylene chloride	4.1
Phenanthrene	10
Trichloroethene	1.6

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1986 ARE BOLD.

LEGEND

I1KWM-02 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)

I1MW1-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)

I1MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

* ALSO SAMPLED BY IT CORPORATION IN 1990

~ ALSO SAMPLED BY IT CORPORATION IN 1993

\# ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR1512	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-12
1986 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 1
NAVAL AIR STATION
KEY WEST, FLORIDA

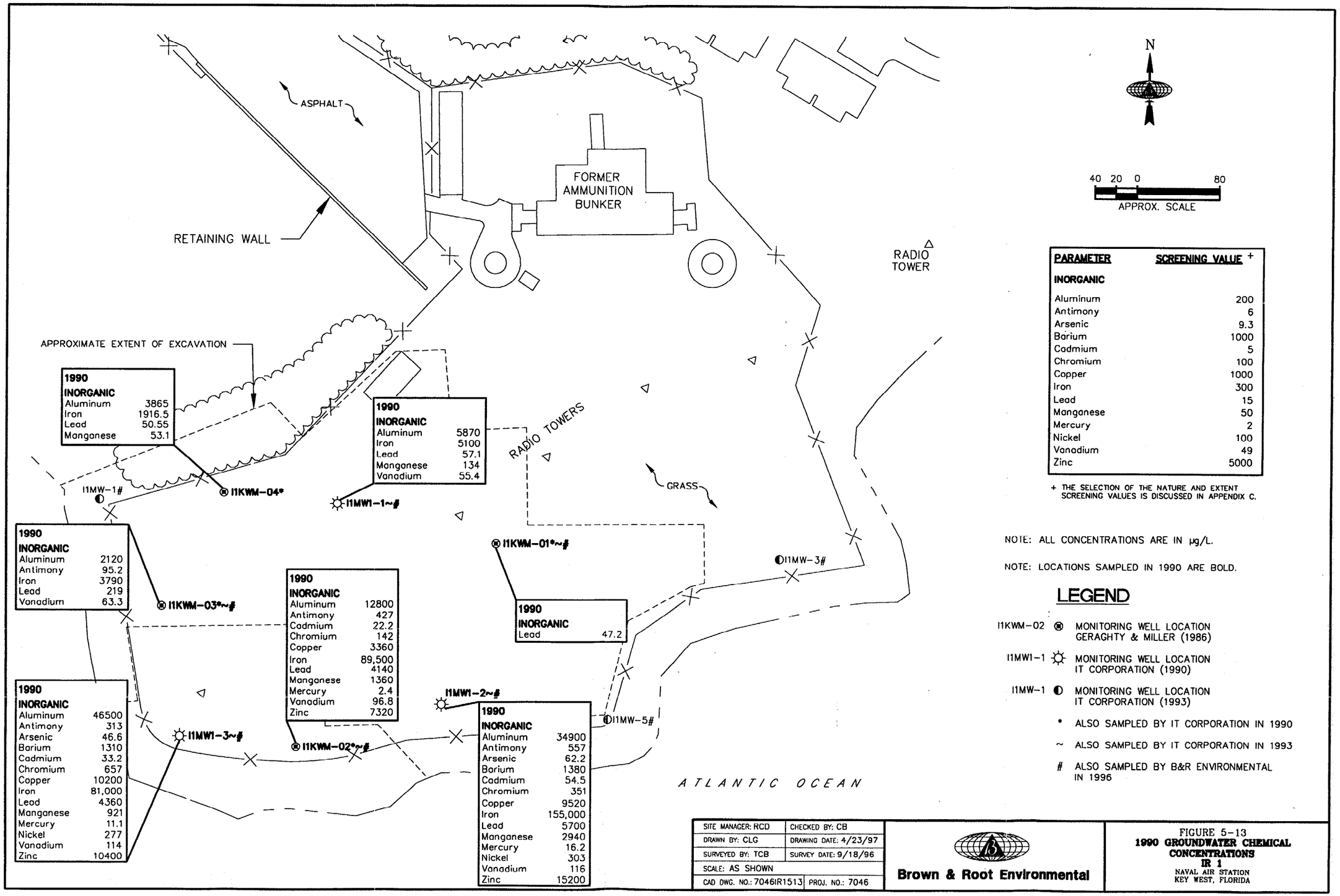
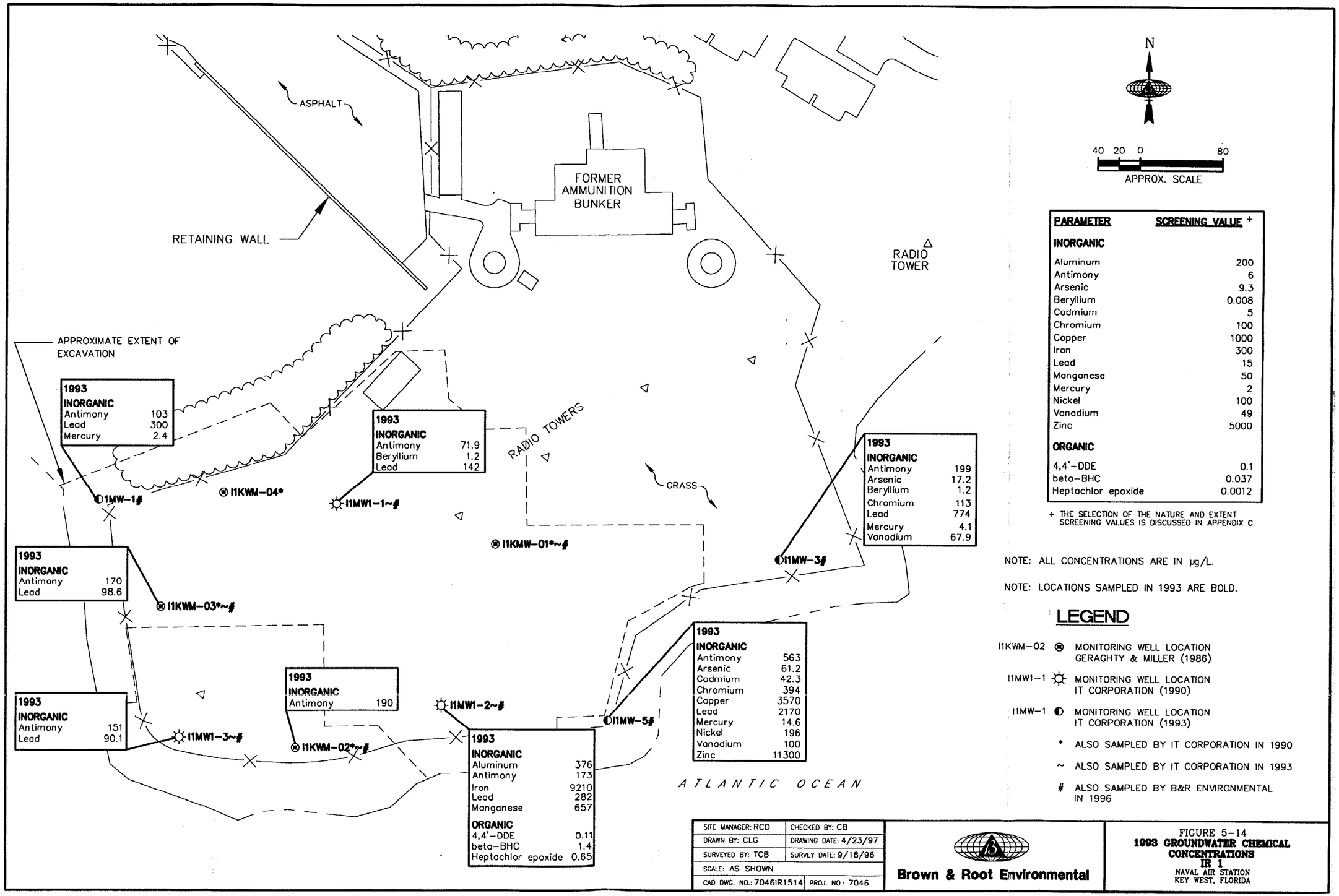


FIGURE 5-13
1990 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 1
NAVAL AIR STATION
KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	200
Antimony	6
Arsenic	9.3
Beryllium	0.008
Cadmium	5
Chromium	100
Copper	1000
Iron	300
Lead	15
Manganese	50
Mercury	2
Nickel	100
Vanadium	49
Zinc	5000
ORGANIC	
4,4'-DDE	0.1
beta-BHC	0.037
Heptachlor epoxide	0.0012

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

LEGEND

I1KWM-02 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)

I1MW1-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)

I1MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

* ALSO SAMPLED BY IT CORPORATION IN 1990

~ ALSO SAMPLED BY IT CORPORATION IN 1993

\# ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR1514	PROJ. NO.: 7046

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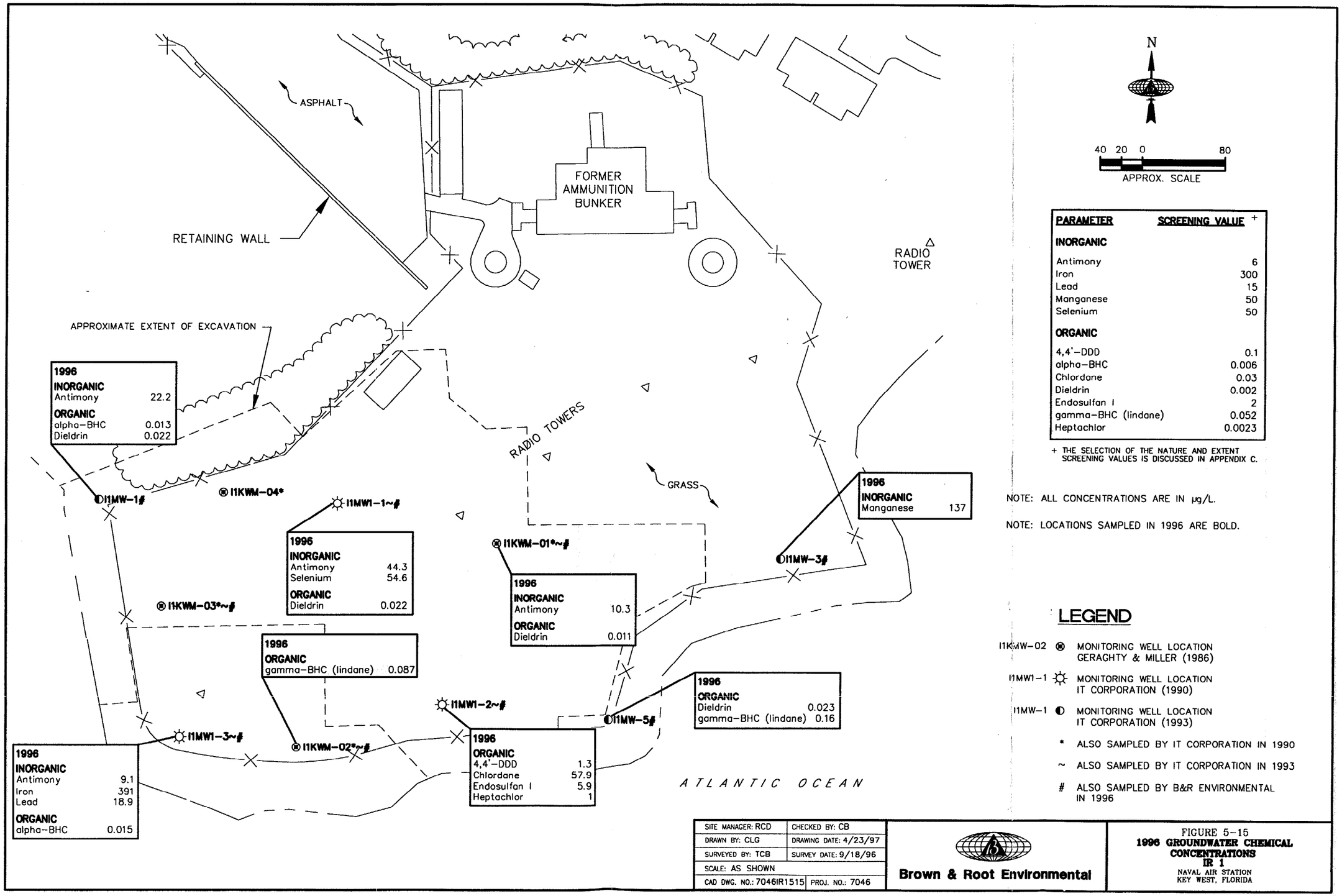
FIGURE 5-14
1993 GROUNDWATER CHEMICAL CONCENTRATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6
Iron	300
Lead	15
Manganese	50
Selenium	50
ORGANIC	
4,4'-DDD	0.1
alpha-BHC	0.006
Chlordane	0.03
Dieldrin	0.002
Endosulfan I	2
gamma-BHC (lindane)	0.052
Heptachlor	0.0023

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1996 ARE BOLD.

LEGEND

I1KWW-02 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)

I1MW1-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)

I1MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

* ALSO SAMPLED BY IT CORPORATION IN 1990

~ ALSO SAMPLED BY IT CORPORATION IN 1993

\# ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/23/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR1515	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 5-15
1996 GROUNDWATER CHEMICAL CONCENTRATIONS IR 1
NAVAL AIR STATION KEY WEST, FLORIDA

and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

5.4.5.1 Volatile Organic Compounds

Although nine VOCs were detected in groundwater, only benzene, methylene chloride, and trichloroethene exceeded screening values. Benzene was detected at a concentration above the Tap Water RBC (0.36 µg/L) used as a screening value only at I1KWM-02 (1.6 µg/L) in 1986. Methylene chloride was detected at monitoring well I1KWM-03 in 1986 at a concentration only slightly above the Tap Water RBC used as a screening value. Methylene chloride was also detected at other monitoring wells in other investigations, but at levels below the screening value. Trichloroethene was detected at monitoring well I1KWM-04 (14 µg/L) in 1986 at a concentration over 8 times the selected screening value. Trichloroethene was detected at the same well in 1990 by IT Corporation at a level less than the screening value. Trichloroethene was not detected in any other monitoring well in any other investigation. Other VOCs, including acetone, carbon disulfide, ethylbenzene, toluene, trans-1,2-dichloroethene, and xylenes were detected in groundwater at IR 1, but were below their respective screening values. Generally, the broadest spectrum of VOCs was detected by Geraghty and Miller in 1986. When the same compounds were detected in later investigations, concentrations were consistently low and occurrences were isolated. VOCs were not tested for by B&R Environmental during the 1996 Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995).

5.4.5.2 Semivolatile Organic Compounds

Only a single SVOC, phenanthrene, was detected in excess of its screening value in groundwater at IR 1 in 1986. It was detected in a single well (I1KWM-02, 14 µg/L). Other SVOCs detected in 1986 included acenaphthene, anthracene, fluoranthrene, fluorene, and pyrene. All were below screening values. SVOCs were not detected in any later investigations. B&R Environmental did not test for SVOCs during the 1996 Supplemental RFI/RI, as per the Sampling and Analysis Plan (ABB, 1995).

5.4.5.3 Pesticides

Prior to 1996, only five pesticides had been detected in groundwater at IR 1 -- all in the same well (I1MW1-2). Alpha-chlordane and gamma-chlordane were detected in 1990 and 1993, while 4,4'-DDE, beta-BHC, and heptachlor epoxide were detected in 1993. Only, 4,4'-DDE, beta-BHC and heptachlor epoxide exceeded groundwater screening values in 1993. None of these compounds were detected in 1996. In 1996, other pesticides were detected in excess of screening values at I1MW1-2, as well as other

wells. Chlordane (57.9 µg/L), heptachlor (1 µg/L), and 4,4'-DDD (1.3 µg/L) were detected in excess of screening values at I1MW1-2 in 1996. None were detected elsewhere in groundwater at IR 1. Alpha-BHC was detected in excess of screening values in two 1996 groundwater samples (I1MW1-3, 0.015 µg/L and I1MW-1, 0.013 µg/L). Gamma-BHC (lindane) was detected in four 1996 samples, and exceeded the selected screening value (0.052 µg/L) in two wells (I1MW-5, 0.16 µg/L and I1KWM-02, 0.087 µg/L). Considering 1996 data, as well as the results from previous investigations, BHC isomers were detected in groundwater samples a total of 7 times and only two detections occurred in the same well, alpha-BHC and gamma-BHC (lindane) , both in I1MW1-3 in 1996. Endosulfan I, detected in six 1996 samples, was the most frequently detected pesticide compound in groundwater at IR 1. However, it exceeded the selected screening value (2 µg/L), in a single sample (I1MW1-2, 5.9 µg/L). Dieldrin was the pesticide compound most frequently detected in excess of screening values. It exceeded its 0.002-µg/L screening value in all four samples in which it was detected. Three of the detections were of comparable concentrations (I1MW-5, I1MW1-1, and I1MW-1), all approximately 0.02 µg/L. The fourth (I1KWM-01, 0.011 µg/L) was lower. Endosulfan sulfate was detected once in 1996, but was below the screening value.

5.4.5.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at IR 1.

5.4.5.5 Inorganics

A number of inorganic parameters were detected in groundwater at IR 1 between 1986 and 1996. A limited number of inorganics were detected in 1986; a broad spectrum of parameters were detected and appeared fairly widespread in 1990 and 1993; and in 1996, detections were limited and greatly reduced from 1990 and 1993 concentrations. In 1996, only five inorganic parameters (antimony, iron, lead, manganese, and selenium) exceeded screening values. Of these compounds, iron, lead, manganese, and selenium each exceeded their respective criteria only once. Each inorganic parameter detected in excess of screening values during any investigation is discussed individually below.

Aluminum was detected eight times at seven monitoring well locatons at IR 1 between 1990 and 1993. Of those eight detections, seven exceeded the screening value (200 µg/L). The maximum concentration detected at I1MW1-3 (46,500 µg/L) in 1990 was greater than 200 times the screening value. Other high concentrations were detected at I1MW1-2 (34,900 µg/L), I1KWM-02 (12,800 µg/L), I1MW1-1 (5,870 µg/L), I1KWM-04 (3,865 µg/L), and I1KWM-03 (2,120 µg/L) all in 1990. Aluminum was not detected at any monitoring well in 1996.

Antimony was detected 17 times at 10 of the monitoring wells at IR 1 between 1986 and 1996. Of those 17 detections, 16 exceeded the selected screening value (6 µg/L). Maximum concentrations were detected in 1990 and 1993 at I1MW-5 (563 µg/L), I1MW1-2 (557 µg/L), I1KWM-02 (427 µg/L), I1MW1-3 (313 µg/L). Concentrations were less than 200 µg/L at other sampling locations. Antimony was detected in five wells in 1996. These were the five lowest concentrations of antimony detected in groundwater.

Arsenic was detected 12 times at 9 of the monitoring wells at IR 1 between 1986 and 1993. Of those 12 detections, four exceeded the selected screening value (9.3 µg/L). Maximum concentrations were detected in 1990 and 1993 at I1MW1-2 (62.2 µg/L), I1MW-5 (61.2 µg/L), I1MW1-3 (46.6 µg/L), and I1MW-3 (17.2 µg/L). Arsenic was detected at other monitoring wells in other investigations but at concentrations less than the screening value. Arsenic was not detected in 1996.

Barium slightly exceeded the selected screening value (1,000 µg/L) in two wells in 1990, I1MW1-2 (1,380 µg/L) and I1MW1-3 (1,310 µg/L). Barium was detected at other monitoring wells in other investigations but at concentrations less than the screening value. 1996 concentrations were generally lower than 1990 and 1993 concentrations detected in the same wells.

Beryllium exceeded the selected screening value (0.008 µg/L) in 1993 at I1MW1-1 (1.2 µg/L) and I1MW-3 (1.2 µg/L). Beryllium was not detected at any other monitoring well by any other investigation.

Cadmium was detected four times in 1990 and 1993, all in excess of the selected screening value (5 µg/L). These concentrations were detected at I1MW1-2 (54.5 µg/L), I1MW-5 (42.3 µg/L), I1MW1-3 (33.2 µg/L), and I1KWM-02 (22.2 µg/L). Cadmium was not detected at any other monitoring well in any other investigation.

Chromium was detected 13 times in monitoring wells at IR 1 between 1990 and 1996. Of those 13 detections, five exceeded the selected screening value (100 µg/L). Maximum concentrations were detected in 1990 and 1993 at I1MW1-3 (657 µg/L), I1MW-5 (394 µg/L), and I1MW1-2 (351 µg/L). Chromium was detected at other monitoring wells by other investigations but at concentrations less than the screening value. The single detection of chromium by B&R Environmental in 1996 was well below both the screening value and the previous concentration at the same location.

Copper was detected 22 times in monitoring wells at IR 1 between 1986 and 1996. Of those 22 detections, 4 exceeded the selected screening value (1,000 µg/L). These maximum concentrations were detected in 1990 and 1993 at I1MW1-3 (10,200 µg/L), I1MW1-2 (9,520 µg/L), I1MW-5 (3,570 µg/L), and I1KWM-02 (3,360 µg/L). Copper was detected at other monitoring wells by other investigations but at

concentrations less than the screening value. In general, concentrations increased from 1986 levels in 1990 and 1993, then decreased in 1996.

Iron was detected 13 times in monitoring wells between 1990 and 1996. Of these 13 detections, eight exceeded the 300 µg/L screening value. Maximum concentrations were detected in 1990 at I1MW1-2 (155,000 µg/L), I1KWM-02 (89,500 µg/L), and I1MW1-3 (81,000 µg/L). All other detections were less than 10,000 µg/L.

Lead was detected 16 times in monitoring wells at IR 1 between 1990 and 1996. Of those 16 detections, 15 exceeded the selected screening value (15 µg/L). Maximum concentrations were detected in 1990 and 1993 at I1MW1-2 (5,700 µg/L), I1MW1-3 (4,360 µg/L), I1KWM-02 (4,140 µg/L), I1MW-5 (2,170 µg/L), I1MW-3 (774 µg/L), and I1MW-1 (300 µg/L). Concentrations were less than 300 µg/L at other sampling locations. The single occurrence of lead in 1996 samples was in excess of the screening value, but was reduced 99.6 percent from the 1990 level at the same location and 80 percent from the 1993 level.

Manganese was detected 15 times in monitoring wells at IR 1 between 1990 and 1996. Of those 15 detections, seven exceeded the selected screening value (50 µg/L). Maximum concentrations were detected in 1990 and 1993 at I1MW1-2 (2,940 µg/L), I1KWM-02 (1,360 µg/L), I1MW1-3 (921 µg/L), and I1MW1-2 (657 µg/L). Concentrations were less than 150 µg/L at other sampling locations. Manganese was detected in seven wells in 1996, although only one 1996 detection exceeded the screening value. Although 1996 levels were generally lower that past concentrations, two of the 1996 detections were in wells where manganese had not been previously detected (I1MW-3 and I1MW-5). The 1996 concentration in I1KWM-01 increased slightly from the 1990 concentration, although it was still well below the screening value.

Mercury was detected 17 times in monitoring wells at IR 1 between 1986 and 1996. Of those 17 detections, 10 exceeded the selected screening value (2 µg/L). Maximum concentrations were detected in 1986 at I1KWM-02 (640 µg/L), I1KWM-03 (120 µg/L), I1KWM-01 (55 µg/L), and I1KWM-04 (46 µg/L). Concentrations were less than 20 µg/L at other sampling locations. The two 1996 detections were well below the screening level and were reduced from previous concentrations at the same locations.

Nickel was detected seven times in monitoring wells at IR 1 between 1990 and 1996. Of those seven detections, three exceeded the selected screening value (100 µg/L). The maximum concentrations were detected in 1990 and 1993 at I1MW1-2 (303 µg/L), I1MW1-3 (277 µg/L), and I1MW-5 (196 µg/L). Nickel was detected twice in 1996, but both detections were well below the screening values.

Selenium was detected in two monitoring wells in 1996. One detection I1MW1-1 (54.6 µg/L) slightly exceeded the selected screening value (50 µg/L). Selenium was not detected in any other monitoring well by any other investigation.

Vanadium was detected 16 times in monitoring wells at IR 1 between 1990 and 1996. Of those 16 detections, seven exceeded the selected screening value (49 µg/L). Maximum concentrations were detected in 1990 and 1993 at I1MW1-2 (116 µg/L), I1MW1-3 (114 µg/L), and I1MW-5 (100 µg/L). Concentrations were less than 100 µg/L at other sampling locations.

Zinc was detected 18 times in monitoring wells at IR 1 between 1990 and 1996. Of those 18 detections, 4 exceeded the secondary selected screening value (5,000 µg/L). The maximum concentrations were detected in 1990 and 1993 at I1MW1-2 (15,200 µg/L), I1MW-5 (11,300 µg/L), I1MW1-3 (10,400 µg/L), and I1MW-02 (7,320 µg/L). Zinc was detected at other monitoring wells but at concentrations less than the screening value. The three 1996 detections of zinc were well below the screening value and were reduced from previous concentrations at the same locations.

Other inorganics, including cobalt, silver, and tin were detected in groundwater at IR 1 but were below their respective screening values.

5.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at IR 1. Section 5.5.1 presents those chemicals detected in excess of the screening values discussed in the nature and extent sections, along with apparent temporal and spatial trends. Section 5.5.2 addresses potential routes of migration, and Section 5.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. Section 3.1.5.1 of Appendix C quantifies the physical and chemical properties of the detected contaminants.

5.5.1 Contaminant Summary and Trends

IR 1 is located along the southern shore of Truman Annex on Key West (see Figure 5-1). The site covers an area of approximately 7 acres, including a Navy antenna field and an area to the immediate north of the antenna field. The Atlantic Ocean shoreline lies around the south half of IR 1 and has erosion protection consisting of large concrete rubble and debris. From 1952 until the mid-1960s IR 1 was used for general refuse disposal and open burning. No restrictions were placed on the types of wastes disposed at the

site. General refuse, waste paint thinners, and solvents may have been disposed of at the site. In 1995, BEI conducted an interim remedial action (IRA) that involved the removal of 4,878 cubic yards of lead-contaminated soil from the area shown in Figure 5-1 for offsite treatment and disposal. Excavated areas were backfilled with clean fill. This IRA reduced the highest lead concentrations in soil from 35,200 ppm to 680 ppm.

Surface soil samples were collected from IR 1 either on a uniform grid pattern across the site, or in the case of the soil removed during the IRA, surface soil samples were collected around the boundary of the excavation (see Figure 5-2). Subsurface soil samples were collected at a depth of 1 foot outside the southwest corner of the area excavated during the IRA (see Figure 5-6). Sediment and surface-water samples were collected in the vicinity of the shoreline between IR 1 and the Atlantic Ocean (see Figures 5-3 and 5-4). And finally, groundwater samples were collected from monitoring wells installed throughout the site as shown in Figure 5-5. Metals and pesticides were the most widespread contaminants detected at IR 1. However, SVOCs and VOCs were present in sediment and groundwater and PCBs were also present in sediment.

Section 5.4.2.5 describes the 16 metals detected in excess of the selected nature and extent screening levels in surface soil at IR 1. Figures 5-7, 5-8, and 5-9 show the wide distribution of the metals contamination in surface soil covering most of the site. However, no metals in excess of the selected nature and extent screening levels were detected in the surface soil at the northern part of the site, south of the ammunition bunker, and near the northeast radio towers. Similar to the surface soil, the subsurface soil located in the southwest corner of IR 1 contained concentrations of the metals including antimony, arsenic, chromium, copper, lead, manganese, mercury, nickel, and zinc in excess of the selected nature and extent screening levels. Thallium was an exception for the subsurface soil in that it occurred in excess of the selected nature and extent screening levels in the subsurface soil but did not exceed the selected nature and extent screening levels in the other media (see Section 5.4.1.5 for a complete discussion). The sediment along the shoreline also had levels of arsenic, copper, iron, lead, mercury, and zinc in excess of the selected nature and extent screening levels. Other metals present in the sediment in excess of screening values included barium and cadmium. Finally, the inorganic compound, cyanide, was also found in excess of the selected nature and extent screening levels in one sediment sampling location (see Section 5.4.3.5).

Antimony was present in excess of the selected nature and extent screening values in all six of the surface-water samples collected. Tin was the only other inorganic found in surface water (in just two sample locations) in excess of the selected nature and extent screening values. In 1996, the only metals detected in groundwater at IR 1 in excess of the selected nature and extent screening values were

antimony, lead, manganese, and selenium. However, as discussed in Section 5.4.5.5, a total of 15 metals have been detected in excess of the selected nature and extent screening levels in groundwater at IR 1 since 1986.

Although many pesticides were detected in sediment and groundwater in excess of the selected nature and extent screening levels along the shoreline of the southern half of IR 1, no pesticides were present in excess of the selected nature and extent screening levels in the surface water along the shoreline. 4,4'-DDT and 4,4'-DDE were the pesticides most frequently detected in excess of the selected nature and extent screening values in sediment and the highest concentrations generally occurred in the 1996 samples. These two compounds were both detected in excess of nature and extent screening values at I1SB-2, a subsurface soil sample from the southwestern corner of the site. Prior to 1996, pesticides were detected in groundwater from only one well at IR 1. In 1996, pesticide compounds were detected in a number of wells. Dieldrin was the pesticide compound most frequently detected in groundwater in excess of screening values. Sections 5.4.3.3 and 5.4.5.3 further describe the 9 pesticides detected in sediment and the 9 pesticides detected in groundwater at IR 1 in excess of the selected nature and extent screening levels.

PCBs were also detected in sediment and subsurface soil in excess of screening levels but did not occur in any other media. Aroclor-1260 was the most common and widespread PCB mixture and was detected in excess of the selected nature and extent screening levels in 14 of the 16 sediment samples (see Section 5.4.3.4 for a complete discussion). There were two subsurface soil detections of PCBs. Both exceeded the selected nature and extent screening values and both occurred at the same location, I1SB-2, in the southwestern corner of the site.

Similar to PCBs, SVOCs in excess of the selected nature and extent screening values were mostly detected in sediment (however, testing for VOCs/SVOCs was performed only on a limited number of samples, if at all, in the other media at IR 1). With the exception of two SVOCs detected in a 1996 sediment sample, SVOC detections were limited to 1990 sediment samples. Phenanthrene was the only SVOC that was also present in groundwater in excess of the selected nature and extent screening levels (at only one monitoring well location). No SVOCs were detected in surface water at IR 1. As shown in Figure 5-10 and discussed in Section 5.4.3.2, the SVOCs in sediment are localized in nature but distributed in distinct areas along the shoreline. A number of SVOCs (14 compounds) were detected in excess of the selected nature and extent screening values in a single subsurface soil sample. None were detected in the other subsurface soil sample tested for SVOCs.

The VOCs, benzene, methylene chloride, and trichloroethene were detected once in 1986 in excess of groundwater screening levels. No VOCs were detected in groundwater in the later investigations. Another VOC, acetone, was detected in excess of screening levels at one sediment sampling location at the south edge of IR 1. No VOCs exceeded the selected nature and extent screening values in any of the surface-water samples. Five VOCs were detected in one of the three subsurface soil samples that underwent VOC analysis. None approached the selected nature and extent screening values.

5.5.2 Potential Routes of Migration

The major contaminant source at IR 1 is soil and buried debris in the former disposal area. As discussed earlier, a large portion of these soils have been removed and backfilled. Constituents in the soil could have volatilized from surficial material or become airborne via resuspension during disposal activities. Contaminated fugitive dust could have been generated during ground-disturbing activities, such as during historical disposal activities, causing possible contaminant dispersion in the surrounding environment and transportation to downwind locations where they could have repartitioned to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition.

However, volatilization, wind erosion, and overland runoff from the disposal area no longer exist to an appreciable degree since surface soil for most of the disposal area was excavated. After excavation, the remediated area was backfilled and re-sodded. As a result, the site is heavily covered with turfgrass. For these reasons, the surface soil migration pathway has been somewhat diminished. Runoff prior to the excavation most likely carried surface soil contaminants into ocean surface water and sediments and runoff of contaminants from remaining soil may be occurring. In addition, offsite sediments carried along the shoreline into IR 1 by sediment transport through wave action may be another possible source of contaminants detected in the sediments. Discharge of contaminants in groundwater to ocean surface water and sediments is also a major migration route at IR 1.

5.5.3 Contaminant Transport Potential and Persistence

Inorganics were the predominant contaminants at IR 1 with concentrations in excess of screening levels in the soil, sediment, groundwater, and to a limited degree, surface water. It was noted, however, that the number and degree of inorganic contaminants in groundwater were greatly reduced in 1996 consistent with the goal of the IRA to remove the source of contaminated soils at IR 1 resulting in reduced contaminant concentrations in groundwater. Pesticides, SVOCs, and VOCs were also found in excess of screening levels in sediment and sporadically in groundwater and subsurface soil. Finally, PCBs were

also present in excess of screening levels in the sediment and subsurface soil along the shoreline of IR 1 with the Atlantic Ocean.

In general, metals are absorbed onto soil and organic matter, greatly reducing both mobility and potential for transport in the aqueous phase. Although in the case of IR 1, geotechnical data collected during the preliminary RI detected only low levels of organic matter in soil which would lower the ability of these soils to attenuate metals. However, the high pH (8.15) of soil and rock at IR 1 would counteract the low organic content by reducing the mobility of most metals (e.g., iron, copper, and zinc). The transport of lead in the environment is strongly influenced by the speciation of the ion. Since sorption appears to exert a dominant effect on the distribution of lead in the environment, lead is strongly complexed to organic materials in soil (Clement Associates, 1985). Although sorption tends to reduce the mobility of inorganics in the subsurface, strong associations with soil particles may increase the persistence of inorganic contamination. Contaminants that persist in the solid media may also continue to be present in groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations would remain low.

Pesticides were also commonly detected in sediment along the shoreline at IR 1 (e.g., 4,4'-DDT and 4,4'-DDE) and sporadically in the groundwater beneath IR 1 (e.g., dieldrin) in excess of screening levels. The pesticides are not expected to migrate significantly due to (1) the relatively low solubility of pesticides in water, (2) low vapor pressures, (3) low Henry's Law constants, and especially (4) soil and sediment/water partition coefficients that strongly favor soil and sediment sorption. However, sediment transport by wave action could disperse the pesticide contamination along the shoreline. As shown in Appendix C, pesticides are some of the most immobile and persistent of environmental organic contaminants. For example, the half-lifes for the biodegradation in groundwater of 4,4'-DDT and 4,4'-DDE can be as long as 31 years (i.e., for groundwater under anaerobic conditions) while the half-life for dieldrin could be 6 years (Howard et al. 1991).

For the same reasons as pesticides, PCBs are also some of the most immobile and persistent of environmental organic contaminants. However, in the environment, the composition of PCBs may differ from the commercial mixtures (e.g., Aroclor-1248, -1254, and -1260). This difference occurs because after release into the environment, the composition of PCB mixtures change over time, through partitioning, chemical transformation, and preferential bioaccumulation (EPA, 1996). The efficiency of these mechanisms often depend on the chlorine content of the PCB mixture or congener. Of the PCB mixtures detected in excess of screening levels, Aroclor-1260 is the most highly chlorinated with an average chlorine content of 60 percent. Aroclor-1254 has 54 percent chlorine while Aroclor-1248 would have the lowest average chlorine content of 48 percent.

Partitioning in the environment of PCB congeners would be by adsorption of PCBs to organic materials, sediments, and soils. This behavior tends to increase with chlorine content of the PCBs and organic content of the other material. Volatilization and solubility of the lower chlorinated congeners (e.g., the PCB congeners present in Aroclor-1248) would occur while limited volatilization and solubility of the higher chlorinated congeners would take place (e.g., the PCB congeners present in Aroclor-1260). During biodegradation of PCBs, anerobic bacteria in sediments selectively remove chlorines from meta and para positions of the PCB congener appearing to reduce the toxicity and bioaccumulation potential of residues. Aerobic bacteria break open the carbon rings through oxidation and also remove chlorines; however, aerobic biodegradation occurs mostly with PCBs containing lower percentages of chlorine (e.g., PCB congeners found in Aroclor-1248 and other congeners that typically contain 1 to 4 chlorines). Photolysis can also slowly break down congeners with high chlorine content.

Eight non-chlorinated SVOCs were also found in sediment at concentration levels in excess of screening values [i.e., acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, phenathrene, and pyrene]. Fourteen SVOCs were detected in a single subsurface soil sample at concentrations in excess of selected nature and extent screening values. Similar to the same reasons as pesticides (i.e., relatively low solubility in water, low vapor pressures, low Henry's Law constants, and high sediment/water partition coefficients), these SVOCs are also relatively immobile in the solid media unless transported under wave action. Biodegradation of these contaminants is more rapid than for pesticides (i.e., in groundwater under anaerobic conditions), with half-lives ranging from a year or less up to a maximum of 6 years for chrysene and 10 years for pyrene (Howard et al. 1991).

The localized VOCs present in excess of screening levels in groundwater (benzene, methylene chloride, and trichloroethene) and sediment (acetone) are considered to be much more mobile than pesticides, PCBs, and SVOCs in the environment due to their (1) higher solubility in water, (2) higher vapor pressures, (3) Henry's Law constants, and (4) relatively lower soil and sediment/water partition coefficients (see Appendix C). However, the persistence of these chemicals is low (generally as short as a few days to a year) due to the relatively high biodegradation rates.

5.6 BASELINE HUMAN HEALTH RISK ASSESSMENT - IR 1

This section presents the baseline human health risk assessment for IR 1. It describes a qualitative and quantitative assessment of actual or potential risks for IR 1. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and remedial goal options. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 3.1.7.8.

5.6.1 Preliminary Risk Evaluation

A PRE was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 5-6 and 5-7 summarize the preliminary risk evaluation for IR 1 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratio calculated assuming an industrial land use scenario is less than 1E-04 for carcinogenic effects. The risk ratio calculated assuming an industrial land use scenario is greater than 1.0 for noncarcinogenic effects. The risk ratios calculated assuming a residential land use scenario is greater than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. Thus, a baseline human health risk assessment is necessary for IR 1. The preliminary contributor to the carcinogenic risk is arsenic in soil. The preliminary contributors to noncarcinogenic HIs are aluminum, antimony, arsenic, cadmium, chromium VI, copper, iron, manganese, mercury, and zinc in soil; antimony, arsenic, iron, and manganese in sediment; and antimony in surface water. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

5.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

5.6.2.1 Soils

Several metals were detected in one or more of the surface soil and subsurface soil samples collected at IR 1. The occurrence and distribution of inorganic chemicals in surface and subsurface soils are presented in Tables 5-8 through 5-9. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in IR 1 soils are also presented in these tables.

TABLE 5-6

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
IR 1
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	44.7	12.1	ND	0.43	0.43	0.045	3.8	1E-04	3E-05	NA	1E-05
Beryllium	0.26	0.14	ND	0.15	0.15	0.016	1.3	2E-06	9E-07	NA	2E-07
PESTICIDES/PCBs											
4,4'-DDD	ND	29.4	ND	2,700	2,700	0.28	24,000	NA	1E-08	NA	NA
4,4'-DDE	ND	296	ND	1,900	1,900	0.2	17,000	NA	2E-07	NA	NA
4,4'-DDT	ND	711	ND	1,900	1,900	0.2	17,000	NA	4E-07	NA	NA
alpha-BHC	ND	0.85	ND	100	100	0.011	910	NA	9E-09	NA	NA
Aroclor-1248	ND	120	ND	319	319	0.0335	2,860	NA	4E-07	NA	NA
Aroclor-1254	ND	669	ND	319	319	0.0335	2,860	NA	2E-06	NA	NA
Aroclor-1260	ND	18,260	ND	319	319	0.0335	2,860	NA	6E-05	NA	NA
beta-BHC	ND	20	ND	350	350	0.037	3,200	NA	6E-08	NA	NA
Dieldrin	ND	13.6	ND	40	40	0.0042	360	NA	3 E-07	NA	NA
gamma-BHC (lindane)	ND	3.3	ND	490	490	0.052	4,400	NA	7E-09	NA	NA
Heptachlor	ND	18.9	ND	140	140	0.0023	1,300	NA	1E-07	NA	NA
Heptachlor epoxide	ND	1.5	ND	70	70	0.0012	630	NA	2E-08	NA	NA
SEMIVOLATILE ORGANIC COMPOUNDS											
Benzo(a)anthracene	ND	230	ND	880	880	0.092	7,800	NA	3-07	NA	NA
Benzo(a)pyrene	ND	180	ND	88	88	0.0092	780	NA	2E-06	NA	NA
Benzo(b)fluoranthene	ND	200	ND	880	880	0.092	7,800	NA	2E-07	NA	NA
Benzo(k)fluoranthene	ND	200	ND	8,800	8,800	0.92	78,000	NA	2E-08	NA	NA
Bis(2-ethylhexyl)phthalate	ND	480	ND	460,00	46,000	4.8	410,000	NA	1E-08	NA	NA
Chrysene	ND	300	ND	88,000	88,000	9.2	780,000	NA	3E-09	NA	NA
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	ND	11	1	85,000	85,000	4.1	760,000	NA	1E-10	2E-07	NA
							Risk Sums by Medium	**1E-04**	**9E-05**	**2E-07**	**1E-05**
							Risk Sums by Use Scenario	**2E-04**			**1E-05**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 5-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
IR 1
NAS KEY WEST
PAGE 1 OF 2

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	12,200	6,170	47.1	78,000	78,000	37,000	1,000,000	2E+00	8E-01	1E-02	1E-01
Antimony	163	6.8	270	31	31	15	820	5E+01	2E+00	2E+02	2E+00
Arsenic	44.7	12.1	ND	23	23	11	610	2E+01	5E+00	NA	7E-02
Barium	284	40.5	6	5,500	5,500	2,600	140,000	5E-01	7E-02	2E-02	2E-02
Beryllium	0.26	0.14	ND	390	390	180	1,000	7E-03	4E-03	NA	3E-03
Cadmium	3.6	1.1	ND	39	39	18	1,000	9E-01	3E-01	NA	4E-02
Chromium VI	153	17.2	ND	390	390	180	10,000	4E+00	4E-01	NA	2E-01
Cobalt	5.5	5.3	ND	4,700	4,700	2,200	120,000	1E-02	1E-02	NA	5E-04
Copper	2,250	132	ND	3,100	3,100	1,500	82,000	7 E+00	4E-01	NA	3E-01
Cyanide	ND	13	ND	1,600	1,600	730	41,000	NA	8E-02	NA	NA
Iron	45,200	32,600	37.8	23,000	23,000	11,000	610,000	2E+01	1E+01	3E-02	7E-01
Manganese	372	295	ND	1,800	1,800	840	47,000	2E+00	2E+00	NA	8E-02
Mercury	9.3	0.15	ND	23	23	11	610	4E+00	7E-02	NA	2E-01
Nickel	49.1	12	ND	1,600	1,600	730	41,000	3E-01	8E-02	NA	1E-02
Selenium	0.53	ND	ND	390	390	180	10,000	1E-02	NA	NA	5E-04
Silver	5.1	0.33	ND	390	390	180	10,000	1E-01	9E-03	NA	5E-03
Tin	ND	64.1	134	47,000	47,000	22,000	1,000,000	NA	1E-02	6E-02	NA
Vanadium	20.2	14	ND	550	550	2,600	14,000	4E-01	3E-01	NA	1E-02
Zinc	3,240	484	9.4	23,000	23,000	11,000	610,000	1E+00	2E-01	9E-03	5E-02
PESTICIDES/PCBs											
2,4-D	ND	21.4	ND	780,000	780,000	61	20,000,000	NA	3E-04	NA	NA
4,4'-DDT	ND	711	ND	39000	39000	18	1,000,000	NA	2E-01	NA	NA
Aroclor-1254	ND	669	ND	1,600,000	1,600,000	0.73	41,000	NA	4E+00	NA	NA
Dieldrin	ND	13.6	ND	3,900	3,900	1.8	100,000	NA	4E-02	NA	NA
Endosulfan I	ND	256	ND	4,700,00	4,700,00	220	12,000,000	NA	5E-03	NA	NA
Endosulfan II	ND	83	ND	470,000	470,000	220	12,000,000	NA	2E-03	NA	NA
Endosulfan sulfate	ND	341	ND	470,000	470,000	220	12,000,000	NA	7E-03	NA	NA
Endrin	ND	1,462	ND	23,000	23,000	11	610,000	NA	6E-01	NA	NA
Endrin aldehyde	ND	380.5	ND	23,000	23,000	11	610,000	NA	2E-01	NA	NA
gamma-BHC (lindane)	ND	3.3	ND	39,000	39,000	180	610,000	NA	9E-04	NA	NA
Heptachlor	ND	18.9	ND	39,000	39,000	18	1,000,000	NA	5E-03	NA	NA
Heptachlor epoxide	ND	1.5	ND	1,000	1,000	0.47	27,000	NA	2E-02	NA	NA

TABLE 5-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
IR 1
NAS KEY WEST
PAGE 2 OF 2

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	ND	480	ND	1,600,000	1,600,000	730	41,000,000	NA	3E-03	NA	NA
Fluoranthene	ND	400	ND	3,100,000	3,100,000	1,500	82,000,000	NA	1E-03	NA	NA
Pyrene	ND	400	ND	2,300,000	2,300,000	1,100	61,000,000	NA	2E-03	NA	NA
VOLATILE ORGANIC COMPOUNDS											
1,2-dichloroethene	ND	3	ND	700,000	700,000	55	18,000,000	NA	4E-05	NA	NA
2-butanone	ND	16	ND	47,000,000	47,000,000	1,900	1,000,000,000	NA	3E-06	NA	NA
Acetone	ND	150	8	7,800,000	7,800,000	3,700	200,000,000	NA	2E-04	2E-02	NA
Methylene chloride	ND	11	1	4,700,000	4,700,000	260	120,000,000	NA	2E-05	4E-02	NA
Toluene	ND	4	ND	16,000,000	16,000,000	750	410,000,000	NA	3E-06	NA	NA
Xylenes (total)	ND	3	ND	160,000,000	160,000,000	12,000	1,000,000,000	NA	2E-07	NA	NA
Hazard Sums by Medium								**1E+02**	**3E+01**	**2E+02**	**2E+00**
Hazard Sums by Use Scenario								**3E+02**			**2E+00**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 5-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT IR 1 (mg/kg) 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	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	14/14	120 - 4,250	1,887	35/35	247 - 12,200	1,273	1,273	7,800	1,450	Y	C
Antimony	2/15	0.26 - 0.48	0.39	35/35	0.17 - 203	14.01	14.01	3.1	32.8	Y	C
Arsenic	6/15	0.63 - 2.7	1.29	83/83	0.81 - 44.7	3.16	3.16	0.43	3.32	Y	C
Barium	15/15	4.4 - 17.7	10.51	35/35	7.1 - 163	38.07	38.07	550	49.8	N	A
Beryllium	2/15	0.13 - 0.15	0.05	32/35	0.01 - 0.26	0.06	0.06	0.15	0.086	Y	C
Cadmium	4/15	0.11 - 0.45	0.15	33/35	0.11 - 3.6	0.83	0.79	3.9	1.17	N	A
Chromium**	15/15	1.9 - 15.5	6.02	35/35	3.6 - 153	24.79	24.79	7,800	35.4	Y	C
Cobalt	7/15	0.22 - 0.51	0.29	34/35	0.06 - 5.5	1.03	1.01	470	1.56	N	A
Copper	14/15	1.3 - 15.6	5.43	35/35	5.5 - 2,250	473.53	473.53	310	1,620	Y	C
Iron	14/14	98.1 - 2,260	1,167	35/35	524 - 45,200	4,540	4,540	2,300	6,250	Y	C
Lead	14/15	0.65 - 48.3	15.66	85/85	8.2 - 680	175	175	400	264	Y	C
Manganese	14/14	2.6 - 33.7	17.65	35/35	9.3 - 372	62	62	180	84	Y	C
Mercury	5/15	0.03 - 0.08	0.03	35/35	0.02 - 9.3	1.28	1.28	2.3	3.55	Y	C
Nickel	11/15	0.63 - 4.1	1.67	35/35	1 - 49.1	8.18	8.18	160	12.2	N	A
Selenium	5/15	0.46 - 1.8	0.65	15/35	0.08 - 0.53	0.20	0.14	39	0.176	N	A
Silver	0/15	Not detected	–	17/35	0.16 - 5.1	0.98	0.57	39	0.898	N	A
Vanadium	15/15	0.8 - 8.8	3.97	29/35	2 - 20.2	5.65	4.72	55	12	N	A
Zinc	12/15	0.63 - 89.1	15.22	35/35	12.6 - 3,240	440.41	440.41	2,300	916	Y	C

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As chromium VI

TABLE 5-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SUBSURFACE SOILS AT IR 1 (mg/kg) 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	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	14/14	120 - 4,250	1,887	8/8	270 - 6,450	1,440	1,440	100,000	4,790	N	A
Antimony	2/15	0.26 - 0.48	0.39	8/9	1.3 - 49.7	9.56	8.51	82	49.7	N	A
Arsenic	6/15	0.63 - 2.7	1.29	9/9	0.33 - 38	6.48	6.48	3.80	38	Y	C
Barium	15/15	4.4 - 17.7	10.51	9/9	4.9 - 538	78.70	78.70	14,000	393	N	A
Beryllium	2/15	0.13 - 0.15	0.05	8/9	0.03 - 0.23	0.08	0.08	1.30	0.127	Y	C
Cadmium	4/15	0.11 - 0.45	0.15	5/9	0.42 - 15.6	3.61	2.1	100	11.4	N	A
Chromium**	15/15	1.9 - 15.5	6.02	9/9	3.6 - 104	25.20	25.20	1,000	82.6	N	A
Cobalt	7/15	0.22 - 0.51	0.29	7/9	0.32 - 14.5	2.72	2.28	12,000	10	N	A
Copper	14/15	1.3 - 15.6	5.43	8/9	39.7 - 2,360	461.00	410.00	8,200	2,360	N	A
Iron	14/14	98.1 - 2,260	1,167	8/8	343 - 56,900	9,790	9,790	61,000	56,900	N	A
Lead	14/15	0.65 - 48.3	15.66	8/9	15.8 - 3,700	588	523	400	3,700	Y	C
Manganese	14/14	2.6 - 33.7	17.65	8/8	4.2 - 874	149	149	4,700	874	N	A
Mercury	5/15	0.03 - 0.08	0.03	8/9	0.02 - 2	0.72	0.64	61	1.05	N	A
Nickel	11/15	0.63 - 4.1	1.67	9/9	0.89 - 78.4	12.4	12.40	4,100	65.4	N	A
Selenium	5/15	0.46 - 1.8	0.65	1/9	0.4 - 0.4	0.40	0.18	100	0.233	N	A
Thallium	0/15	Not detected	–	1/9	0.45 - 0.45	0.45	0.22	16	16	N	A
Tin	2/5	0.78 - 2.1	1.94	2/2	13.4 - 178	95.70	95.70	100,000	178	N	A
Vanadium	15/15	0.8 - 8.8	3.97	2/9	2.7 - 34.9	18.8	4.4	1,400	34.9	N	A
Zinc	12/15	0.63 - 89.1	15.22	9/9	2.2 - 7,050	978	978	61,000	7,050	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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 industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As Cr VI

TABLE 5-9a

OCCURRENCE, DISTRIBUTION AND SELECTION OF COPCs ORGANICS IN SUBSURFACE SOILS AT IR 1 (µg/kg) NAS KEY WEST

Chemical	Background			Site			Applicable Risk-Based Concentration	Representative Concentration For Site Data	COPC	Basis of COPC Selection*	Average of Detected Values
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average					
PESTICIDES/PCBs											
4,4'-DDD	3/11	2 - 233	26	1/2	92 - 92	48	24,000	92	N	A	92
4,4'-DDE	5/11	1.8 - 741	76.60	2/2	3 - 420	212	17,000	420	N	A	212
4,4'-DDT	7/11	1.8 - 557	56.50	1/2	150 - 150	77	17,000	150	N	A	150
aldrin	0/11	Not detected	–	1/2	26 - 26	14	340	26	N	A	26
Aroclor-1254	0/11	Not detected	–	1/2	3,900 - 3,900	1,970	2,800	3,900	Y	B	3,900
Aroclor-1260	1/11	69 - 69	48.20	1/2	2,000 - 2,000	1,020	2,800	2,000	Y	E	2,000
SEMIVOLATILE ORGANIC COMPOUNDS											
acenaphthene	0/14	Not detected	–	1/2	740 - 740	375	12,000,000	740	N	A	740
benz(a)anthracene	0/14	Not detected	–	1/2	3,200 - 3,200	1,600	7,800	3,200	Y	E	3,200
benzo(a)pyrene	0/14	Not detected	–	1/2	4,300 - 4,300	2,150	780	4,300	Y	A	4,300
benzo(b)fluoranthene	1/14	390 - 390	415.00	1/2	3,400 - 3,400	1,700	7,800	3,400	Y	E	3,400
benzo(g,h,i)perylene	0/14	Not detected	–	1/2	1,800 - 1,800	903	-	1,800	Y	EF	1,800
benzo(k)fluoranthene	0/14	Not detected	–	1/2	3,400 - 3,400	1,700	78,000	3,400	Y	E	3,400
bis(2-ethylhexyl)phthalate	0/0	Not detected	–	1/1	1,800 - 1,800	1,800	410,000	1,800	N	A	1,800
chrysene	1/14	280 - 280	407.00	1/2	4,100 - 4,100	2,050	780,000	4,100	Y	E	4,100
dibenz(a,h)anthracene	0/14	Not detected	–	1/2	560 - 560	283	780	560	Y	E	560
di-n-butylphthalate	1/11	82 - 82	427.00	1/1	500 - 500	500	20,000,000	500	N	A	500
fluoranthene	1/14	660 - 660	434.00	1/2	4,600 - 4,600	2,300	8,200,000	4,600	N	A	4,600
fluorene	0/14	Not detected	–	1/2	650 - 650	328	8,200,000	650	N	A	650
indeno(1,2,3-cd)pyrene	0/14	Not detected	–	1/2	2,300 - 2,300	1,150	7,800	2,300	Y	E	2,300
naphthalene	0/14	Not detected	–	1/2	890 - 890	450	8,200,000	890	N	A	890
phenanthrene	0/14	Not detected	–	1/2	2,700 - 2,700	1,350	-	2,700	Y	F	2,700
pyrene	1/14	470 - 470	421.00	1/2	3,400 - 3,400	1,700	6,100,000	3,400	N	A	3,400
VOLATILE ORGANIC COMPOUNDS											
2-butanone	0/0	Not detected	–	1/1	2 - 2	2.00	100,000,000	2	N	A	2
carbon disulfide	0/12	Not detected	–	1/1	3 - 3	3.00	20,000,000	3	N	A	3
ethylbenzene	1/15	0.31 - 0.31	1.58	1/3	2 - 2	1.47	20,000,000	2	N	A	2
methylene chloride	6/12	0.11 - 14	2.80	1/3	30 - 30	16.20	760,000	30	N	A	30
toluene	1/15	1 - 1	1.62	1/3	2 - 2	1.47	41,000,000	2	N	A	2

Notes:

Units are mg/kg for inorganics, ug/kg for organics.

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 10-6 cancer risk level or a non-cancer hazard index of 0.1.

Applicable RBCs originate from EPA Region 3 RBCs for industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC); B - COPC (Max>RBC, organics); C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics); D - Not COPC (nut./mineral); E - COPC - (same family);
F - COPC (eval. qual.); G - Not COPC (Max>RBC & Max<2XBkgdAvg)

**As Cr VI

The following chemicals were selected as COPCs at IR 1 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
Aluminum	None Sampled	Arsenic	Aroclor-1254
Antimony		Beryllium	Aroclor-1260
Arsenic			Benzo(a)anthracene
Beryllium			Benzo(a)pyrene
Chromium			Benzo(b)fluoranthene
Copper			Benzo(g,h,i)perylene*
Iron			Benzo(k)fluoranthene
Lead*			Dibenzo(a,h)anthracene
Manganese			Chrysene
Mercury			Indeno(1,2,3-cd)pyrene
Zinc			Phenanthrene*

Lead, identified with an asterisk (*), will be evaluated using the Integrated Exposure and Uptake Biokinetic (IEUBK) Lead Model (v. 0.99) for surface soils only.

Metals were detected in surface soil at IR 1 at high frequencies (i.e., detected in greater than 85 percent of the samples analyzed, except silver and selenium). The maximum and representative concentrations for these metals generally exceed RBCs developed for the land use scenario for surface soils. Lead will be evaluated quantitatively using the IEUBK model (v. 0.99). Metals were detected in subsurface soil at IR 1 at high frequencies (i.e., detected in greater than 85 percent of the samples analyzed, except cadmium). Only arsenic and beryllium concentrations exceeded industrial RBCs for subsurface soils.

Two PCBs, Aroclor-1254 and Aroclor-1260, were detected in one subsurface soil sample at concentrations of 3,900 µg/kg and 2,000 µg/kg, respectively. Aroclor-1254 and Aroclor-1260 both exceeded applicable soil RBC values and were selected as COPCs. Several PAHs were detected in one subsurface soil sample. Benzo(a)pyrene (3,400 µg/kg) was the only COPC that exceeded RBC values; however, all other carcinogenic PAHs were selected as COPCs because they are chemically and toxicologically similar to benzo(a)pyrene. Phenanthrene and benzo(g,h,i)perylene [marked by asterisks (*) above] do not have established toxicity values and, therefore, will be evaluated qualitatively in the uncertainty section.

5.6.2.2 Sediment and Surface Water

Several VOCs, SVOCs, pesticides, and metals were detected in one or more of the sediment samples collected at IR 1. Acetone, methylene chloride, and metals were detected in surface-water samples collected at IR 1. The occurrence and distribution of chemicals in sediment and surface water is presented in Tables 5-10 through 5-13. Summary statistics COPC selection results and representative concentrations for chemicals detected in IR 1 in sediment and surface water are also presented in these tables.

TABLE 5-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
INORGANICS IN SEDIMENT AT IR 1 (mg/kg)
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	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	12/12	97.7 - 3,350	1,332	12/12	72.4 - 6,170	1,044	1,044	7,800	2,920	N	A
Antimony	0/13	Not detected	–	1/16	6.8 - 6.8	6.80	1.66	3.1	3.5	Y	C
Arsenic	8/12	1.5 - 7	2.63	15/16	0.92 - 12.1	4.59	4.41	0.43	6.81	Y	C
Barium	13/13	5 - 15.2	9.27	16/16	3.3 - 40.5	10.48	10.48	550	14.9	N	A
Beryllium	1/13	0.12 - 0.12	0.06	1/16	0.14 - 0.14	0.14	0.05	0.15	0.095	N	A
Cadmium	3/13	0.06 - 0.9	0.22	1/16	1.1 - 1.1	1.1	0.27	3.9	0.662	N	A
Chromium**	8/13	2.1 - 11.7	5.01	13/16	4.2 - 17.2	7.7	6.64	39	10.1	N	A
Cobalt	2/13	0.12 - 0.56	0.47	4/16	1.35 - 5.3	3.04	1.45	470	4.4	N	A
Copper	13/13	0.76 - 34.6	8.88	16/16	9.4 - 132	34.65	34.65	310	55.2	N	A
Cyanide	0/13	Not detected	–	1/12	13 - 13	13	2	160,000	13	N	A
Iron	12/12	109 - 3,640	1,199	12/12	387 - 32,600	8,460	8,460	2,300	32,100	Y	C
Lead	12/13	5.5 - 56.5	17.97	16/16	15.3 - 226	71	71	400	113	N	A
Manganese	12/12	4 - 38.6	15.39	12/12	7.3 - 295	73.24	73.24	180	212	Y	C
Mercury	4/13	0.04 - 0.07	0.05	15/16	0.04 - 0.15	0.07	0.07	2.3	0.103	N	A
Nickel	10/13	0.7 - 5.5	2.15	10/16	1 - 12	4.89	3.56	160	5.95	N	A
Silver	1/13	0.5 - 0.5	0.27	1/16	0.33 - 0.33	0.33	0.42	39	0.33	N	A
Tin	1/2	0.99 - 0.99	2.85	4/6	9.3 - 64.1	26	19.56	4,700	64.1	N	A
Vanadium	13/13	1.6 - 11.7	5.08	13/16	0.73 - 14	6.13	5.13	55	12	N	A
Zinc	8/13	3.5 - 140	25.74	16/16	1.1 - 484	100.45	100.45	2,300	449	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Sediment RBCs are adapted using residential soil RBC.

*A - Not COPC (Max<RBC)

**C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As chromium VI

TABLE 5-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
ORGANICS IN SEDIMENT AT IR 1 (µg/kg)
NAS KEY WEST
PAGE 1 OF 2

Chemical	Background			Site				Applicable Risk-Based Concentration	Representative Concentration For Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values				
PESTICIDES/PCBs											
2,4-D	1/10	24.7 - 24.7	39.15	1/7	21.4 - 21.4	21.4	4.19	78,000	18.4	N	A
4,4'-DDD	1/12	3.9 - 3.9	13.03	5/15	2.5 - 29.4	8.42	39.07	2,700	29.4	N	A
4,4'-DDE	5/12	2.2 - 149	19.85	15/16	3.2 - 296	41.54	39.73	1,900	96.2	N	A
4,4'-DDT	1/12	3.7 - 3.7	13.02	12/15	4.6 - 711	98.50	99.20	1,900	415	N	A
alpha-BHC	3/11	1.1 - 1.5	7.11	1/16	0.85 - 0.85	0.85	10.17	100	0.85	N	A
Aroclor-1248	0/9	Not detected	–	1/16	120 - 120	120	79.15	320	120	Y	E
Aroclor-1254	0/9	Not detected	–	2/16	220 - 669	444.50	173.96	320	669	Y	B
Aroclor-1260	1/15	40.8 - 40.8	70.57	14/16	24.1 - 18,260	2,676	2,353.69	320	18,300	Y	B
beta-BHC	1/15	Not detected	–	1/16	20 - 20	20	11.38	350	20	N	A
delta-BHC	2/12	2.8 - 15.7	7.35	1/16	1 - 1	1	10.78	–	1	Y	F
Dieldrin	0/12	Not detected	–	4/16	2.4 - 13.6	7.75	32.57	40	13.6	N	A
Endosulfan I	3/12	1.2 - 2.7	6.7	7/16	1.7 - 256	44.57	24.74	47,000	51.1	N	A
Endosulfan II	0/9	Not detected	–	1/16	83 - 83	83	33.79	47,000	83	N	A
Endosulfan sulfate	0/9	Not detected	–	2/15	0.84 - 341	170.92	32.79	47,000	123	N	A
Endrin	1/12	1.4 - 1.4	12.89	7/15	1.2 - 1,462	224.90	117.72	2,300	460	N	A
Endrin aldehyde	0/8	Not detected	–	2/10	89 - 380.5	234.75	75.65	2,300	381	N	A
gamma-BHC (lindane)	4/12	1.2 - 2.1	6.72	4/16	0.78 - 3.3	1.95	10.65	490	3.3	N	A
Heptachlor	2/12	1.1 - 1.3	6.51	5/16	0.76 - 18.9	6.13	11.44	140	18.9	N	A
Heptachlor epoxide	0/9	Not detected	–	2/16	1.2 - 1.5	1.35	17.51	70	1.5	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Acenaphthylene	0/13	Not detected	–	1/12	75 - 75	75	458.46	–	75	Y	F
Benzo(a)anthracene	0/13	Not detected	–	3/12	120 - 230	173.33	362.21	880	230	Y	E
Benzo(a)pyrene	0/13	Not detected	–	2/12	130 - 180	155	419.71	88	180	Y	B
Benzo(b)fluoranthene	1/13	489 - 489	966.92	3/12	160 - 200	180	363.88	880	200	Y	E
Benzo(k)fluoranthene	0/13	Not detected	–	3/12	160 - 200	183.33	364.71	8,800	200	Y	E
Bis(2-ethylhexyl)phthalate	1/6	4,500 - 4,500	1,992.17	3/5	390 - 480	433	730	46,000	480	N	A
Chrysene	1/13	417 - 417	961.38	3/12	190 - 300	247	381	88,000	300	Y	E
Fluoranthene	1/13	690 - 690	982.38	4/12	250 - 400	322.25	403.13	310,000	400	N	A
Phenanthrene	0/13	Not detected	–	3/12	110 - 220	163.33	359.71	–	220	Y	F
Pyrene	1/13	509 - 509	968.46	4/12	250 - 400	324	404	230,000	400	N	A

TABLE 5-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
ORGANICS IN SEDIMENT AT IR 1 (µg/kg)
NAS KEY WEST
PAGE 2 OF 2

Chemical	Background			Site				Applicable Risk-Based Concentration	Representative Concentration For Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values				
VOLATILE ORGANIC COMPOUNDS											
1,2-dichloroethene	0/1	Not detected	–	2/5	2 - 3	2.5	2.50	70,000	2.91	N	A
2-butanone	1/6	4 - 4	8.49	2/5	14 - 16	15	9.30	4,700,000	16	N	A
Acetone	3/6	4 - 120	30.9	2/5	130 - 150	140	59.30	780,000	150	N	A
Methylene chloride	2/6	5 - 20	7.5	5/5	2 - 11	6	6.00	85,000	11	N	A
Toluene	2/13	3.5 - 16.9	4.49	2/5	2 - 4	3	3.00	1,600,000	4	N	A
Xylenes, total	0/13	Not detected	–	1/5	3 - 3	3	2.90	16,000,000	3	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
Sediment RBCs are adapted using residential soil RBC.
Applicable RBCs originate from EPA Region 3 RBCs for residential exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)
B - COPC (Max > RBC, organics)
E - COPC - (same family)
F - COPC (eval. qual.)

TABLE 5-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
INORGANICS IN SURFACE WATER AT IR 1 (µg/L)
NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values				
Aluminum	2/12	25 - 148	25	1/2	47.1 - 47.1	47.1	34	–	47	Y	
Antimony	4/12	3.5 - 205	33.71	6/6	236 - 270	252.67	252.67	14	264	N	
Barium	11/13	4.7 - 16.3	6.88	6/6	5.4 - 6	5.75	5.75	–	5.94	Y	
Iron	4/12	12.2 - 170	24.15	2/2	27.5 - 37.8	32.65	32.65	–	37.8	Y	
Tin	0/4	Not detected	–	2/6	118 - 134	126	52.00	–	134	Y	
Zinc	5/13	1.4 - 39.6	7.19	5/6	5 - 9.4	6.96	6.22	–	9.4	Y	

Notes:
Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

*A - Not COPC (Max<RBC)
F - COPC (eval. qual.)

TABLE 5-12
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
INORGANICS IN SURFACE WATER AT IR 1 (µg/L)

TABLE 5-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE WATER AT IR 1 (µg/L) NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values				
VOLATILE ORGANIC COMPOUNDS											
Acetone	2/9	4 - 12	4.33	1/2	8 - 8	6.5	6.50	–	8	Y	F
Methylene chloride	3/9	1 - 1	1.68	1/2	1 - 1	1	1.75	4.70	1	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening values (RBCs).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

F - COPC (eval. qual.)

The following chemicals were selected as COPCs for IR 1 sediment and surface water:

SEDIMENT		SURFACE WATER	
Inorganics	Organics	Inorganics	Organics
Antimony	Aroclor-1248	Aluminum**	Acetone**
Arsenic	Aroclor-1254	Barium**	
Iron	Aroclor-1260	Iron**	
Manganese	Benzo(a)anthracene	Tin**	
	Benzo(a)pyrene	Zinc**	
	Benzo(b)fluoranthene		
	Benzo(k)fluoranthene		
	Chrysene		
	Acenaphthylene*		
	Delta-BHC*		
	Phenanthrene*		

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No WQSs (for consumption of water and organisms) are listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Metals selected as COPCs for sediment at IR 1 were detected in 50 percent or more of the samples analyzed with the exception of antimony which was detected in 1 out of 16 samples. Maximum and representative concentrations for all inorganic COPCs exceeded RBCs for residential soil ingestion. Aroclor-1254, Aroclor-1260, and benzo(a)pyrene were the only organic compounds detected at a maximum concentrations exceeding RBCs for residential soil ingestion. Other organics selected as COPCs are either PCBs, PAHs, or chemicals that lack toxicity criteria for quantitative risk analysis. Chemicals that lack toxicity criteria will be evaluated qualitatively in the uncertainty section. Soil RBCs are used because RBCs protective of human health for sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health.

The metals and organics selected as COPCs for surface water all lack applicable WQSs. WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure basis for developing an applicable WQS. Thus, the use of WQSs as RBCs to select surface-water COPCs is conservative regarding protection of human health.

Aluminum, barium, iron, tin, zinc, and acetone were also selected as COPCs for surface water at IR 1. These chemicals did not have listed WQSs, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

5.6.2.3 Shellfish Tissue

This baseline human health risk assessment includes a calculation of risk to humans from the presence of contaminants in shellfish tissue. Aroclor-1260, several pesticides, and several metals were detected in one or more of the lobster tissue samples collected at IR 1. The occurrence and distribution of chemicals in lobster tissue is presented in Tables 5-14 through 5-15. Summary statistics and COPC selection results for chemicals detected in IR 1 lobster tissue samples are also presented in these tables. The following chemicals were selected as COPCs for IR 1 lobster tissue:

LOBSTER TISSUE

Inorganics	Organics
None selected	Aldrin
	Aroclor-1260

Aroclor-1260 was selected as a COPC for lobster tissue at IR 1. It was detected in one out of 12 samples at a concentration of 7 µg/kg. Aldrin was also selected as a COPC for lobster tissue at IR 1. It was detected in 3 out of 12 samples at a range of 0.06 µg/kg to 0.12 µg/kg. Maximum and average concentrations for Aroclor-1260 and aldrin exceeded fish RBCs.

5.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at IR 1 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

TABLE 5-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN LOBSTER TISSUE AT IR 1 (mg/kg) 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	Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
Arsenic	19/19	4.7 - 20.7	13.43	12/12	16.2 - 32	22.68	22.68	0.0021	N	G
Cadmium	12/19	0.65 - 1.5	0.66	9/12	0.1 - 0.3	0.15	0.13	0.068	N	G
Copper	19/19	14.2 - 37.1	26.18	12/12	18 - 125	43.73	43.73	5.4	N	G
Lead	3/19	0.58 - 0.78	0.26	1/12	0.39 - 0.39	0.39	0.18	–	N	A
Mercury	5/19	0.02 - 0.08	0.02	10/12	0.01 - 0.07	0.05	0.04	0.041	N	A
Vanadium	0/19	Not detected	–	1/12	0.25 - 0.25	0.25	0.20	0.95	N	A
Zinc	19/19	12.5 - 26.8	20.51	12/12	20.3 - 36.4	27.42	27.42	41	N	A

Notes:
Metals are selected as COPCs if average values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
*G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 5-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN LOBSTER TISSUE AT IR 1(µg/kg) NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values			
PESTICIDES/PCBs										
4,4'-DDT	0/19	Not detected	–	6/12	0.11 - 2.3	0.76	1.20	9.3	N	A
Aldrin	5/19	0.08 - 0.21	0.07	3/12	0.06 - 0.12	0.09	0.66	0.19	Y	B
Aroclor-1260	0/19	Not detected	–	1/12	7 - 7	7	15.71	1.6	Y	B
beta-BHC	3/19	0.11 - 0.2	0.74	2/12	0.12 - 0.27	0.2	0.74	1.8	N	A
Chlorobenzilate	0/19	Not detected	–	1/12	28 - 28	28	10.13	12	N	A
Dieldrin	1/19	0.58 - 0.58	1.59	1/12	0.18 - 0.18	0.18	1.53	0.2	N	G
Endosulfan I	0/19	Not detected	–	2/12	0.12 - 0.17	0.15	0.73	810	N	A
Endosulfan sulfate	0/19	Not detected	–	2/12	1.5 - 5	3.05	1.88	810	N	A
Endrin	9/19	0.06 - 0.56	0.98	1/12	0.09 - 0.09	0.09	1.52	41	N	A
Endrin aldehyde	5/19	0.66 - 3.1	2	8/12	0.12 - 1	0.34	0.78	41	N	A
Heptachlor	10/19	0.07 - 0.33	0.5	1/12	0.13 - 0.13	0.13	0.79	1	N	G
Methoxychlor	1/19	1.3 - 1.3	8.12	1/12	0.74 - 0.74	0.74	7.85	6,800	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)

B - COPC (Avg>RBC, organics)

G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

5.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at IR 1 are presented in Section 5.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

5.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under a RME and a CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if an HI (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in four parts:

- Carcinogenic risks
- Noncarcinogenic risks
- The results of the evaluation of lead in surface soils using the IEUBK model
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. A target cancer risk of 1E-06 has been established by FDEP. The risks estimated in this risk assessment will be compared to these benchmarks.

5.6.5.1 Carcinogenic Risks

Table 5-16 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents is 1E-04, which is greater than both the EPA "target risk range" of 1E-04 to 1E-06 and the FDEP target cancer risk of 1E-06. Dermal contact with surface soil for the future resident has an incremental cancer risk of 3E-05 and dermal contact with sediment has an incremental cancer risk of 6.66E-05. The dermal exposure route for surface soil and sediment contributes the most to the cumulative carcinogenic risk for the future resident. This exposure route is also

TABLE 5-16

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
IR 1*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidential Ingestion	8E-06	1E-07	2E-07	1E-07	NA	9E-07
Dermal Contact	3E-05	1E-06	1E-06	8E-07	NA	6E-06
Inhalation of Fugitive Dust	1E-11	7E-14	5E-14	9E-14	NA	2E-12
Subtotal	4E-05	1E-06	1E-06	9E-07	NA	7E-06
Subsurface Soil						
Incidential Ingestion	NA	NA	NA	NA	2E-07	NA
Dermal Contact	NA	NA	NA	NA	1E-06	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	6E-13	NA
Subtotal	NA	NA	NA	NA	1E-06	NA
Sediment						
Incidential Ingestion	2E-05	1E-06	2E-06	NA	NA	NA
Dermal Contact	7E-05	9E-06	8E-06	NA	NA	NA
Subtotal	9E-05	1E-05	1E-05	NA	NA	NA
Surface Water						
Incidential Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish* **						
Ingestion	1E-05	NA	NA	NA	NA	NA
Subtotal	1E-05	NA	NA	NA	NA	NA
TOTAL	1E-04	1E-05	1E-05	9E-07	1E-06	7E-06
HAZARD INDEX						
Surface Soil						
Incidential Ingestion	2E+00	2E-02	4E-02	1E-02	NA	9E-02
Dermal Contact	3E-01	1E-02	2E-02	7E-03	NA	6E-02
Inhalation of Fugitive Dust	2E-07	9E-10	1E-09	9E-10	NA	2E-08
Subtotal	3E+00	3E-02	6E-02	2E-02	NA	2E-01
Subsurface Soil						
Incidential Ingestion	NA	NA	NA	NA	4E-02	NA
Dermal Contact	NA	NA	NA	NA	3E-01	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	3E-01	NA
Sediment						
Incidential Ingestion	6E-01	2E-02	4E-02	NA	NA	NA
Dermal Contact	3E-01	4E-02	7E-02	NA	NA	NA
Subtotal	9E-01	6E-02	1E-01	NA	NA	NA
Surface Water						
Incidential Ingestion	1E-03	7E-05	2E-04	NA	NA	NA
Dermal Contact	8E-04	4E-05	6E-05	NA	NA	NA
Subtotal	2E-03	1E-04	2E-04	NA	NA	NA
Shellfish* **						
Ingestion	2E-02	NA	NA	NA	NA	NA
Subtotal	2E-02	NA	NA	NA	NA	NA
TOTAL	4E+00	9E-02	2E-01	2E-02	3E-01	2E-01

* = Chemical-Specific Risks are presented in Section 5.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

*** = Adult Resident Only.

NA = Not Applicable; pathway is not applicable for the respective media.

associated with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPCs contributing to this cancer risk are arsenic in surface soil and sediment, Aroclor-1260 in sediment, and Aroclor-1254 in sediment. The estimated carcinogenic risks for trespasser adults (1E-05), trespasser adolescents (1E-05), excavation workers (1E-06), and occupational workers (7E-06) are within the EPA target risk range and meet or exceed the FDEP target cancer risk. The estimated carcinogenic risk for maintenance workers is below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 5.6.8.

Table 5-17 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future residents (1E-05) is within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds the FDEP target risk of 1E-06. The incidental ingestion and dermal contact with surface soil and sediment contributes the most to the cumulative carcinogenic risk for the future resident. The estimated carcinogenic risks for all other receptors are below the EPA target risk range and the FDEP target risk. Chemical-specific risks for COPCs are presented in Section 5.6.8.

Table 5-16 lists the estimated cumulative RME carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk for the hypothetical future adult resident (1E-05) is within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds the FDEP target cancer risk of 1E-06. Aroclor-1260 in shellfish contributes the most to the cumulative carcinogenic risk. Table 5-17 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk for the hypothetical future adult resident is below both the EPA "target risk range" of 1E-04 to 1E-06 and the FDEP target cancer risk of 1E-06. Chemical-specific risks for COPCs are presented in Section 5.6.8.

5.6.5.2 Noncarcinogenic Risks

Table 5-16 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The principal COPCs contributing to the noncarcinogenic risk are antimony, copper, and iron in surface soils, arsenic in surface soils and sediment, and Aroclor-1254 in sediment. The target organs for these chemicals are as follows: antimony (heart), arsenic (skin), copper (circulatory system, liver, and kidney), iron (liver and pancreas), and Aroclor-1254 (skin, liver, and reproductive system). The HIs for antimony, copper, and iron (via exposure to surface soil) are less than 1.0. The HI for arsenic (via exposure to surface soil and

TABLE 5-17

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
IR 1*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidential Ingestion	3E-06	1E-08	8E-09	2E-08	NA	3E-07
Dermal Contact	2E-06	4E-08	2E-08	6E-08	NA	5E-07
Inhalation of Fugitive Dust	3E-12	1E-14	4E-15	3E-14	NA	6E-13
Subtotal	4E-06	6E-08	3E-08	7E-08	NA	8E-07
Subsurface Soil						
Incidential Ingestion	NA	NA	NA	NA	6E-08	NA
Dermal Contact	NA	NA	NA	NA	5E-08	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	1E-13	NA
Subtotal	NA	NA	NA	NA	1E-07	NA
Sediment						
Incidential Ingestion	4E-06	1E-07	7E-08	NA	NA	NA
Dermal Contact	2E-06	3E-07	2E-07	NA	NA	NA
Subtotal	6E-06	5E-07	2E-07	NA	NA	NA
Surface Water						
Incidential Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish* **						
Ingestion	5E-07	NA	NA	NA	NA	NA
Subtotal	5E-07	NA	NA	NA	NA	NA
TOTAL	1E-05	5E-07	3E-07	7E-08	1E-07	8E-07
HAZARD INDEX						
Surface Soil						
Incidential Ingestion	2E+00	4E-03	9E-03	4E-03	NA	9E-02
Dermal Contact	6E-02	1E-03	4E-04	1E-03	NA	1E-02
Inhalation of Fugitive Dust	2E-07	5E-10	6E-10	9E-10	NA	2E-08
Subtotal	2E+00	6E-03	1E-02	6E-03	NA	1E-01
Subsurface Soil						
Incidential Ingestion	NA	NA	NA	NA	2E-02	NA
Dermal Contact	NA	NA	NA	NA	3E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	5E-02	NA
Sediment						
Incidential Ingestion	3E-01	4E-03	9E-03	NA	NA	NA
Dermal Contact	3E-02	4E-03	7E-03	NA	NA	NA
Subtotal	3E-01	9E-03	2E-02	NA	NA	NA
Surface Water						
Incidential Ingestion	7E-04	4E-05	8E-05	NA	NA	NA
Dermal Contact	5E-04	2E-05	3E-05	NA	NA	NA
Subtotal	1E-03	5E-05	1E-04	NA	NA	NA
Shellfish* **						
Ingestion	2E-03	NA	NA	NA	NA	NA
Subtotal	2E-03	NA	NA	NA	NA	NA
TOTAL	3E+00	1E-02	3E-02	6E-03	5E-02	1E-01

* = Chemical-Specific Risks are presented in Section 5.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

*** = Adult Resident Only.

NA = Not Applicable; pathway is not applicable for the respective media.

sediment) is less than 1.0. The HI for Aroclor-1254 (via exposure to surface soil) is less than 1.0. The HIs for all other receptors at IR 1 are less than 1.0. Chemical-specific risks for COPCs are presented in Secton 5.6.8.

Table 5-17 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The HIs for antimony, copper, and iron (via exposure to surface soil) are less than 1.0. The HI for arsenic (via exposure to surface soil and sediment) is less than 1.0. The HI for Aroclor-1254 (via exposure to surface soil) is less than 1.0. The HIs for all other receptors at IR 1 are less than or equal to 1.0. Chemical-specific risks for COPCs are presented in Section 5.6.8.

Table 5-16 lists the estimated cumulative RME noncarcinogenic risks for future adult resident via the ingestion of shellfish exposure scenario. The cumulative HI for the hypothetical future resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Table 5-17 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The cumulative hazard index (HI) for the hypothetical future resident is less than 1.0. Chemical-specific risks for COPCs are presented in Section 5.6.8.

5.6.5.3 IEUBK Lead Results

The IEUBK Lead Model (v. 0.99) was used to characterize risks from lead in soil, dust, and water for the hypothetical future child residents (ages 0 through 6), who are considered the most sensitive receptor group at IR 1. The simulated range of blood-lead values that might occur in a population as a result of exposures to lead was compared to a guideline level of 10 micrograms per deciliter (µg/dL).

Based on model results under an RME (See Appendix C), 32.1 percent of child residents exposed under similar conditions might have blood-lead levels exceeding 10 µg/dL. This exceeds a protective guideline of 5 percent for the maximum proportion of individuals with blood levels exceeding 10 µg/dL (EPA, 1994a). The model inputs were default parameter values and a site soil lead concentration of 680 mg/kg. The IEUBK population histograms for background and IR 1 (based on RME exposure) exposures are presented in Appendix A.

Based on model results under a CTE (See Appendix C), 1.1 percent of child residents exposed under similar conditions might have blood-lead levels exceeding 10 µg/dL. This is below a protective guideline of

5 percent for the maximum proportion of individuals with blood levels exceeding 10 µg/dL (EPA, 1994a). The model inputs were default parameter values and a site soil lead concentration of 174.6 mg/kg lead. The IEUBK population histograms for background and IR 1 (based on CTE exposure) exposures are presented in Appendix A.

5.6.5.4 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the IR 1 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 5-18 and 5-19 for inorganics and organics, respectively. The results of this preliminary comparison for IR 1 are presented in this section.

The maximum values of antimony, arsenic, cadmium, lead, mercury, nickel, selenium, alpha-chlordane, dieldrin, heptachlor, heptachlor epoxide, methylene chloride, and TCE exceeded both their respective MCL and RBC values. Most of the metals that exceeded both MCLs and tap water RBCs were detected in 50 percent of more of the samples analyzed with the exception of cadmium, nickel, and selenium. A majority of the detections of these metals were above tap water RBCs. Generally the higher range of detections of these metals were above MCLs. Heptachlor and heptachlor epoxide were each detected in one sample exceeding MCLs and tap water RBCs. Alpha-chlordane was detected in two samples with the maximum value exceeding MCLs and tap water RBCs. Methylene chloride was detected in 11 out of 12 samples with the maximum value exceeding MCLs and tap water RBCs. Barium, beryllium, iron, manganese, silver, vanadium, and zinc concentrations exceeded tap water RBCs; however, this is not uncommon for unfiltered groundwater. Chromium levels exceeded its MCL. 4,4'-DDD, alpha-BHC, beta-BHC, dieldrin, gamma-chlordane, and benzene exceed tap water RBCs.

TABLE 5-18

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs INORGANICS IN GROUNDWATER AT IR 1 (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				
Aluminum	0/10	Not detected	–	8/17	162 - 46,500	1,324.13	6,281.32	–	NA	3,700	Y
Antimony	0/12	Not detected	–	17/28	5.6 - 563	182.62	127.06	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	12/28	3.6 - 62.2	19.72	11.98	50	Y	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	24/24	12.1 - 1,380	219.43	219.43	2,000	N	260	Y
Beryllium	0/13	Not detected	–	2/28	1.2 - 1.2	1.20	1.06	4	N	0.016	Y
Cadmium	0/13	Not detected	–	4/28	22.2 - 54.5	38.05	7.20	5	Y	1.8	Y
Chromium*	3/13	0.71 - 13	2.51	13/28	11.4 - 657	155.10	75.29	100	Y	3,700	N
Cobalt	0/13	Not detected	–	4/24	2.9 - 48.1	31.65	10.61	–	NA	220	N
Copper	1/13	3.15 - 3.15	2.45	22/28	11.5 - 10,200	1,321	1,038.53	1,300**	Y	150	Y
Iron	2/10	76.9 - 97.4	41.72	13/17	51.4 - 155,000	26,657	20,386.17	–	NA	1,100	Y
Lead	1/12	2.5 - 2.5	1.39	16/28	13.2 - 5,700	1,154	660.32	15***	Y	15	Y
Manganese	7/10	2.2 - 10.3	3.78	15/17	3.4 - 2,940	424	374	–	NA	84	Y
Mercury	4/13	0.13 - 0.24	0.10	17/28	0.14 - 640	53.81	32.69	2	Y	1	Y
Nickel	0/13	Not detected	–	7/28	7 - 303	130	41.83	100	Y	73.	Y
Selenium	1/10	3.05 - 3.05	3	2/28	4.7 - 54.6	29.65	6.39	50	Y	18	Y
Silver	1/13	3.3 - 3.3	1.37	1/28	22 - 22	22	17.04	–	NA	18	Y
Tin	0/3	Not detected	–	2/8	30 - 340	185	57.50	–	NA	2,200	N
Vanadium	4/13	3.4 - 3.9	3	16/24	2 - 116	47.35	32.57	–	NA	26	Y
Zinc	3/13	3.425 - 15.3	2.82	18/28	12.8 - 15,200	2,627	1,689.40	–	NA	1,100	Y

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

**Copper Action Level

***Lead Action Level

TABLE 5-19

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RCBs
ORGANICS IN GROUNDWATER AT IR 1 (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				
PESTICIDES/PCBs											
4,4'-DDD	0/10	Not detected	–	1/29	1.3 - 1.3	1.3	0.09	–	NA	0.28	Y
4,4'-DDE	0/10	Not detected	–	1/29	0.11 - 0.11	0.11	0.07	–	NA	0.2	N
alpha-BHC	0/10	Not detected	–	2/29	0.0125 - 0.015	0.01	0.04	–	NA		Y
alpha-chlordane	0/3	Not detected	–	2/8	0.98 - 2.1	1.54	0.58	2	Y	0.052	Y
beta-BHC	0/10	Not detected	–	1/29	1.4 - 1.4	1.4	0.09	–	NA	0.037	Y
Chlordane	0/7	Not detected	–	1/21	57.9 - 57.9	57.9	2.87	2	Y		Y
Dieldrin	0/10	Not detected	–	4/29	0.011 - 0.023	0.02	0.07	–	NA		Y
Endosulfan I	0/10	Not detected	–	6/29	0.011 - 5.9	1	0.23	–	NA	22	N
Endosulfan sulfate	0/10	Not detected	–	1/29	0.027 - 0.027	0.027	0.13	–	NA	22	N
gamma-BHC (lindane)	0/10	Not detected	–	4/29	0.015 - 0.16	0.07	0.05	0.2	N	–	NA
gamma-chlordane	0/3	Not detected	–	2/8	1.1 - 1.3	1.2		2	N		Y
Heptachlor	0/10	Not detected	–	1/29	1 - 1	1	0.06	0.4	Y		Y
Heptachlor epoxide	0/10	Not detected	–	1/29	0.65 - 0.65	0.65	0.19	0.2	Y	0.001	Y
SEMIVOLATILE ORGANIC COMPOUNDS											
Acenaphthene	0/7	Not detected	–	1/12	7.4 - 7.4	7.4	4.24	–	NA	220	N
Anthracene	0/7	Not detected	–	1/12	1.1 - 1.1	1.1	3.72	–	NA	1,100	N
Fluoranthene	0/7	Not detected	–	1/12	2.4 - 2.4	2.4	3.83	–	NA	150	N
Fluorene	0/7	Not detected	–	1/12	7.5 - 7.5	7.5	4.25	–	NA	150	N
Phenanthrene	0/7	Not detected	–	1/12	14 - 14	14	5	–	NA	–	NA
Pyrene	0/7	Not detected	–	1/12	1 - 1	1	3.71	–	NA	110	N
VOLATILE ORGANIC COMPOUNDS											
Acetone	1/4	5 - 5	5	2/7	2 - 4	3	4.43	–	NA	370	N
Benzene	0/4	Not detected	–	1/12	1.6 - 1.6	1.6	1.93	5	N		Y
Carbon disulfide	0/4	Not detected	–	1/8	1 - 1	1	2.31	–	NA	100	N
Ethylbenzene	0/4	Not detected	–	1/12	1.6 - 1.6	1.6	1.93	700	N	130	N
Methylene chloride	2/4	1 - 1	1.75	11/12	1 - 5.2	2.45	2.46	5	Y	4	Y
Toluene	0/4	Not detected	–	1/11	4.3 - 4.3	4.3	2.12	1,000	N	75	N
Trans-1,2-dichloroethene	1/3	1.2 - 1.2	2.07	1/4	18 - 18	18	4.88	100	N	–	NA
Trichloroethene	0/4	Not detected	–	2/12	1 - 14	7.5	2.83	5	Y	1.6	Y
Xylenes, total	0/4	Not detected	–	1/12	7.2 - 7.2	7.2	2.39	10,000	N	1,200	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

5.6.6 Uncertainties for IR 1

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of IR 1 risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and hazard index (via surface soils and sediment) for the future residential receptors. The uncertainty associated with the dermal exposure route may overestimate the risk at IR 1.

- Arsenic is a major contributor to the cumulative carcinogenic risks in surface soil. The carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Since arsenic is a major contributor to the risk, risks may be overstated.

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at IR 1 (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

5.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for IR 1.

5.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment (based on RME), a subset of chemicals, called COCs, was selected for the evaluation of RGOs. At SWMU 5, COCs were included in the RGO evaluation only if the COC's contribution to risk exceeds a cancer risk level of 1E-06 or a hazard quotient of 0.1. The COCs selected at IR 1 are as follows:

- Surface Soils

  - Arsenic
  - Antimony
  - Copper
  - Iron
  - Mercury

Arsenic was selected as a COC in soil because its contribution to the cancer risk level is greater than 1E-06 and because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor). Antimony, copper, iron, and mercury are selected as COCs in soil because their contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor).

- Sediment

  - Aroclor-1254
  - Aroclor-1260
  - Arsenic
  - Iron

Aroclor-1254 and arsenic are selected as COCs in soil because their contribution to the cancer risk level is greater than 1E-06 and because their contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor). Aroclor-1260 is selected as a COC in sediment because its contribution to the cancer risk was greater than 1E-06 (future residential receptor). Iron is selected as a COC in sediment because its contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor).

5.6.7.2 Remedial Goal Options

RGO based on generic FDEP and RCRA TBCs for COCs in surface soils are listed in Table 5-20 for residential exposure scenarios. RGO are not listed for sediment because generic levels for sediment exposure have not been established. The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 5-21 (surface soil - future resident) and Table 5-22 (sediment - future resident). These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

5.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 5-23 and 5-24. The purpose of these tapes is to resent individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium
- Representative concentrations for each COPC in each applicable medium
- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use
- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents and excavation workers) receptors. COPCs in IR 1 media were not present at sufficient concentrations to cause adverse noncarcinogenic health effects to any current potential receptors and the future excavation worker. The cancer risks estimated for the current potential receptors were below or within the 1E-04 to 1E-06 target risk range that is often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation. For the reasonable maximum exposure calculation, all scenarios except the maintenance worker exceeded the FDEP target risk range of 1E-06. For the central tendency exposure, only the hypothetical future resident exceeded the FDEP target cancer risk.

TABLE 5-20

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE SOIL AT IR 1
NAS KEY WEST

COC	RCRA Subpart S Action Levels (mg/kg)	FDEP Residential Soil Cleanup Goals (mg/kg)
INORGANICS		
Arsenic	80	0.8
Antimony	32	26
Copper	-	-
Iron	-	-
Mercury	20	23

TABLE 5-21

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE SOIL AT IR 1
NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	0.09	0.88	8.8	0.93	9.3	27.8
Antimony	-	-	-	3.0	29.8	89.5
Copper	-	-	-	298	3,000	9,000
Iron	-	-	-	2,200	22,000	66,000
Mercury	-	-	-	2.3	22.5	67.4

TABLE 5-22

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SEDIMENT AT IR 1
NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	0.31	3.1	31	3.2	32.4	97.3
Iron	-	-	-	7,900	79,000	240,000
ORGANICS (µg/kg)						
Aroclor-1254	288	2,900	29,000	254	2,500	7,500
Aroclor-1260	288	2,900	29,000	-	-	-

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	1.9E-02	8.9E-04	NA	1.9E-02
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	1.0E+00	5.0E-02	NA	1.1E+00
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	7.8E-06	3.0E-05	5.0E-13	3.8E-05	1.4E-01	2.2E-01	NA	3.6E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	5.8E-07	6.9E-08	1.7E-14	6.5E-07	2.2E-04	1.1E-05	NA	2.3E-04
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	9.9E-12	NA	9.1E-02	4.3E-03	NA	9.5E-02
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	5.2E-01	2.5E-02	NA	5.4E-01
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	2.7E-01	1.3E-02	NA	2.8E-01
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	7.7E-03	3.7E-04	2.5E-07	8.0E-03
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	1.5E-01	7.2E-03	4.2E-09	1.6E-01
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	3.9E-02	1.9E-03	NA	4.1E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	8.4E-06	3.0E-05	1.0E-11	3.8E-05	2.3E+00	3.2E-01	2.5E-07	2.6E+00
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrace	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	3.2E-02	1.5E-03	NA	3.3E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	4.6E-06	1.8E-05	NA	2.2E-05	8.3E-02	1.3E-01	NA	2.1E-01
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	3.9E-01	1.9E-02	NA	4.1E-01
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	5.5E-03	2.7E-04	NA	5.8E-03
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	1.1E-07	3.1E-07	NA	4.2E-07	NA	NA	NA	
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	6.0E-07	1.7E-06	NA	2.3E-06	1.2E-01	1.4E-01	NA	2.6E-01
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	1.6E-05	4.7E-05	NA	6.3E-05	NA	NA	NA	
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	7.5E-08	NA	NA	7.5E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	5.9E-07	NA	NA	5.9E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	6.5E-08	NA	NA	6.5E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	6.5E-09	NA	NA	6.5E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	9.8E-10	NA	NA	9.8E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.2E-05	6.7E-05	NA	8.9E-05	6.3E-01	2.9E-01	NA	9.2E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	1.1E-04	7.5E-05	NA	1.9E-04
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	2.0E-04	1.4E-04	NA	3.4E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	3.0E-04	2.0E-04	NA	5.0E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	5.3E-04	3.6E-04	NA	8.9E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	7.4E-05	5.0E-05	NA	1.2E-04
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	1.9E-04	NA	NA	1.9E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4E-03	8.2E-04	NA	2.2E-03
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	3.7E-06	NA	NA	NA	1.7E-02	NA	NA	1.7E-02
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	1.0E-05	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.4E-05	NA	NA	NA	1.7E-02	NA	NA	1.7E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.5E-05	9.7E-05	1.0E-11	1.3E-04	2.9E+00	6.1E-01	2.5E-07	3.5E+00

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 3 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	1.4E-04	3.9E-05	NA	1.8E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	7.7E-03	2.2E-03	NA	9.9E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	1.3E-07	1.2E-06	3.1E-15	1.3E-06	1.0E-03	9.6E-03	NA	1.1E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	9.4E-09	2.7E-09	1.1E-16	1.2E-08	1.6E-06	4.6E-07	NA	2.1E-06
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	6.2E-14	6.2E-14	6.7E-04	1.9E-04	NA	8.6E-04
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	3.8E-03	1.1E-03	NA	4.9E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	2.0E-03	5.6E-04	NA	2.5E-03
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	5.6E-05	1.6E-05	9.0E-10	7.3E-05
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	1.1E-03	3.2E-04	1.5E-11	1.4E-03
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA		2.9E-04	8.2E-05	NA	3.7E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.4E-07	1.2E-06	6.5E-14	1.3E-06	1.7E-02	1.4E-02	9.2E-10	3.1E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrace	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA		8.2E-04	2.4E-04	NA	1.1E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	2.6E-07	2.4E-06	NA	2.7E-06	2.1E-03	2.0E-02	NA	2.2E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA		1.0E-02	2.9E-03	NA	1.3E-02
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA		1.4E-04	4.1E-05	NA	1.8E-04
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	6.1E-09	4.2E-08	NA	4.8E-08	NA	NA	NA	
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	3.4E-08	2.4E-07	NA	2.7E-07	3.1E-03	2.2E-02	NA	2.5E-02
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	9.3E-07	6.4E-06	NA	7.4E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	4.3E-09	NA	NA	4.3E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	3.4E-08	NA	NA	3.4E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	3.7E-09	NA	NA	3.7E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	3.7E-10	NA	NA	3.7E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	5.6E-11	NA	NA	5.6E-11	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.3E-06	9.1E-06	NA	1.0E-05	1.6E-02	4.4E-02	NA	6.1E-02
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	5.8E-06	3.3E-06	NA	9.1E-06
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	1.0E-05	6.0E-06	NA	1.6E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	1.5E-05	8.8E-06	NA	2.4E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	2.7E-05	1.6E-05	NA	4.3E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	3.8E-06	2.2E-06	NA	6.0E-06
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	9.8E-06	NA	NA	9.8E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2E-05	3.6E-05	NA	1.1E-04
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.4E-06	1.0E-05	6.5E-14	1.2E-05	3.3E-02	5.9E-02	9.2E-10	9.2E-02

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	3.0E-04	6.2E-05	NA	3.6E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	1.7E-02	3.5E-03	NA	2.0E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	1.6E-07	1.1E-06	2.3E-15	1.2E-06	2.3E-03	1.5E-02	NA	1.7E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	1.2E-08	2.5E-09	7.7E-17	1.4E-08	3.5E-06	7.3E-07	NA	4.2E-06
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	4.5E-14	4.5E-14	1.5E-03	3.0E-04	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	8.3E-03	1.7E-03	NA	1.0E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	4.3E-03	8.8E-04	NA	5.2E-03
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	1.2E-04	2.5E-05	1.1E-09	1.5E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	2.4E-03	5.0E-04	1.9E-11	2.9E-03
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	6.3E-04	1.3E-04	NA	7.6E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.7E-07	1.1E-06	4.7E-14	1.2E-06	3.7E-02	2.2E-02	1.1E-09	5.9E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrace	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	1.8E-03	3.7E-04	NA	2.2E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	3.3E-07	2.2E-06	NA	2.5E-06	4.7E-03	3.1E-02	NA	3.6E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	2.2E-02	4.5E-03	NA	2.7E-02
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	3.1E-04	6.4E-05	NA	3.8E-04
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	7.7E-09	3.8E-08	NA	4.6E-08	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	4.3E-08	2.1E-07	NA	2.6E-07	6.9E-03	3.4E-02	NA	4.1E-02
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	1.2E-06	5.9E-06	NA	7.0E-06	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	5.4E-09	NA	NA	5.4E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	4.2E-08	NA	NA	4.2E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	4.7E-09	NA	NA	4.7E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	4.7E-10	NA	NA	4.7E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	7.1E-11	NA	NA	7.1E-11	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.6E-06	8.3E-06	NA	9.9E-06	3.6E-02	7.0E-02	NA	1.1E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	1.3E-05	5.2E-06	NA	1.8E-05
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	2.3E-05	9.4E-06	NA	3.2E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	3.4E-05	1.4E-05	NA	4.8E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	6.0E-05	2.5E-05	NA	8.4E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	8.4E-06	3.5E-06	NA	1.2E-05
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	2.1E-05	NA	NA	2.1E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6E-04	5.7E-05	NA	2.1E-04
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.8E-06	9.4E-06	4.7E-14	1.1E-05	7.2E-02	9.2E-02	1.1E-09	1.6E-01

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RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	8.0E-05	2.0E-05	NA	1.0E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	4.5E-03	1.1E-03	NA	5.7E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	9.9E-08	7.7E-07	4.1E-15	8.7E-07	6.1E-04	4.8E-03	NA	5.4E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	7.3E-09	1.8E-09	1.4E-16	9.1E-09	9.5E-07	2.3E-07	NA	1.2E-06
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	8.1E-14	8.1E-14	3.9E-04	9.6E-05	NA	4.9E-04
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	2.2E-03	5.5E-04	NA	2.8E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	1.2E-03	2.8E-04	NA	1.4E-03
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	3.3E-05	8.1E-06	9.0E-10	4.1E-05
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	6.6E-04	1.6E-04	1.5E-11	8.2E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	1.7E-04	4.1E-05	NA	2.1E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.1E-07	7.7E-07	8.6E-14	8.8E-07	9.9E-03	7.0E-03	9.2E-10	1.7E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrace	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.1E-07	7.7E-07	8.6E-14	8.8E-07	9.9E-03	7.0E-03	9.2E-10	1.7E-02

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RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	1.1E-07	8.8E-07	4.6E-13	9.9E-07	1.8E-02	1.4E-01	NA	1.5E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	1.1E-09	2.6E-10	2.0E-15	1.3E-09	3.5E-06	8.6E-07	NA	4.4E-06
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	1.5E-08	9.0E-08	NA	1.1E-07	2.7E-02	1.6E-01	NA	1.9E-01
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	7.9E-09	4.6E-08	NA	5.4E-08	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	4.6E-09	NA	6.8E-15	4.6E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	6.2E-08	NA	9.1E-14	6.2E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	4.9E-09	NA	7.2E-15	4.9E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	4.9E-10	NA	7.2E-16	4.9E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	5.9E-11	NA	8.7E-17	5.9E-11	NA	NA	NA	NA
Dibenzo(a,h)anthrace	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	8.1E-09	NA	1.2E-14	8.1E-09	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	3.3E-09	NA	4.9E-15	3.3E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.2E-07	1.0E-06	5.8E-13	1.2E-06	4.5E-02	2.9E-01	NA	1.5E-01
SEDIMENT															
Inorganics															

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RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds								NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.2E-07	1.0E-06	5.8E-13	1.2E-06	4.5E-02	2.9E-01	NA	1.5E-01

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RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	7.1E-04	1.6E-04	NA	8.7E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	4.0E-02	9.2E-03	NA	4.9E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	8.7E-07	6.4E-06	8.6E-14	7.3E-06	5.4E-03	4.0E-02	NA	4.5E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	6.4E-08	1.5E-08	2.9E-15	7.9E-08	8.4E-06	1.9E-06	NA	1.0E-05
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	1.7E-12	1.7E-12	3.5E-03	8.0E-04	NA	4.3E-03
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	2.0E-02	4.6E-03	NA	2.4E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	1.0E-02	2.3E-03	NA	1.3E-02
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	2.9E-04	6.8E-05	1.9E-08	3.6E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	5.8E-03	1.3E-03	3.2E-10	7.1E-03
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	1.5E-03	3.4E-04	NA	1.8E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	9.3E-07	6.4E-06	1.8E-12	7.4E-06	8.7E-02	5.9E-02	1.9E-08	1.5E-01
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrace	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	5.6	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-23

RME -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 12 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	9.3E-07	6.4E-06	1.8E-12	7.4E-06	8.7E-02	5.9E-02	1.9E-08	1.5E-01

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 1 OF 12

Parameter	Dose-Response Parameters						Representative	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]	Concentration[3]	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	1.9E-02	1.8E-04	NA	1.9E-02
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	1.0E+00	9.9E-03	NA	1.1E+00
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	2.5E-06	1.8E-06	1.6E-13	4.3E-06	1.4E-01	4.3E-02	NA	1.8E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	1.9E-07	4.2E-09	5.3E-15	1.9E-07	2.2E-04	2.1E-06	NA	2.2E-04
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	3.1E-12	3.1E-12	9.1E-02	8.6E-04	NA	9.1E-02
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	3.3E-04	3.2E-06	NA	3.4E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	5.2E-01	4.9E-03	NA	5.2E-01
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	2.7E-01	2.5E-03	NA	2.7E-01
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	7.7E-03	7.3E-05	2.5E-07	7.7E-03
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	1.5E-01	1.4E-03	4.2E-09	1.5E-01
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	3.9E-02	3.7E-04	NA	3.9E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.7E-06	1.8E-06	3.3E-12	4.5E-06	2.3E+00	6.3E-02	2.5E-07	2.3E+00
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrac	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 2 OF 12

Parameter	Dose-Response Parameters						Representative	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]	Concentration[3]	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	1.6E-02	1.5E-04	NA	1.6E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	7.3E-07	5.3E-07	NA	1.3E-06	4.1E-02	1.3E-02	NA	5.4E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	2.0E-01	1.9E-03	NA	2.0E-01
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	2.8E-03	2.6E-05	NA	2.8E-03
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	1.7E-08	9.3E-09	NA	2.7E-08	NA	NA	NA	
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	9.6E-08	5.2E-08	NA	1.5E-07	6.1E-02	1.4E-02	NA	7.5E-02
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	2.6E-06	1.4E-06	NA	4.0E-06	NA	NA	NA	
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	1.2E-08	NA	NA	1.2E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	9.4E-08	NA	NA	9.4E-08	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	1.0E-08	NA	NA	1.0E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	1.0E-09	NA	NA	1.0E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	1.6E-10	NA	NA	1.6E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.6E-06	2.0E-06	NA	5.6E-06	3.2E-01	2.9E-02	NA	3.5E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	5.6E-05	5.0E-05	NA	1.1E-04
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	1.0E-04	8.9E-05	NA	1.9E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	1.5E-04	1.3E-04	NA	2.8E-04
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	2.7E-04	2.4E-04	NA	5.0E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	3.7E-05	3.3E-05	NA	7.0E-05
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	9.5E-05	NA	NA	9.5E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.0E-04	5.4E-04	NA	1.2E-03
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	1.3E-07	NA	NA	NA	2.0E-03	NA	NA	2.0E-03
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	3.8E-07	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.1E-07	NA	NA	NA	2.0E-03	NA	NA	2.0E-03
TOTAL	NA	NA	NA	NA	NA	NA	NA	6.8E-06	3.8E-06	3.3E-12	1.0E-05	2.6E+00	9.2E-02	2.5E-07	2.7E+00

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 3 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	3.4E-05	3.9E-06	NA	3.8E-05
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	1.9E-03	2.2E-04	NA	2.1E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	1.2E-08	4.3E-08	5.7E-16	5.5E-08	2.6E-04	9.6E-04	NA	1.2E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	8.7E-10	1.0E-10	2.0E-17	9.6E-10	4.0E-07	4.6E-08	NA	4.5E-07
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	1.1E-14	1.1E-14	1.7E-04	1.9E-05	NA	1.9E-04
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	6.1E-07	7.0E-08	NA	6.8E-07
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	9.5E-04	1.1E-04	NA	1.1E-03
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	4.9E-04	5.6E-05	NA	5.5E-04
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	1.4E-05	1.6E-06	4.5E-10	1.6E-05
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	2.8E-04	3.2E-05	7.7E-12	3.1E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA		7.2E-05	8.2E-06	NA	8.0E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.3E-08	4.3E-08	1.2E-14	5.6E-08	4.2E-03	1.4E-03	4.6E-10	5.6E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrac	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 4 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA		2.1E-04	2.4E-05	NA	2.3E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	2.4E-08	8.8E-08	NA	1.1E-07	5.3E-04	2.0E-03	NA	2.5E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA		2.5E-03	2.9E-04	NA	2.8E-03
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA		3.6E-05	4.1E-06	NA	4.0E-05
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	5.6E-10	1.6E-09	NA	2.1E-09	NA	NA	NA	
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	3.1E-09	8.7E-09	NA	1.2E-08	7.9E-04	2.2E-03	NA	3.0E-03
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	8.6E-08	2.4E-07	NA	3.2E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	3.9E-10	NA	NA	3.9E-10	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	3.1E-09	NA	NA	3.1E-09	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	3.4E-10	NA	NA	3.4E-10	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	3.4E-11	NA	NA	3.4E-11	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	5.1E-12	NA	NA	5.1E-12	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.2E-07	3.4E-07	NA	4.5E-07	4.1E-03	4.4E-03	NA	8.5E-03
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	2.9E-06	1.7E-06	NA	4.5E-06
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	5.2E-06	3.0E-06	NA	8.2E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	7.7E-06	4.4E-06	NA	1.2E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	1.4E-05	7.8E-06	NA	2.1E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	1.9E-06	1.1E-06	NA	3.0E-06
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	4.9E-06	NA	NA	4.9E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.6E-05	1.8E-05	NA	5.4E-05
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.3E-07	3.8E-07	1.2E-14	5.1E-07	8.3E-03	5.9E-03	4.6E-10	1.4E-02

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	7.4E-05	1.2E-06	NA	7.6E-05
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	4.2E-03	6.5E-05	NA	4.3E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	7.3E-09	2.0E-08	2.1E-16	2.7E-08	5.7E-04	2.8E-04	NA	8.5E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	5.4E-10	4.6E-11	7.0E-18	5.9E-10	8.8E-07	1.4E-08	NA	8.9E-07
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	4.1E-15	4.1E-15	3.6E-04	5.6E-06	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	1.3E-06	2.1E-08	NA	1.4E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	2.1E-03	3.2E-05	NA	2.1E-03
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	1.1E-03	1.7E-05	NA	1.1E-03
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	3.1E-05	4.8E-07	5.6E-10	3.1E-05
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	6.1E-04	9.4E-06	9.6E-12	6.2E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	1.6E-04	2.4E-06	NA	1.6E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	7.9E-09	2.0E-08	4.3E-15	2.8E-08	9.2E-03	4.1E-04	5.7E-10	9.6E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrac	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser -- Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	4.5E-04	3.8E-05	NA	4.9E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	1.5E-08	4.1E-08	NA	5.6E-08	1.2E-03	3.2E-03	NA	4.3E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	5.5E-03	4.7E-04	NA	6.0E-03
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	7.8E-05	6.6E-06	NA	8.4E-05
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	3.5E-10	7.2E-10	NA	1.1E-09	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	2.0E-09	4.0E-09	NA	6.0E-09	1.7E-03	3.5E-03	NA	5.2E-03
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	5.4E-08	1.1E-07	NA	1.6E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	2.5E-10	NA	NA	2.5E-10	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	1.9E-09	NA	NA	1.9E-09	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	2.1E-10	NA	NA	2.1E-10	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	2.1E-11	NA	NA	2.1E-11	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	3.2E-12	NA	NA	3.2E-12	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	7.3E-08	1.5E-07	NA	2.3E-07	8.9E-03	7.2E-03	NA	1.6E-02
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	6.3E-06	2.7E-06	NA	9.0E-06
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	1.1E-05	4.8E-06	NA	1.6E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	1.7E-05	7.1E-06	NA	2.4E-05
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	3.0E-05	1.3E-05	NA	4.2E-05
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	4.2E-06	1.8E-06	NA	6.0E-06
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	1.1E-05	NA	NA	1.1E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9E-05	2.9E-05	NA	1.1E-04
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	8.1E-08	1.7E-07	4.3E-15	2.6E-07	1.8E-02	7.6E-03	5.7E-10	2.6E-02

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CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	3.4E-05	3.9E-06	NA	3.8E-05
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	1.9E-03	2.2E-04	NA	2.1E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	1.5E-08	5.5E-08	1.5E-15	7.0E-08	2.6E-04	9.6E-04	NA	1.2E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	1.1E-09	1.3E-10	5.0E-17	1.2E-09	4.0E-07	4.6E-08	NA	4.5E-07
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	2.9E-14	2.9E-14	1.7E-04	1.9E-05	NA	1.9E-04
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	6.1E-07	7.0E-08	NA	6.8E-07
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	9.5E-04	1.1E-04	NA	1.1E-03
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	4.9E-04	5.6E-05	NA	5.5E-04
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	1.4E-05	1.6E-06	9.0E-10	1.6E-05
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	2.8E-04	3.2E-05	1.5E-11	3.1E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	7.2E-05	8.2E-06	NA	8.0E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.6E-08	5.5E-08	3.1E-14	7.2E-08	4.2E-03	1.4E-03	9.2E-10	5.6E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrac	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.6E-08	5.5E-08	3.1E-14	7.2E-08	4.2E-03	1.4E-03	9.2E-10	5.6E-03

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	2.8E-08	4.4E-08	1.1E-13	7.2E-08	8.8E-03	1.4E-02	NA	2.2E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	2.7E-10	1.3E-11	5.1E-16	2.8E-10	1.8E-06	8.6E-08	NA	1.8E-06
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	3.9E-09	4.5E-09	NA	8.4E-09	1.4E-02	1.6E-02	NA	2.9E-02
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	2.0E-09	2.3E-09	NA	4.3E-09	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	1.2E-09	NA	1.7E-15	1.2E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	1.6E-08	NA	2.3E-14	1.6E-08	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	1.2E-09	NA	1.8E-15	1.2E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	1.2E-10	NA	1.8E-16	1.2E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	1.5E-11	NA	2.2E-17	1.5E-11	NA	NA	NA	NA
Dibenzo(a,h)anthrac	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	2.0E-09	NA	3.0E-15	2.0E-09	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	8.3E-10	NA	1.2E-15	8.3E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.5E-08	5.1E-08	1.5E-13	1.1E-07	8.8E-03	1.4E-02	NA	2.2E-02

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
PAGE 10 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	5.5E-08	5.1E-08	1.5E-13	1.1E-07	8.8E-03	1.4E-02	NA	2.2E-02

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1450	NA	NA	NA	NA	7.1E-04	3.3E-05	NA	7.4E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	32.8	NA	NA	NA	NA	4.0E-02	1.8E-03	NA	4.2E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.32	3.1E-07	4.6E-07	3.1E-14	7.7E-07	5.4E-03	8.0E-03	NA	1.3E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.086	2.3E-08	1.1E-09	1.1E-15	2.4E-08	8.4E-06	3.9E-07	NA	8.8E-06
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	35.4	NA	NA	6.1E-13	6.1E-13	3.5E-03	1.6E-04	NA	3.6E-03
Copper	4.00E-02	8.00E-03	-	-	-	-	1620	NA	NA	NA	NA	1.3E-05	5.9E-07	NA	1.3E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	6250	NA	NA	NA	NA	2.0E-02	9.1E-04	NA	2.1E-02
Lead	-	-	-	-	-	-	264	NA	NA	NA	NA	1.0E-02	4.7E-04	NA	1.1E-02
Manganese	1.40E-01	2.80E-02	-	-	-	-	84	NA	NA	NA	NA	2.9E-04	1.4E-05	1.9E-08	3.1E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	3.55	NA	NA	NA	NA	5.8E-03	2.7E-04	3.2E-10	6.1E-03
Zinc	3.00E-01	6.00E-02	-	-	-	-	916	NA	NA	NA	NA	1.5E-03	6.9E-05	NA	1.6E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.4E-07	4.6E-07	6.4E-13	8.0E-07	8.7E-02	1.2E-02	1.9E-08	9.9E-02
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	38	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.127	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	3900	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	2000	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	3200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	4300	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	3400	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	3400	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	4100	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthrac	-	-	-	7.30E+00	1.46E+01	3.10E+00	560	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyre	-	-	-	7.30E-01	1.46E+00	3.10E-01	2300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	-	-	-	-	3.5	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	6.81	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-24

CTE -- CHEMICAL SPECIFIC RISKS AT IR 1
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Iron	3.00E-01	6.00E-02	-	-	-	-	32100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	212	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1248	-	-	-	2.00E+00	4.00E+00	-	120	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	2.00E-05	1.00E-05	-	2.00E+00	4.00E+00	-	669	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	18300	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	230	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	180	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthen	-	-	-	7.30E-01	1.46E+00	3.10E-01	200	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	200	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	300	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	47	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	5.94	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	37.8	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	134	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	9.4	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER															
Pesticides/PCBs															
Aldrin	3.00E-05	1.50E-05	-	1.70E+01	3.40E+01	1.70E+01	0.66	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	-	-	-	2.00E+00	4.00E+00	-	15.71	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.4E-07	4.6E-07	6.4E-13	8.0E-07	8.7E-02	1.2E-02	1.9E-08	9.9E-02

1 Units are (mg/kg)/day.
2 Units are $[(mg/kg)/day]^{-1}$.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

COPCs at IR 1 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Additionally, cancer risks for this receptor were estimated at levels exceeding 1E-04. Aroclor-1254, Aroclor-1260, and arsenic are the main contributors to the carcinogenic risk, and antimony, arsenic, copper, iron, and Aroclor-1254 are the main contributors to the noncarcinogenic risk.

5.7 ECOLOGICAL RISK ASSESSMENT

This section discusses the results of the ecological risk assessment performed at IR 1 including a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

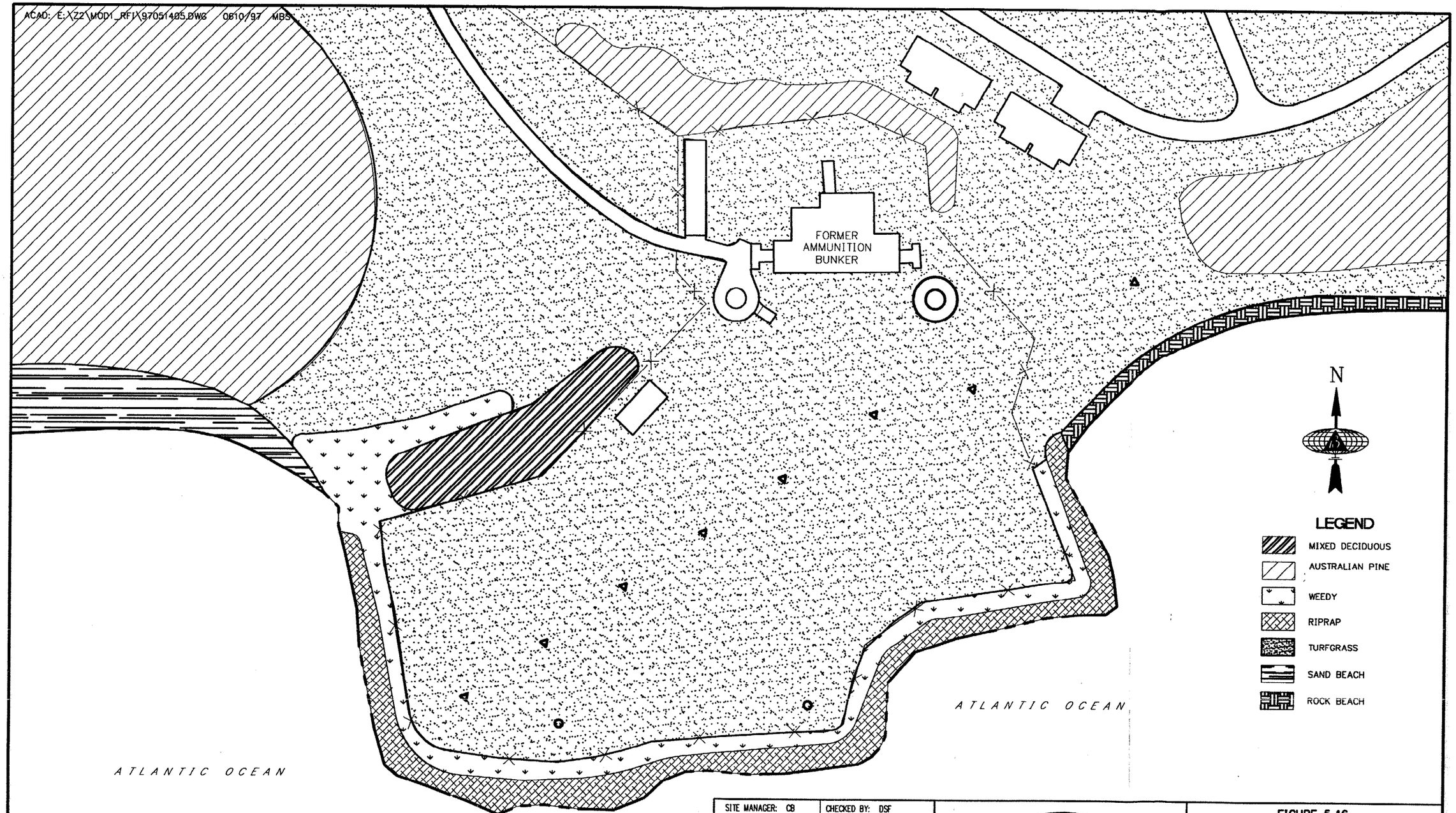
5.7.1 Problem Formulation

This section presents the ecological problem formulation including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

5.7.1.1 Habitat Types and Ecological Receptors

Section 5.1 (See Figure 5-16) describes the physical setting at IR 1. Terrestrial habitat within the former disposal area consists largely of mowed turfgrass enclosed by a chain link fence. Thus, the area within the fence is essentially devoid of all native vegetation. Outside the chain link fence is a narrow 15-foot strip of weeds and a few Australian pines. Seaward of this weedy strip along the water's edge is a border of large boulders and blocks of concrete. Due to the overall lack of vegetation (other than turf grass) the site is probably utilized by few terrestrial receptors. Birds, however, probably forage occasionally in grassy areas on the site. There are no freshwater resources at the site.

A diverse assemblage of marine life was observed within the near shore vicinity of IR 1 during sampling activities of September 1996. Common plants included turtle grass (*Thalassia testudinum*), sea fan (*Gorgonia* spp.), sea plume (*Pseudopterogorgia* spp.), and sea whip (*Leptogorgia* spp.). Observed animal life included spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*), hawkwing conch (*Strombus raninus*), Caribbean vase conch (*Vasum muricatum*), green moray eel (*Gymnothorax funebris*), hermit crabs, tarpon (*Megalops atlanticus*), barracuda (*Sphyraena barracuda*), and several other fish. Spiny lobster, Caribbean vase conch, giant hermit crab (*Petrochirus diogenes*), and turtle grass were collected from the nearshore vicinity of the site for tissue analysis.



SITE MANAGER: CB	CHECKED BY: DSF
DRAWN BY: TCB/SRM/MBS	DRAWING DATE:
SURVEYED BY:	SURVEY DATE:
SCALE: 1"=100'	
CAD DWG. NO.: 7046IR_4/97051405	

BROWN & ROOT ENVIRONMENTAL

FIGURE 5-16
HABITATS AT IR 1

NAVAL AIR STATION
KEY WEST, FLORIDA

Ecological receptors listed as threatened, endangered, or of special concern that could potentially be exposed to site-related contamination include the brown pelican, osprey, least tern, roseate tern, and sea turtles. An osprey nest was reported to exist approximately 600 yards northwest of the site in 1992 (IT Corporation, 1994). The roofs of several buildings approximately 500 yards northwest of the site are used as nesting sites by least terns and roseate terns (FNAI, 1994). A sandy beach approximately 200 feet northwest of IR 1 was used for nesting by Atlantic loggerhead turtles (*Caretta caretta caretta*) in 1991 (IT Corporation, 1994). There are no known bald eagle nests in the vicinity, but eagles could potentially forage in nearshore waters.

Water quality at IR 1 is typical of shallow, nearshore marine environments in the Lower Keys. Salinities ranged from 32.4 ppt to 33.1 ppt in September 1996 (Appendix C, Table C.1-3), which is slightly lower than the salinity of open ocean water. Water temperatures ranged from 28.0°C to 31.9°C (82.4 to 89.4°F) and are assumed to be characteristic of late-summer temperatures in shallow, near-shore areas of the Lower Keys. DO levels were high (>6.0 mg/L), sufficient to support a diverse assemblage of estuarine and marine fish. As mentioned above, submerged aquatic vegetation, mostly turtle grass, was abundant at this site. Seagrasses are generally indicative of good water quality because they are associated with high water clarity, low levels of nutrients (particularly those from agricultural and domestic wastes), and low levels of contaminants (Day et al. 1989).

5.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways at IR 1 is presented in Section 5.5.2.

5.7.1.3 Exposure Routes

Terrestrial animals may be exposed to IR 1-related contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue. Volatile constituents could be present in some site soils, soil-bound contaminant resuspension can occur, and combustion can release contaminants into the air at IR 1. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered

for ecological receptors. However, terrestrial habitat is limited and of marginal quality at the site, precluding significant use by terrestrial organisms. Terrestrial receptors can also come to contact with contaminants in surface water by using it for drinking, although this exposure route generally represents a negligible portion of total exposure for most receptors. In addition, the salt content in nearby surface water precludes the use of the water for drinking. Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation. Yet since airborne migration of contaminants is minimal, only the root translocation route was considered for terrestrial plants. However, a large portion of the soils have been excavated and the site is mostly covered with turfgrass, which provides poor terrestrial habitat. Thus, terrestrial exposure routes are possible, but are most likely minimal.

Aquatic and semi-aquatic organisms utilizing the near shore ocean area may be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semi-aquatic organisms can also be exposed to constituents in contaminated groundwater that discharges to surface water.

5.7.1.4 Selection of Ecological Chemicals of Potential Concern

Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water. Otherwise, contaminants selected for evaluation consisted of all analytes detected during current and previous sampling of surface water, sediment, and surface soil at IR 1. Groundwater analytes selected for evaluation consisted of those detected during current sampling of the six monitoring wells closest to the ocean. Inorganic contaminants whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

5.7.1.5 Assessment and Measurement Endpoints

A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3 .1.1.5 of Appendix C.

5.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway

has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 5-17 shows the conceptual model for IR 1. It should be noted that terrestrial exposure routes were included in the model since they are possible, but are most likely minimal for the reasons discussed earlier.

5.7.2 Ecological Effects Characterization

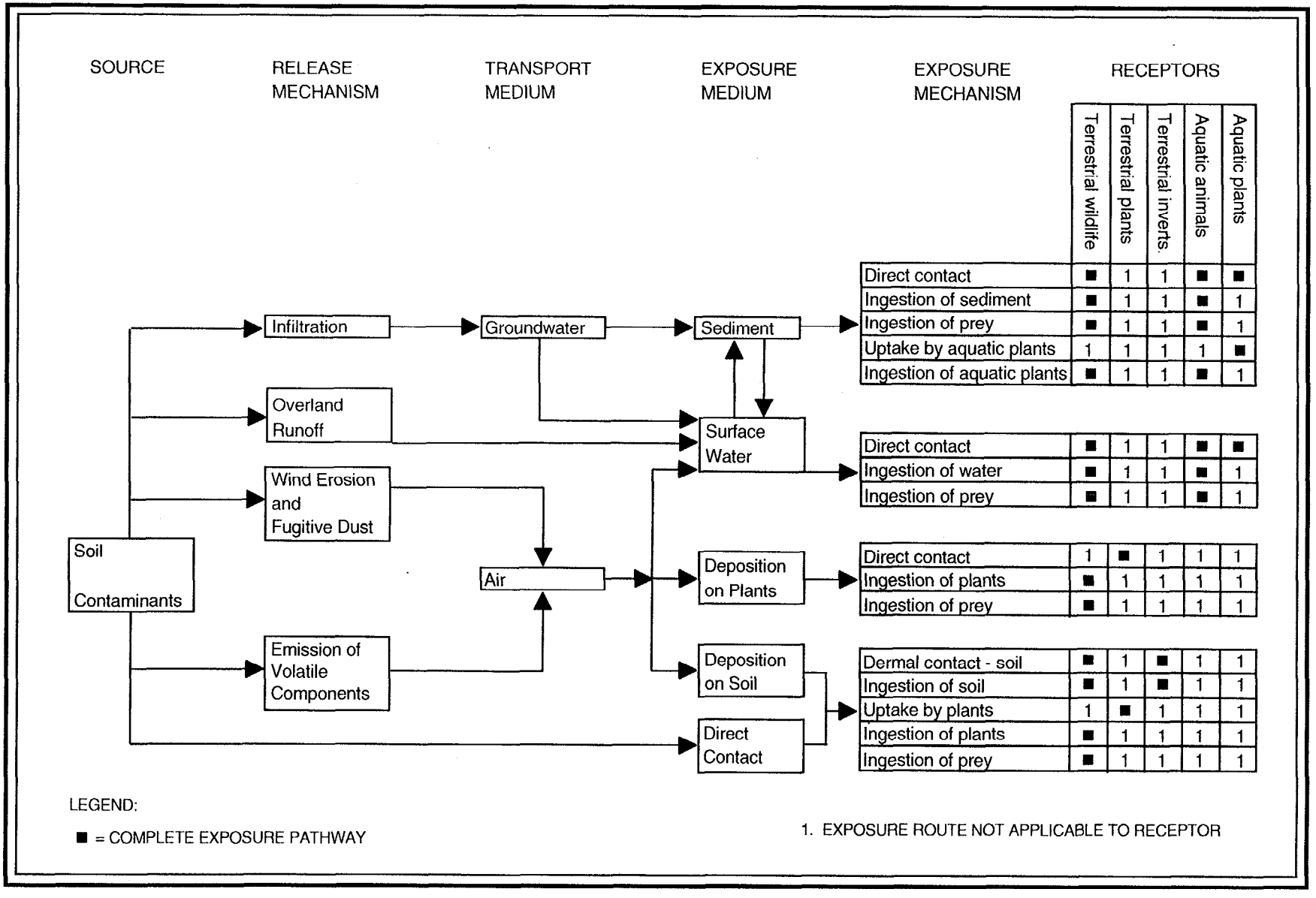
Ecologically based thresholds, e.g., concentrations of contaminants in various media protective of ecological receptors, were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at IR 1. Brief descriptions of each COPC are included in Appendix B, Part 3. Terrestrial plant thresholds were obtained to assess potential risks to plants from soil contaminants. Groundwater, surface-water, sediment, terrestrial plant, and surface soil thresholds are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Spiny lobster, Caribbean vase conch, giant hermit crab, and turtle grass were collected from the nearshore vicinity of the site for tissue analysis. Tissue samples were analyzed for pesticides, PCBs, and metals. Concentrations of contaminants detected in tissues were compared to concentrations in similar tissue collected at background sites.

5.7.3 Exposure Assessment

The ecological exposure assessment for IR 1 consisted of a comparison of exposure point contaminant concentrations to threshold values.

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil (post-IRA samples) from current and previous investigations were used as representative exposure point concentrations for screening against threshold values. It should be noted that since the surface soil samples used to obtain exposure point concentrations were from the IRA for lead they were not analyzed for organics. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.



7046-24PC\Mod1/R2-RFI-RI\F5-17.ppt

Figure 5-17. Conceptual Site Model - IR 1, NAS Key West, Florida

Foodchain modeling was not performed using IR 1 data. Terrestrial receptors do not utilize the site to any appreciable extent, due to the poor terrestrial habitat (i.e., turfgrass) at the site. Modeling of potential risks to piscivorous wading birds and semiaquatic receptors (i.e., the raccoon) was not conducted due to the absence of shallow water at the site.

5.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at IR 1.

5.7.4.1 Results

The results of the ecological risk characterization at IR 1 are presented in this section, which includes a discussion of the results from the Phase I and Phase II ecological screening assessments and tissue analyses.

5.7.4.1.1 Phase I

The Phase I ecological risk assessment for IR 1 conducted by IT Corporation (1994) identified the inorganics antimony, chromium, copper, lead, manganese, mercury, nickel, vanadium, and zinc as groundwater COCs. Barium, cadmium, copper, manganese, mercury, vanadium, and zinc were identified as inorganic COCs in sediment. The assessment concluded that the greatest potential risk to aquatic organisms from inorganics is through direct contact via groundwater discharges, and to a much lesser extent contact with contaminated sediment. Antimony was the only surface-water inorganic COC. Heptachlor epoxide, beta-BHC, and gamma-chlordane were identified as organic groundwater COCs. In sediments, dieldrin and endrin aldehyde were identified as organic COCs. Cadmium, chromium, copper, lead, mercury, zinc, phenanthrene, 4,4'-DDT, endrin aldehyde, Aroclor-1248, Aroclor-1254, Aroclor-1260, gamma-chlordane, and heptachlor epoxide were considered to be capable of bioaccumulating sufficiently in fish to pose potential risks to piscivores.

The Phase I assessment identified the organics benzo(a)pyrene, dibenzo(a,h)anthracene, fluorene, 4,4'-DDT, Aroclor-1254, and Aroclor-1260 as soil COCs. The metals antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, tin, vanadium, and zinc were also identified as soil COCs. Consumption of antimony, cadmium, copper, lead, zinc, Aroclor-1254, and Aroclor-1260 in vegetation was determined to pose potential risk to terrestrial receptors that forage on plants. However, the study concluded that due to highly compacted soils, sparse vegetation, man-made structures, and a chain-link fence surrounding the site, IR 1 surface soils pose minimal risks to terrestrial receptors. The

overall conclusion of the assessment was that moderate to high potential risks were present from several COCs in various media, primarily aquatic, and that additional ecological investigations to more fully characterize ecological risks were warranted (IT Corporation, 1994).

5.7.4.1.2 Phase II - Ecological Screening Assessment

The inorganics copper, iron, lead, manganese, mercury, and zinc in groundwater exceeded surface-water thresholds and two times their average background concentrations, and therefore, were retained as groundwater COPCs (Table 5-25). The organochlorine pesticides and daughter compounds 4,4'-DDD, chlordane, endosulfan I, dieldrin, gamma-BHC (lindane), and heptachlor exceeded surface-water thresholds and were retained as groundwater COPCs.

Tin was the only contaminant detected in IR 1 surface water at a maximum value that exceeded its surface-water threshold and was retained as a COPC (Table 5-26). This inorganic was not detected in background surface waters. Barium and cyanide exceeded two times their average background and threshold and were retained as sediment COPCs (Table 5-27). Four inorganics had maxima that exceeded two times average background and the most conservative thresholds available and were, therefore, retained as sediment COPCs but did not exceed less conservative thresholds. These include arsenic, cadmium, copper, and mercury. Also, lead and zinc exceeded two times their average background concentrations and both most and less conservative thresholds. Aluminum, beryllium, tin, and vanadium were conservatively retained as sediment COPCs since they exceeded two times average background and no thresholds were available. A multitude of organics were retained as sediment COPCs since their maxima exceeded the only threshold available, exceeded the most conservative threshold, or exceeded both most and less conservative thresholds used in the assessment. These included several pesticides/PCBs, SVOCs (mainly PAHs), and acetone. Also, 2,4-D and 2-butanone were conservatively retained as sediment COPCs since no thresholds were available.

In IR 1 surface soils, aluminum, chromium, copper, lead, manganese, mercury, vanadium, and zinc had maximum detected concentrations in excess of two times their background concentrations and threshold values (Table 5-28). Antimony and beryllium were conservatively retained as surface soil COPCs since their maxima exceeded two times their average background concentrations and no suitable thresholds were available. Twelve contaminants in surface soils were retained as terrestrial plant COCs since their maxima exceeded two times average background and terrestrial plant thresholds. These included aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc (Table 5-29).

TABLE 5-25

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER (µg/L) - IR 1
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 Chemicals of Potential Concern (COPC)
INORGANICS						
Antimony	3/6	ND	5.6 - 22.2	4,300	0.01	Eliminated - does not exceed threshold
Barium	6/6	10.2	36.3 - 64.6	10,000	0.01	Eliminated - does not exceed threshold
Chromium	1/6	2.51	12.60	50	0.25	Eliminated - does not exceed threshold
Copper	2/6	2.45	60.5 - 88.4	2.4	36.83	Retained - exceeds 2 X background and HQ > 1
Iron	4/6	41.72	51.4 - 391	300	1.30	Retained - exceeds 2 X background and HQ > 1
Lead	1/6	1.39	18.90	5.6	3.38	Retained - exceeds 2 X background and HQ > 1
Manganese	4/6	3.78	5.5 - 137	10	13.70	Retained - exceeds 2 X background and HQ > 1
Mercury	1/6	0.1	0.43	0.025	17.20	Retained - exceeds 2 X background and HQ > 1
Nickel	1/6	ND	7.00	8.2	0.85	Eliminated - does not exceed threshold
Selenium	1/6	ND	4.70	71	0.07	Eliminated - does not exceed threshold
Vanadium	2/6	2.62	2.0 - 2.3	10,000	0.00	Eliminated - does not exceed 2 X background
Zinc	3/6	2.82	52.2 - 96.2	86	1.12	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs						
4,4'-DDD	1/6	ND	1.30	0.025	52.00	Retained - HQ > 1
alpha-BHC	2/6	ND	0.0125 - 0.015	1,400	0.00	Eliminated - does not exceed threshold
Chlordane	1/6	ND	57.50	0.00059	97,457.63	Retained - HQ > 1
Endosulfan I	6/6	ND	0.011 - 5.9	0.0087	678.16	Retained - HQ > 1
Dieldrin	2/6	ND	0.0215 - 0.023	0.00014	164.29	Retained - HQ > 1
gamma-BHC (lindane)	3/6	ND	0.024 - 0.16	0.016	10.00	Retained - HQ > 1
Heptachlor	1/6	ND	1.00	0.00021	4,761.90	Retained - HQ > 1

ND = Not detected.

TABLE 5-26

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L) - IR 1
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 Chemicals of Potential Concern (COPC)
INORGANICS						
Aluminum	1/2	24.97	47.10	1,500	0.03	Eliminated - does not exceed 2 X background
Antimony	6/6	33.71	236 - 270	4,300	0.06	Eliminated - does not exceed threshold
Barium	6/6	6.93	5.4 - 6	10,000	0.001	Eliminated - does not exceed 2 X background
Iron	2/2	24.70	27.5 - 37.8	300	0.13	Eliminated - does not exceed 2 X background
Tin	2/6	ND	118 - 134	73	1.8	Retained - HQ > 1
Zinc	5/6	7.19	5 - 9.4	86	0.11	Eliminated - does not exceed 2 X background
VOLATILE ORGANIC COMPOUNDS						
Acetone	1/2	4.33	8.00	9,000,000	8.8E-07	Eliminated - does not exceed threshold
Methylene chloride	1/2	1.50	1.00	2,560	0.0004	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 5-27

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 1
NAS KEY WEST
PAGE 1 OF 3

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemicals of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	12/12	1,331.89	72.4 - 6,170	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Antimony	1/16	ND	6.80	12	0.6	Eliminated - does not exceed threshold
Arsenic	15/16	2.63	0.92 - 12.1	7.24/70	1.7/0.2	Retained - exceeds 2 X background and HQ > 1
Barium	16/16	9.27	3.3 - 40.5	40	1.0	Retained - exceeds 2 X background and HQ > 1
Beryllium	1/16	0.06	0.14	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	1/16	0.22	1.10	0.676/9.6	1.6/0.1	Retained - exceeds 2 X background and HQ > 1
Chromium	13/16	5.01	4.2 - 17.2	52.3	0.3	Eliminated - does not exceed threshold
Cobalt	4/16	0.47	1.35 - 5.3	50	0.1	Eliminated - does not exceed threshold
Copper	16/16	8.88	9.4 - 132	18.7/270	7.1/0.5	Retained - exceeds 2 X background and HQ > 1
Cyanide	1/12	ND	13.00	0.1	130.0	Retained - HQ > 1
Lead	16/16	17.97	15.3 - 226	30.2/218	7.5/1.0	Retained - exceeds 2 X background and HQ > 1
Manganese	12/12	15.39	7.3 - 295	460	0.6	Eliminated - does not exceed threshold
Mercury	15/16	0.05	0.04 - 0.15	0.13/0.71	1.2/0.2	Retained - exceeds 2 X background and HQ > 1
Nickel	10/16	2.15	1 - 12	15.9	0.8	Eliminated - does not exceed threshold
Silver	1/16	0.27	0.33	0.733	0.5	Eliminated - does not exceed 2 X background
Tin	4/6	2.85	9.3 - 64.1	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	13/16	5.08	0.73 - 14	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Zinc	16/16	25.74	1.1 - 484	124/410	3.9/1.2	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs (µg/kg)						
2,4-D	1/7	39.15	21.40	NA	-	Retained - no suitable threshold available
4,4'-DDD	5/15	13.03	2.5 - 29.4	1.22/7.81	24.0/3.8	Retained - HQ > 1
4,4'-DDE	15/16	19.85	3.2 - 296	2.07/27	143/11.0	Retained - HQ > 1

TABLE 5-27

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 1
NAS KEY WEST
PAGE 2 OF 3

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemicals of Potential Concern (COPC)
PESTICIDES/PCBs (µg/kg) (continued)						
4,4'-DDT	12/15	13.02	4.6 - 711	1.19/4.77	597/149	Retained - HQ > 1
alpha-BHC	1/16	7.11	0.85	6	0.1	Eliminated - does not exceed threshold
Aroclor-1248	1/16	ND	120.00	30/1500	4.0/0.08	Retained - HQ > 1
Aroclor-1254	2/16	ND	210 - 669	60/340	11.2/2.0	Retained - HQ > 1
Aroclor-1260	14/16	70.57	24.1 - 18,260	5/240	3,652.0/76.1	Retained - HQ > 1
beta-BHC	1/16	ND	20.00	5	4.0	Retained - HQ > 1
delta-BHC	1/16	7.35	1.00	3	0.3	Eliminated - does not exceed threshold
Dieldrin	4/16	ND	2.4 - 13.6	0.715/95	19.0/0.1	Retained - HQ > 1
Endosulfan I	7/16	6.7	1.7 - 256	2.9	88.3	Retained - HQ > 1
Endosulfan II	1/16	ND	83.00	14	5.9	Retained - HQ > 1
Endosulfan sulfate	2/15	ND	0.84 - 341	5.4	63.1	Retained - HQ > 1
Endrin	7/15	12.89	1.2 - 1,462	3.3/3.5	443.0/417.7	Retained - HQ > 1
Endrin aldehyde	2/10	ND	89 - 380.5	3.3/3.5	115.3/108.7	Retained - HQ > 1
gamma-BHC (lindane)	4/16	6.72	0.78 - 3.3	0.32/0.99	10.3/3.3	Retained - HQ > 1
Heptachlor	5/16	6.51	0.76 - 18.9	4.9	3.9	Retained - HQ > 1
Heptachlor epoxide	2/16	ND	1.2 - 1.5	5/50	0.3	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Acenaphthylene	1/12	ND	75	5.87/128	12.8/0.6	Retained - HQ > 1
Benzo(a)anthracene	3/12	ND	120 -230	74.8/1,600	3.1/0.1	Retained - HQ > 1
Benzo(a)pyrene	2/12	ND	130 - 180	88.8/1,600	2.0/0.1	Retained - HQ > 1
Benzo(b)fluoranthene	3/12	966.92	160 - 200	655/1,700	0.3	Eliminated - does not exceed threshold
Benzo(k)fluoranthene	3/12	ND	160 - 200	655	0.3	Eliminated - does not exceed threshold
Bis(2-ethylhexyl)phthalate	3/5	1,992.17	390 - 480	182/2,647	2.6/0.2	Retained - HQ > 1
Chrysene	3/12	961.38	190 - 300	108/2,800	2.8/0.1	Retained - HQ > 1
Fluoranthene	4/12	982.38	250 - 400	113/5,100	3.5/0.8	Retained - HQ > 1

TABLE 5-27

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 1
NAS KEY WEST
PAGE 3 OF 3

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemicals of Potential Concern (COPC)
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg) (continued)						
Phenanthrene	3/12	ND	110 - 220	86.7/1,100	2.5/0.2	Retained - HQ > 1
Pyrene	4/12	968.46	250 - 400	153/2,600	2.6/0.2	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
1,2-dichloroethene	2/5	ND	2 - 3	23	0.1	Eliminated - does not exceed threshold
2-butanone	2/5	8.49	14 - 16	NA	-	Retained - no suitable threshold available
Acetone	2/5	30.9	130 - 150	64	2.3	Retained - HQ > 1
Methylene chloride	5/5	7.5	2.0- 11.0	427	0.03	Eliminated - does not exceed threshold
Toluene	2/5	4.49	2.0 - 4.0	670	0.006	Eliminated - does not exceed threshold
Xylenes, total	1/5	ND	3.0	25	0.12	Eliminated - does not exceed threshold

NA = No suitable ecological threshold value was available.

ND = Not detected.

TABLE 5-28

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - IR 1
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 Chemicals of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	35/35	1887.29	247 - 12,200	600	20.3	Retained - exceeds 2 X background and HQ > 1
Antimony	35/35	0.39	0.17 - 203	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Arsenic	83/83	1.29	0.81 - 44.7	60	0.7	Eliminated - does not exceed threshold
Barium	35/35	10.51	7.1 - 163	440	0.4	Eliminated - does not exceed threshold
Beryllium	32/35	0.05	0.01 - 0.26	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	33/35	0.15	0.11 - 3.6	20	0.2	Eliminated - does not exceed threshold
Chromium	35/35	6.02	3.6 - 153	0.4	382.5	Retained - exceeds 2 X background and HQ > 1
Cobalt	34/35	0.29	0.06 - 5.5	200	0.03	Eliminated - does not exceed threshold
Copper	35/35	5.43	5.5 - 2,250	50	45.0	Retained - exceeds 2 X background and HQ > 1
Lead	85/85	15.66	8.2 - 680	500	1.4	Retained - exceeds 2 X background and HQ > 1
Manganese	35/35	17.65	9.3 - 372	100	3.7	Retained - exceeds 2 X background and HQ > 1
Mercury	35/35	0.03	0.02 - 9.3	0.1	93.0	Retained - exceeds 2 X background and HQ > 1
Nickel	35/35	1.67	1 - 49.1	200	0.2	Eliminated - does not exceed threshold
Selenium	15/35	0.65	0.08 - 0.53	70	0.008	Eliminated - does not exceed 2 X background
Silver	17/35	ND	0.16 - 5.1	50	0.1	Eliminated - does not exceed threshold
Vanadium	29/35	3.97	2 - 20.2	20	1.01	Retained - exceeds 2 X background and HQ > 1
Zinc	35/35	15.22	12.6 - 3,240	200	16.2	Retained - exceeds 2 X background and HQ > 1

NA = No suitable ecological threshold value was available.

ND = Not detected.

TABLE 5-29

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - IR 1
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 Chemicals of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	37/37	1887.29	247 - 12,200	50	244	Retained - exceeds 2 X background and HQ > 1
Antimony	37/37	0.39	0.17 - 203	5	40.6	Retained - exceeds 2 X background and HQ > 1
Arsenic	85/85	1.29	0.81 - 44.7	10	4.47	Retained - exceeds 2 X background and HQ > 1
Barium	37/37	10.51	7.1 - 284	500	0.57	Eliminated - does not exceed threshold
Beryllium	34/37	0.05	0.01 - 0.26	10	0.03	Eliminated - does not exceed threshold
Cadmium	35/37	0.15	0.11 - 12.5	3	4.17	Retained - exceeds 2 X background and HQ > 1
Chromium	37/37	6.02	3.6 - 153	1	153	Retained - exceeds 2 X background and HQ > 1
Cobalt	36/37	0.29	0.06 - 6.1	20	0.30	Eliminated - does not exceed threshold
Copper	37/37	5.43	5.5 - 2,250	100	22.5	Retained - exceeds 2 X background and HQ > 1
Lead	87/87	15.66	8.2 - 6,140	50	122.8	Retained - exceeds 2 X background and HQ > 1
Manganese	37/37	17.65	9.3 - 441	500	0.88	Eliminated - does not exceed threshold
Mercury	37/37	0.03	0.02 - 9.3	0.3	31	Retained - exceeds 2 X background and HQ > 1
Nickel	37/37	1.67	1 - 63.5	30	2.12	Retained - exceeds 2 X background and HQ > 1
Selenium	16/37	0.65	0.08 - 0.53	1	0.53	Eliminated - does not exceed 2 X background
Silver	19/37	ND	0.16 - 5.8	2	2.9	Retained - HQ > 1
Vanadium	31/37	3.97	2 - 22.2	2	11.1	Retained - exceeds 2 X background and HQ > 1
Zinc	37/37	15.22	12.6 - 4,610	50	92.2	Retained - exceeds 2 X background and HQ > 1

5.7.4.1.3 Tissue Analysis

The inorganics arsenic, cadmium, copper, lead, mercury, vanadium, and zinc were detected in lobsters collected near IR 1 (Table 5-30). A number of organochlorine pesticides and the PCB mixture Aroclor-1260 were detected in lobsters as well. In hermit crabs the inorganics arsenic, barium, copper, manganese, nickel, selenium, and zinc were detected, and the organics 4,4'-DDD, 4,4'-DDE, Aroclor-1260, and endosulfan I were detected (Table 5-31). The inorganics, aluminum, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, and zinc were detected in vase conchs, along with a number of organochlorine pesticides and Aroclor-1260 (Table 5-32). Turtle grass collected near IR 3 contained the inorganics lead, manganese, mercury, nickel, and zinc, several organochlorine pesticides, and the PCB mixture Aroclor-1260 (Table 5-33).

5.7.4.2 Discussion

Copper, iron, lead, manganese, mercury, and zinc were inorganic groundwater COPCs. Of these, lead and mercury were detected only in 1 of 6 groundwater samples collected in 1996, and copper was detected in only 2 of 6 samples. Iron and zinc also had relatively low HQ values in groundwater (1.3 or less) using the maximum detected concentrations. Copper, lead, manganese, and mercury were not detected in surface water and iron and zinc were not surface-water COPCs, although this is not unexpected given the open and dynamic nature of surface water at the shoreline. Manganese was not elevated in sediments. Copper, lead, and mercury were significantly elevated in soils (relative to background), and were slightly elevated in sediments. Zinc was elevated in both soils and sediments. This suggests that if the presence of copper, lead, mercury, and zinc in sediments is IR 1-related, it is most likely a result of runoff from soils rather than from groundwater discharge.

Several organochlorine pesticides were also present in elevated concentrations in groundwater, including 4,4'-DDD, chlordane, endosulfan I, dieldrin, gamma-BHC, and heptachlor. Heptachlor, 4,4'-DDD, and chlordane were detected only in 1 of 6 groundwater samples. Also, chlordane was not detected in surface water or sediments. As such, significant groundwater to surface-water migration of these contaminants is unlikely. In contrast, the other organics detected in groundwater had higher frequencies of detection and were detected in sediments. The presence of these compounds in these two media are discussed in detail below.

Tin was the only surface-water COPC. This inorganic was detected only in two of six samples and had a relatively low HQ value (HQ = 1.8), indicating relatively low potential risks to aquatic receptors. Tin was

TABLE 5-30

SUMMARY STATISTICS FOR ANALYTES DETECTED IN LOBSTERS FROM IR 1 AND BACKGROUND SITES, NAS KEY WEST

	IR 1			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Arsenic	12/12	15.20-31.80	22.66	19/19	4.70-20.70	13.43
Cadmium	9/12	0.10-0.30	0.13	12/19	0.65-1.50	0.66
Copper	12/12	18.00-125.00	43.73	19/19	14.20-37.10	26.18
Lead	1/12	0.39	0.18	3/19	0.58-0.78	0.26
Mercury	10/12	0.01-0.07	0.04	5/19	0.02-0.08	0.02
Vanadium	1/12	0.25	0.20	0/19		
Zinc	12/12	20.30-35.40	27.42	19/19	12.50-25.80	20.51
PESTICIDE/PCBs (µg/kg)						
4,4'-DDT	6/12	0.11-2.30	1.20	0/19		
Aldrin	3/12	0.06-0.12	0.66	5/19	0.08-0.21	0.66
Aroclor-1260	1/12	7.00	15.71	0/19		
beta-BHC	2/12	0.12-0.27	0.74	3/19	0.11-0.20	0.74
Chlorobenzilate	1/12	28.00	10.13	0/19		
Dieldrin	1/12	0.18	1.53	1/19	0.56	1.59
Endosulfan I	2/12	0.12-0.17	0.73	0/19		
Endosulfan sulfate	2/12	1.50-4.60	1.88	0/19		
Endrin	1/12	0.09	1.52	9/19	0.06-0.56	0.98
Endrin aldehyde	8/12	0.12-1.00	0.78	5/19	0.65-3.10	1.54
Heptachlor	1/12	0.13	0.79	10/19	0.07-0.33	0.50
Methoxychlor	1/12	0.74	7.85	1/19	1.30	8.12

1 One-half the detection limit used for all non-detected values.

TABLE 5-31

SUMMARY STATISTICS FOR ANALYTES DETECTED IN RED HERMIT CRABS FROM IR 1 AND BACKGROUND SITES, NAS KEY WEST

	IR 1			BACKGROUND[1]		
	Frequency of Detection	Range of Detected Values	Average[2]	Frequency of Detection	Range of Detected Values	Average[2]
INORGANICS (mg/kg)						
Arsenic	2/2	12.60-21.80	17.20	1/1	7.60	7.60
				14/15	4.10-31.00	15.14
Barium	2/2	2.70-3.10	2.90	0/1		
				7/15	1.10-3.50	1.13
Copper	2/2	34.40-39.50	36.95	1/1	16.70	16.70
				14/15	5.50-60.50	20.38
Manganese	2/2	2.90-3.10	3.00	0/1		
				12/15	0.36-3.60	1.30
Nickel	2/2	0.30-0.33	0.32	0/1		
				0/15		
Selenium	2/2	2.20	2.2	0/1		
				0/15		
Zinc	2/2	36.30-43.90	40.10	1/1	26.40	26.40
				15/15	8.50-58.00	33.87
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	1/2	1.70	1.68	0/1		
				10/15	0.41-1.60	1.14
4,4'-DDE	2/2	0.99-17.00	8.99	1/1	0.60	0.60
				5/15	0.37-1.90	1.37
Aroclor-1260	1/2	260.00	138.25	0/1		
				1/15	280.00	34.07
Endosulfan I	1/2	1.20	1.03	0/1		
				1/15	0.40	0.82

1 Background values in first row for each analyte are for hermit crabs only (n=1); values in second row for each analyte are for crabs of all species from background sites.
2 One-half the detection limit used for all non-detected values.

TABLE 5-32

SUMMARY STATISTICS FOR ANALYTES DETECTED IN VASE CONCHS FROM IR 1 AND BACKGROUND SITES, NAS KEY WEST

	IR 1			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum	1/10	32.60	5.94	0/5		
Arsenic	10/10	46.90-110.00	69.40	5/5	28.60-46.70	37.14
Cadmium	7/10	0.16-1.80	0.33	1/5	5.40	1.32
Copper	10/10	8.70-63.00	29.48	5/5	9.00-81.70	24.90
Lead	4/10	0.33-0.36	0.29	0/5		
Manganese	7/10	2.10-7.60	3.64	4/5	1.80-5.00	2.27
Mercury	6/10	0.01-0.19	0.03	0/5		
Nickel	3/10	0.36-10.50	2.02	1/5	0.72	0.43
Selenium	3/10	1.30-2.10	0.84	1/5	2.40	0.88
Zinc	10/10	14.90-223.00	38.55	5/5	13.80-477.00	107.22
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	4/10	0.69-2.40	4.13	1/5	0.12	1.89
4,4'-DDE	9/10	0.49-10.00	3.96	0/5		
4,4'-DDT	5/10	0.64-7.90	3.43	2/5	0.15-1.70	1.91
Aldrin	5/10	0.19-2.60	1.43	4/5	0.09-0.26	0.31
Aroclor-1260	4/10	28.00-53.00	51.80	0/5		
delta-BHC	3/10	0.27-20.00	3.70	0/5		
gamma-BHC (lindane)	1/10	0.35	2.23	2/5	0.20-0.25	0.75
Chlorobenzilate	6/10	17.00-150.00	49.95	2/5	11.00-54.00	19.60
Dieldrin	2/10	0.10-0.11	4.07	1/5	0.58	1.99
Endosulfan I	3/10	0.23-0.48	2.00	3/5	0.16-0.33	0.65
Endosulfan II	3/10	0.57-1.40	3.56	3/5	0.16-0.94	1.10
Endosulfan sulfate	1/10	3.10	4.40	0/5		
Endrin	4/10	1.20-3.00	4.06	2/5	0.22-0.24	1.47
Endrin aldehyde	5/10	2.10-10.00	5.12	4/5	0.26-1.20	0.83
Heptachlor	2/10	0.11-0.96	2.22	2/5	0.14-0.23	0.78
Isodrin	1/10	0.35	4.24	0/5		

1 One-half the detection limit used for all non-detected values.

TABLE 5-33

SUMMARY STATISTICS FOR ANALYTES DETECTED IN AQUATIC VEGETATION (TURTLE GRASS) FROM IR 1 AND BACKGROUND SITES, NAS KEY WEST

	IR 1			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Lead	4/4	0.61-1.20	0.88	3/9	0.43-0.93	0.38
Manganese	4/4	6.50-10.90	8.43	9/9	3.20-15.90	9.34
Mercury	3/4	0.01-0.02	0.01	2/9	0.01-0.02	0.01
Nickel	2/4	0.79-0.90	0.60	1/9	26.10	3.15
Zinc	4/4	18.70-26.20	23.78	9/9	1.10-14.60	7.34
PESTICIDE/PCBs (µg/kg)						
4,4'-DDT	2/4	0.35-0.38	2.60	0/9		
Aldrin	2/4	0.07-0.22	1.34	1/9	0.48	0.81
Aroclor-1260	1/4	760.00	202.38	0/9		
gamma-BHC (lindane)	2/4	0.08-0.21	1.34	7/9	0.13-0.64	0.46
Endosulfan I	2/4	0.28-0.38	1.43	1/9	0.20	0.78
Endrin	2/4	0.26-0.48	2.60	1/9	0.10	1.48
Endrin aldehyde	1/4	0.15	2.86	5/9	3.30-18.00	6.28
Methoxychlor	1/4	0.53	14.88	0/9		

1 One-half the detection limit used for all non-detected values.

detected in four of six sediment samples, but was not detected in IR 1 groundwater or soil, suggesting that IR 1 is not likely to be the source of this metal. Cadmium was a sediment COPC but was detected only in 1 of 16 samples, was not detected in 1996 samples, and the maximum detected concentration only slightly exceeded the most conservative threshold available. It was not detected in groundwater and was detected in soil but was not a soil COPC. The HQ value for cyanide in sediments was considerably elevated, but it was detected in only 1 of 12 samples (and not in 1996 samples). Therefore, the maximum detected concentrations of cadmium and cyanide appear to be "hot spots" and not indicative of ubiquitous contamination. Arsenic, barium, and mercury were sediment inorganic COPCs, but their HQ values were relatively low (all < 1.7).

Conversely, copper, lead, and zinc had elevated HQ values in sediments or exceeded both most and less conservative thresholds, and each had high frequencies of detection. This suggests that these metals may pose potential risks to aquatic organisms. However, it should be noted that only one detection of zinc and lead exceeded the less conservative thresholds used for those metals, and no detections of copper exceeded the less conservative threshold used. All three of these inorganics were COPCs in soil and were considerably elevated in several surface soil samples (Table 5-2). Again, since detections of these three metals in groundwater were spotty or the HQ values were relatively low, runoff from contaminated surface soils appears to the be primary migration pathway from IR 1. Beryllium, vanadium, and tin were conservatively retained as COPCs since their maximum concentrations exceeded two times their average background concentrations but no suitable sediment thresholds were available. Yet, beryllium was detected in only 1 of 16 samples and vanadium is generally not considered to be highly toxic in the environment (Mailman, 1980). As mentioned above, tin was not detected in soils or groundwater at the site, suggesting that tin in sediments does not originate from IR 1.

Several semivolatile compounds were sediment COPCs. Fluoranthene and pyrene were COPCs but were detected only in 1 of 7 sediment samples collected in 1996. Benzo(a)anthracene and chrysene were detected in 3 of 12 sediment samples but were not detected in samples collected in 1996. Acenapthylene was a COPC but was detected only in 1 of 12 samples, and the COPC benzo(a)pyrene was detected only in 2 of 12 samples. The HQ values for bis(2-ethylhexyl)phthalate, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, and pyrene were all relatively low (all 3.5 or less). Phthalates are also ubiquitous environmental contaminants. In addition, all PAH COPCs were detected at maxima that did not exceed the less conservative thresholds used in the assessment. More importantly, the shoreline near IR 1 most likely receives runoff from developed areas on Truman Annex. These developed areas include several roadways and parking areas; PAHs are common contaminants in runoff from these areas. As such, the presence of slightly elevated concentrations of some semivolatiles in sediments near IR 1 is unremarkable.

Several pesticides and PCB mixtures were sediment COPCs but had low frequencies of detection. Alpha-BHC, Aroclor-1248, endosulfan II, beta-BHC, and delta-BHC were detected only in 1 of 16 sediment samples. Aroclor-1254 and heptachlor epoxide were detected only in 2 of 16 samples and endosulfan sulfate was detected only in 2 of 15 samples. The organic 2,4-D was retained as a COPC since no sediment threshold was available but was detected only in 1 of 7 samples. Conversely, the pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan I, endrin, gamma-BHC (lindane), and heptachlor all had high frequencies of detection and considerably elevated HQ values. Of these pesticides, endosulfan I, dieldrin, and gamma-BHC in groundwater all considerably exceeded surface-water screening values and had high frequencies of detection. Since recent soil samples were not analyzed for organics, the presence of these compounds in sediments as a result of runoff from IR 1 cannot be fully evaluated. It should be noted, however, than endosulfan I, dieldrin, and gamma-BHC were not soil COCs from the Phase I assessment. Heptachlor epoxide, beta-BHC, and gamma-chlordane were identified as organic groundwater COCs in the Phase I assessment, but these compounds were not detected in any of the most recently collected groundwater samples.

The PCB mixture Aroclor-1260 also had a high frequency of detection and considerably elevated sediment HQ values. Concentrations of Aroclor-1260 in several sediment samples considerably exceeded both most and less conservative sediment thresholds (Table 5-3). Aroclor-1260, however, was not detected in groundwater, but was detected in Phase I soil samples from the area that was later excavated during the IRA, as was 4,4'-DDT. Also, chlordane was considerably elevated in groundwater but was not detected in sediments, thereby suggesting the absence of migration to open water. On the whole, the combination of several pesticides and PCBs in elevated concentrations in sediments most likely poses potential risks to aquatic receptors near IR 1. The likelihood of cumulative or synergistic toxic effects is heightened by the presence of several organics and metals in elevated concentrations.

Aluminum, chromium, copper, lead, manganese, mercury, vanadium, and zinc were soil COPCs at IR 1. Aluminum is one of the most abundant metals in the earth's crust, and is ubiquitous in the environment (Goyer, 1986). Aluminum exceeded two times its average background concentration in only 2 of 35 soil samples collected at IR 1. Vanadium, as mentioned earlier, is not considered to be highly toxic in the environment (Mailman, 1980). Also, manganese is an essential nutrient that is a cofactor in a number of enzymatic reactions (Goyer, 1986). Therefore, the presence of these metals in soils in slightly elevated concentrations is unremarkable. Lead had a maximum detected concentration in excess of its threshold, but the HQ value was rather low (HQ = 1.4). This suggests that lead poses low potential risks to terrestrial receptors. However, lead was significantly elevated compared to background values. The significance of lead as a source of sediment contamination (via runoff) is discussed later.

Chromium, copper, mercury, and zinc were detected in soils in concentrations that may pose potential risks to terrestrial receptors (terrestrial invertebrates) and had high frequencies of detection. Of these metals, copper, mercury, and zinc were all groundwater COPCs, although their groundwater HQ values were low or they had low frequencies of detection in groundwater. Antimony and beryllium were conservatively retained as soil COPCs since their maxima exceeded two times their average background concentrations but no suitable thresholds were available. Antimony was detected in groundwater but was not a groundwater COPC and beryllium was not detected in groundwater. Also, antimony was detected in sediments but was not a sediment COPC and beryllium was not detected. Consequently potential risks from antimony and beryllium appear to be insignificant. Several metals were also terrestrial plant COPCs. Yet since terrestrial habitat is limited at IR 1 the presence of elevated concentrations of metals in IR 1 soils is of greater concern from potential runoff to surface water or leaching and migration to groundwater. It should also be noted that the only suitable inorganic terrestrial plant thresholds are thought to be very conservative (Will and Suter, 1995b).

Arsenic, cadmium, copper, lead, mercury, vanadium, and zinc were detected in lobsters collected near IR 1. Of these metals, cadmium, lead, and mercury were detected in average concentrations below or comparable to the concentrations detected in lobsters collected at background sites for this study. Lead and vanadium, which were not detected in background tissue, were detected in only 1 of 12 samples. However, copper was detected in average concentrations in lobsters at approximately two times the concentration detected in background lobsters for this assessment. Zinc was detected in IR 1 lobsters at an average concentration slightly above background. Arsenic concentrations are highly variable in marine organisms, and arsenic concentrations of more than 100 mg/kg dry weight (≈25 mg/kg fresh weight) present little hazard to the organism or its consumers (Eisler, 1988). The average concentration of arsenic in lobsters from IR 1 was 22.66 mg/kg. As a result, and since arsenic was not detected in groundwater or surface water, was not a COPC in soil, and was not elevated in most sediment samples, the arsenic concentrations in lobsters and conchs are not believed to pose significant potential ecological risks. Copper was not detected in surface water and zinc was not a surface-water COPC, but similar to arsenic, this may be a result of the dynamic hydrology in the area. Copper and zinc were COPCs in sediments, surface soils, and groundwater. Thus, the presence of elevated levels of these two metals in lobsters may be site-related.

Concentrations of zinc in tissues of aquatic organisms are usually far in excess of those required for normal metabolism (Eisler, 1993). For example, American oysters (*Crassostrea virginica*) may naturally contain up to 4,000 mg/kg in soft parts. Zinc concentrations in marine crustacean tissues are usually < 75 mg/kg (Eisler, 1993). The average concentration of zinc in lobsters (27.4 mg/kg) is well below 75 mg/kg.

Background concentrations of copper ranging from 8.5 to 25.9 mg/kg have been reported for marine shrimp (*Crangon* spp.) (Jorgensen et al., 1991). Background concentrations of copper in crabs (*Cancer pagurus, Carcinus maenas*) ranging from 6.0 to 43.8 mg/kg have also been reported (Jorgensen et al., 1991). The average concentration of copper in IR 1 lobsters (43.7 mg/kg) is nearly identical to the upper range of these background concentrations.

Several pesticides and PCBs were also detected in lobsters from IR 1. Aroclor-1260, chlorobenzilate, dieldrin, endrin, heptachlor, and methoxychlor were each detected in only 1 of 12 samples. Beta-BHC, endosulfan I, and endosulfan sulfate were each detected in only 2 of 12 lobster samples. Also, aldrin, beta-BHC, dieldrin, endrin aldehyde, heptachlor, and methoxychlor were detected in average concentrations comparable to those detected in background lobsters. The pesticide 4,4'-DDT was detected in several samples at an average concentration of 1.20 µg/kg and was not detected in background samples. No protective criteria (residue levels) have been promulgated for contaminant levels in crustaceans based on ecological concerns, but nearly all of the concentrations of the organics detected in lobsters were low (less than 2 µg/kg), and all concentrations were well below 100 µg/kg. In a review of approximately 1,200 studies of tissue residues and sublethal effects in marine animals, Gibson and Dillon (1989) noted that 100 µg/kg or less of any chlorinated organic is considered to be low.

Only two red hermit crab samples could be collected near IR 1 and only one red hermit crab sample could be collected from the background sites, making interpretation of tissue concentrations difficult. Arsenic, barium, copper, manganese, nickel, selenium, and zinc were detected in red hermit crabs collected near IR 1. Arsenic in hermit crabs was present in concentrations greater than that detected in the single background sample, but was comparable to the average concentration of arsenic detected in all background crabs. Barium was not detected in the background red hermit crab, but was roughly twice as high in the IR 1 crabs as the average concentration detected in all background crabs. Barium, however, was not considerably elevated in surface water, sediment, surface soil, or groundwater at IR 1.

The average concentration of copper in IR 1 crabs was considerably higher than the concentration in the background red hermit crab and the average concentration in all background crabs collected for this assessment. Copper was a COPC in sediments, surface soils, and groundwater. The average concentration of copper in IR 1 crabs is within the range of background concentrations in crustaceans reported in the literature (discussed earlier). Manganese was not detected in the background crabs, and the average concentration in IR 1 samples was roughly twice the average concentration in all background crabs. Manganese is an essential nutrient that is a cofactor in a number of enzymatic reactions (Goyer, 1986) and was not a COPC in surface water or sediment. Hence, its slightly elevated concentration in hermit crabs is unremarkable. Nickel and selenium were detected in relatively low concentrations in IR 1

crabs but were not detected in any background crabs. Yet, these metals were not COPCs in surface water, sediment, soil, or groundwater at IR 1. The average concentration of zinc in hermit crabs was considerably higher than the concentrations detected in the background hermit crab and the average concentration in all background crabs. However, the average concentration of zinc in IR 1 crabs is within the range of the zinc concentrations commonly found in marine crustaceans (discussed earlier). Zinc was a COPC in sediments, surface soils, and groundwater.

The organics 4,4'-DDD, 4,4'-DDE, Aroclor-1260, and endosulfan I were detected in IR 1 red hermit crabs. Of these compounds, the average concentrations of 4,4'-DDD and endosulfan I were only slightly higher than those detected in all background crabs. They were not detected in the background red hermit crab. The average concentrations of Aroclor-1260 and 4,4'-DDE were considerably higher than the average concentrations of those organics in all background crabs. Endosulfan I was not detected in the background red hermit crab, and 4,4'-DDE was detected in a higher average concentration in IR 1 crabs than in the background red hermit crab. However, one detection of Aroclor-1260 (260 µg/kg) was the only detection of any organic that exceeded the 100 µg/kg value indicative of low levels of contamination mentioned earlier (Gibson and Dillon, 1989).

The inorganics aluminum, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, and zinc were detected in vase conchs collected near IR 1. Aluminum was not detected in background conchs but was detected in only 1 of 10 IR 1 samples. Aluminum is one of the most abundant metals in the earth's crust, and is ubiquitous in the environment (Goyer, 1986). The average concentrations of cadmium, manganese, selenium, and zinc were less than or comparable to the average concentrations detected in background conchs. Mercury was not detected in background conchs but was detected in 6 of 10 IR 1 samples. Although not specific for shellfish, Wiener and Spry (1996) present a fish protection residue criterion of 3.0 mg/kg, which is one order of magnitude higher than the maximum detected concentration in conchs of 0.19 mg/kg.

Nickel was detected in an average concentration in site-related conchs (3 of 10 samples) moderately higher than the average concentration detected in background conchs, but was not a COPC in surface water, sediment, soil, or groundwater at IR 1. Lead was detected in IR 1 conchs at maximum of 0.36 mg/kg but was not detected in background conchs. This is comparable to the average concentration of lead in background lobsters, and is below a 2.0 mg/kg fish tissue concentration protective of marine animals (Maddock and Taylor, 1980). Conversely, the average concentrations of arsenic in IR 1 conchs was considerably higher than the average concentration of this metal in background conchs. However, as mentioned above, arsenic was not detected in groundwater or surface water, was not considerably elevated in sediment, and it was not a surface soil COPC. The range of concentrations of copper in IR 1

conchs was similar to the range in background conchs. Also, the maximum detected concentrations of copper in background conchs collected for this assessment was higher than the maximum concentrations in IR 1 conchs. Copper was considerably elevated in IR 1 sediments, surface soils, and to a lesser extent groundwater.

The average concentrations of all organics detected in conchs from IR 1 were higher than the average background conch concentrations, and some organics detected in IR 1 samples were not detected in background samples. However, gamma-BHC, endosulfan sulfate, and isodrin were detected in only 1 of 10 samples and heptachlor and dieldrin were detected in only 2 of 10 samples. The remaining organics were detected in 3 to 9 of 10 samples. The highest maximum and average concentrations among these compounds were for Aroclor-1260 and chlorobenzilate. The maximum detected concentration of Aroclor-1260 (0.051 mg/kg) is below the fish protection criterion of 0.4 mg/kg presented by Eisler (1986b). Aquatic toxicity data for chlorobenzilate are not available. Also, no detection of any organic in conch tissue exceeded the 100-µg/kg value indicative of low levels of contamination mentioned earlier (Gibson and Dillon, 1989).

Lead, manganese, mercury, nickel, and zinc were detected in turtle grass samples collected near IR 1. The concentrations of all of these metals, with the exception of zinc, were comparable to the concentrations detected in turtle grass at background sites. The average concentration of zinc in IR 1 turtle grass samples was approximately three times the average concentration in background turtle grass. Zinc was elevated in sediments, surface soils, and groundwater. Several pesticides and Aroclor-1260 were detected in turtle grass samples at IR 1. The average concentrations of all pesticides were higher in IR 1 samples than in background samples, but detected concentrations of all compounds (except Aroclor-1260) were less than 1 µg/kg. Aroclor-1260 was detected in 1 of 4 samples at 760 µg/kg.

5.7.4.3 Ecological Risk Summary

IR I is located adjacent to the open ocean along the southwestern shore of Key West. The site itself provides terrestrial habitat of marginal quality. Only occasional transient birds and small mammals likely use IR 1. The nearby open ocean provides excellent aquatic habitat. A variety of fish, shellfish, and aquatic vegetation were observed at the site and collected for tissue analysis for this ERA. Runoff and groundwater discharge to the ocean are potential contaminant migration pathways from IR 1.

The Phase I ecological risk assessment for IR 1 conducted by IT Corporation (1994) identified a number of inorganics as sediment and groundwater COCs. The assessment concluded that the greatest potential risk to aquatic organisms from inorganics is through direct contact via groundwater discharges, and to a

much lesser extent contact with contaminated sediment. Antimony was the only surface-water inorganic COC. Several organics were identified as organic groundwater COCs. In sediments, dieldrin and endrin aldehyde were identified as organic COCs, and several metals and organics were considered to be capable of bioaccumulating sufficiently in fish to pose potential risks to piscivores.

The Phase I assessment also identified several metals and organics as soil COCs. Consumption of antimony, cadmium, copper, lead, zinc, Aroclor-1254, and Aroclor-1260 in vegetation was determined to pose potential risk to terrestrial receptors that forage on plants. However, the study concluded that due to highly compacted soils, sparse vegetation, man-made structures, and a chain-link fence surrounding the site, IR 1 surface soils pose minimal risks to terrestrial receptors. The overall conclusion of the assessment was that moderate to high potential risks were present from several COCs in various media, primarily aquatic, and that additional ecological investigations to more fully characterize ecological risks were warranted (IT Corporation, 1994).

In this Phase II assessment, copper, iron, lead, manganese, mercury, and zinc were groundwater COPCs. However, these metals either had low frequencies of detection, low HQ values, or were not elevated in aquatic media near IR 1. A number of pesticides were detected in groundwater samples collected closest to the shoreline. Of these compounds, endosulfan I, dieldrin, and gamma-BHC in groundwater all considerably exceeded surface-water screening values and had high frequencies of detection. Since recent soil samples were not analyzed for organics, the presence of these compounds in sediments as a result of runoff from IR 1 cannot be fully evaluated. However, endosulfan I, dieldrin, and gamma-BHC were not soil COCs from the Phase I assessment.

Tin was the only surface-water COPC, but its HQ value was rather low. Hence, potential risks to IR 1 biota from contaminants in surface waters are not significant. This is not unusual given the dynamic nature of surface water at the shoreline. That is, the movement and mixing of surface water from constant wave action most likely rapidly dilutes surface-water contaminants. Tin was present in sediments, but was not detected in IR 1 soils or groundwater, suggesting that IR 1 is not the source of this inorganic. A number of other inorganics had considerably elevated HQ values and high frequencies of detection in sediments, primarily copper, lead, and zinc, suggesting direct potential risks to benthic organisms, although it should be noted that of these three metals only one detection of lead and zinc exceeded the less conservative sediment thresholds used in this assessment.

Copper is high in IR 1 lobsters and to a lesser extent crabs relative to background lobsters and crabs collected for this assessment. Zinc appears to be accumulating in crabs, turtle grass, and lobsters relative to background crabs, lobsters, and turtle grass collected for this assessment. Nonetheless, the

concentrations of copper and zinc in IR 1 crabs and lobsters are similar to concentrations from several other background studies reported in the literature. Copper, lead, and zinc were considerably elevated in surface soils and, to a lesser extent groundwater at IR 1, but frequencies of detection in groundwater or HQ values for groundwater were relatively low. This suggests migration of these contaminants to the ocean primarily via runoff.

A number of organochlorine pesticides and PCBs were detected in elevated concentrations in sediments, several of which exceeded both most and less conservative threshold values used in the assessment. Of these, the PCB mixture Aroclor-1260 was detected in a maximum concentration much higher than even the less conservative sediment threshold used and had a high frequency of detection, suggesting potential risks to benthic organisms. No PCBs were detected in groundwater, but they were detected in Phase I surface soil samples. Many of the pesticides detected in sediments were also detected in groundwater. Therefore, both groundwater discharge and runoff from IR 1 may be contributing organic contaminants to the ocean. Nonetheless, organics do not appear to be accumulating considerably in biota. The exception was Aroclor-1260, which was present in slightly elevated concentrations in turtle grass, crabs, lobsters, and conchs. However, Aroclor-1260 was detected in only one crab, lobster, and turtle grass sample. This PCB mixture was detected in 4 of 10 conch samples. The single detection of Aroclor-1260 in crabs was the only detection of organics in crabs, lobsters, and conchs that exceeded 100 µg/kg, a level below which is considered to be low (Gibson and Dillon, 1989).

Several metals were COPCs in surface soils. Also, a number of metals were terrestrial plant COPCs. Yet due to the limited amount of terrestrial habitat on the site and the presence of only turfgrass and scattered trees, potential risks to terrestrial receptors are considered to be insignificant. The presence of elevated concentrations in site soils appears to be more important as a contaminant source to groundwater and in runoff. Runoff may have been more significant during previous disposal activities and during IRA excavation than at present since the site is now heavily covered with turfgrass and other vegetation and ground-disturbing activities are no longer performed. Nonetheless, continued runoff of contaminants to the ocean water is still possible, especially from lower-lying areas around the site periphery that have a thin understory.

In summary, elevated concentrations of copper, lead, and zinc are present in sediments, suggesting potential risks to benthic receptors. Runoff appears to be the primary migration pathway. Some of the pesticides present in elevated concentrations in sediments (endosulfan I, dieldrin, and gamma-BHC) were elevated in groundwater samples collected close to the shore, suggesting migration of these contaminants via groundwater discharge. However, several pesticides and Aroclor-1260 present in elevated concentrations in sediments were not detected in groundwater. Recent soil sampling did not include

organics analysis, and therefore, it is unclear if IR 1 soils are the source of these compounds in sediments. Since organics do not appear to be significantly accumulating in biota, potential risks from these compounds appear to be limited to benthic organisms.

Organic compounds chosen as final COCs in sediment consist of 4,4'-DDT, dieldrin, endrin, endosulfan, gamma-BHC, and some daughter products of these pesticides, as well as Aroclor-1260. Final COCs in groundwater consist of endosulfan I, dieldrin, and gamma-BHC. Metals chosen as COCs in soil and sediment consist of copper, lead, and zinc. Since the use of the site by terrestrial receptors is minimal, these metals do not pose a potential risk to terrestrial receptors; however, they are considered soil COCs due to their potential for migration (via runoff) to aquatic habitats near IR 1. The bioavailability and toxicity of sediment contaminants to benthos is not known. As a result, sediment toxicity testing is recommended at IR 1 to evaluate whether elevated concentrations of copper, lead, zinc, and organic compounds are potentially impacting benthic organisms near the site.

5.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of investigation at IR 1 were to the identify the existing nature and extent of contamination (after interim remedial action) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

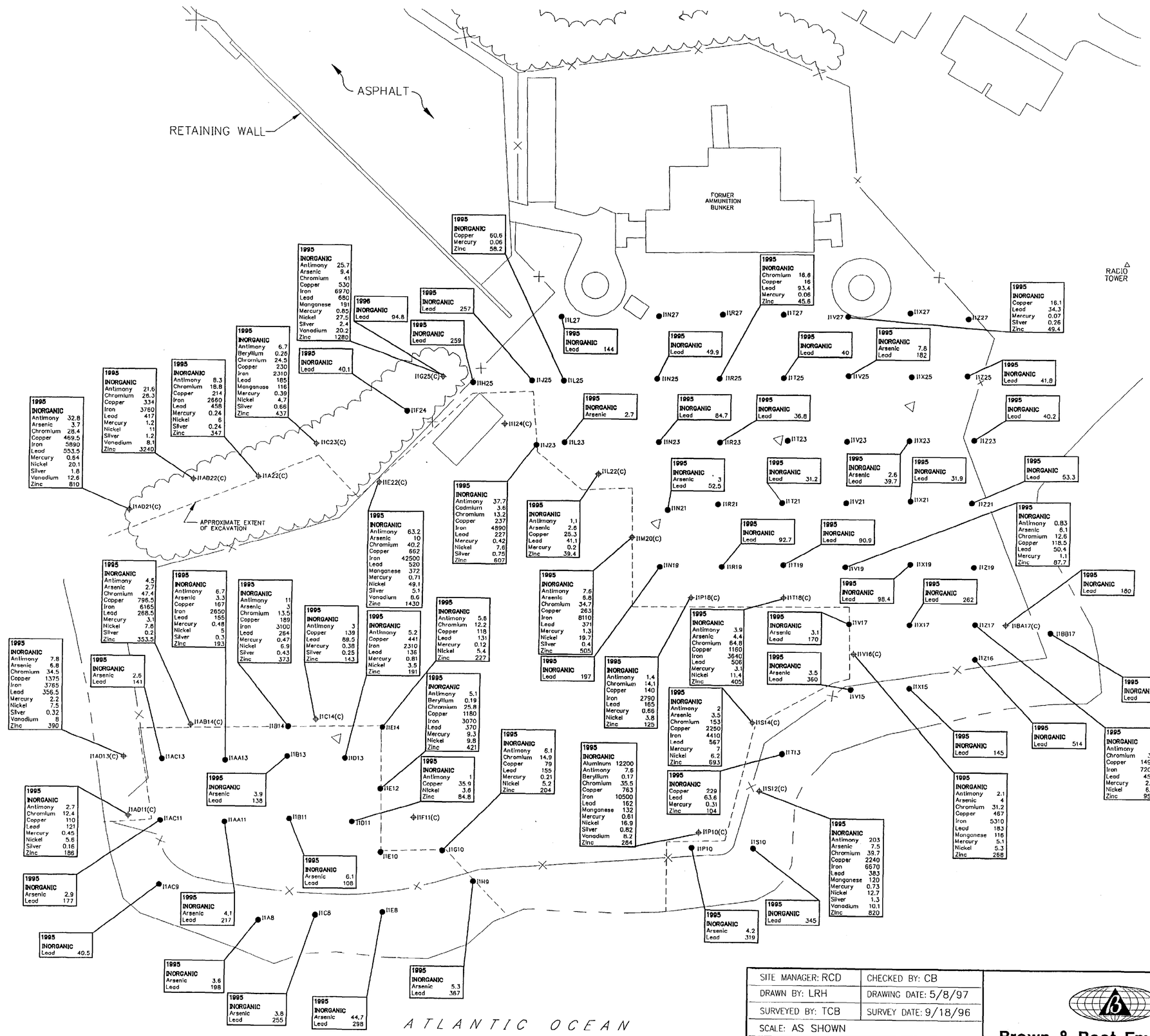
Although a large portion of the soils have been removed and backfilled during the IRA conducted in 1996, elevated concentrations of some contaminants remain at IR 1. Metals were detected at high frequencies in soil at IR 1. Metals were also detected in sediment, surface water, and groundwater. Several VOCs, SVOCs, pesticides, and PCBs were also detected at the site.

The human health risks for current receptors caused by the low level of contaminants at IR 1 are within or below the EPA target risk range of 1.0E-04 to 1.0E-06 for cancer-causing chemicals, exceed the FDEP target risk of 1E-06 for all scenarios, except the maintenance worker, and are below the 1.0 hazard index for noncancer-causing chemicals. However, contaminants are present at concentrations indicating that adverse carcinogenic and noncarcinogenic health effects might occur for the hypothetical future resident exposure scenario using both EPA and FDEP target risks. Aroclor-1254, Aroclor-1260, and arsenic are the main contributors to the carcinogenic risk. Antimony, arsenic, copper, iron, and Aroclor-1254 are the main contributors to the noncarcinogenic risk.

The ecological risk assessment concludes that elevated concentrations of copper, lead, and zinc are present in sediments near IR 1 that pose potential risks to benthic receptors. Runoff appears to be the primary migration pathway. In addition, elevated concentrations of pesticides were detected in

groundwater samples collected close to the shore, suggesting migration of these contaminants via groundwater discharge. However, several pesticides and Aroclor-1260 were not detected in groundwater but were present in elevated concentrations in sediments. Recent soil sampling did not include organics analysis, therefore, it is unclear if IR 1 soils are the source of the contamination in sediments.

A feasibility study (FS) is recommended for IR 1. The FS should include the performance of toxicity tests to determine whether the concentrations of chemicals detected in sediments are actually toxic to benthic organisms. The results of the toxicity tests should be used to identify any additional sampling required to support the FS. Finally, the results of the toxicity tests and any additional sampling should be used with existing data to support the evaluation of remedial alternatives in the FS. Because of the calculated human health risk posed to a future resident, the FS should include the evaluation of NFA and institutional controls. Additional remedial actions may be evaluated in the FS based on the results of the toxicity tests and any additional sampling.



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APPROX. SCALE 20 10 0 40

PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	3800
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Cadmium	2.5
Chromium	12
Copper	15
Iron	2300
Lead	31
Manganese	100
Mercury	0.08
Nickel	3.4
Silver	9.8E-06
Vanadium	7.9
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg

NOTE: SURFACE SOILS SAMPLES WERE NOT ANALYZED FOR ORGANIC PARAMETERS.

NOTE: II025(C) WAS SAMPLED AND ANALYZED FOR LEAD TWICE DURING THE BEI CONFIRMATION STUDY.

LEGEND

II1AC9 ● SOIL SAMPLE LOCATION BEI (1995)

II1AD11(C) ⊕ SOIL SAMPLE LOCATION BEI (1995,1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: LRH	DRAWING DATE: 5/8/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR1516	PROJ. NO.: 7046

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IR 1
SURFACE SOIL CHEMICAL CONCENTRATIONS

NAVAL AIR STATION
KEY WEST, FLORIDA

6.0 INSTALLATION RESTORATION SITE 3 (IR 3)

This chapter describes the site-specific evaluation of data for IR 3 (Truman Annex DDT Mixing Area). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 6.8 presents a summary and conclusions with recommendations for IR 3.

6.1 UNIT DESCRIPTION

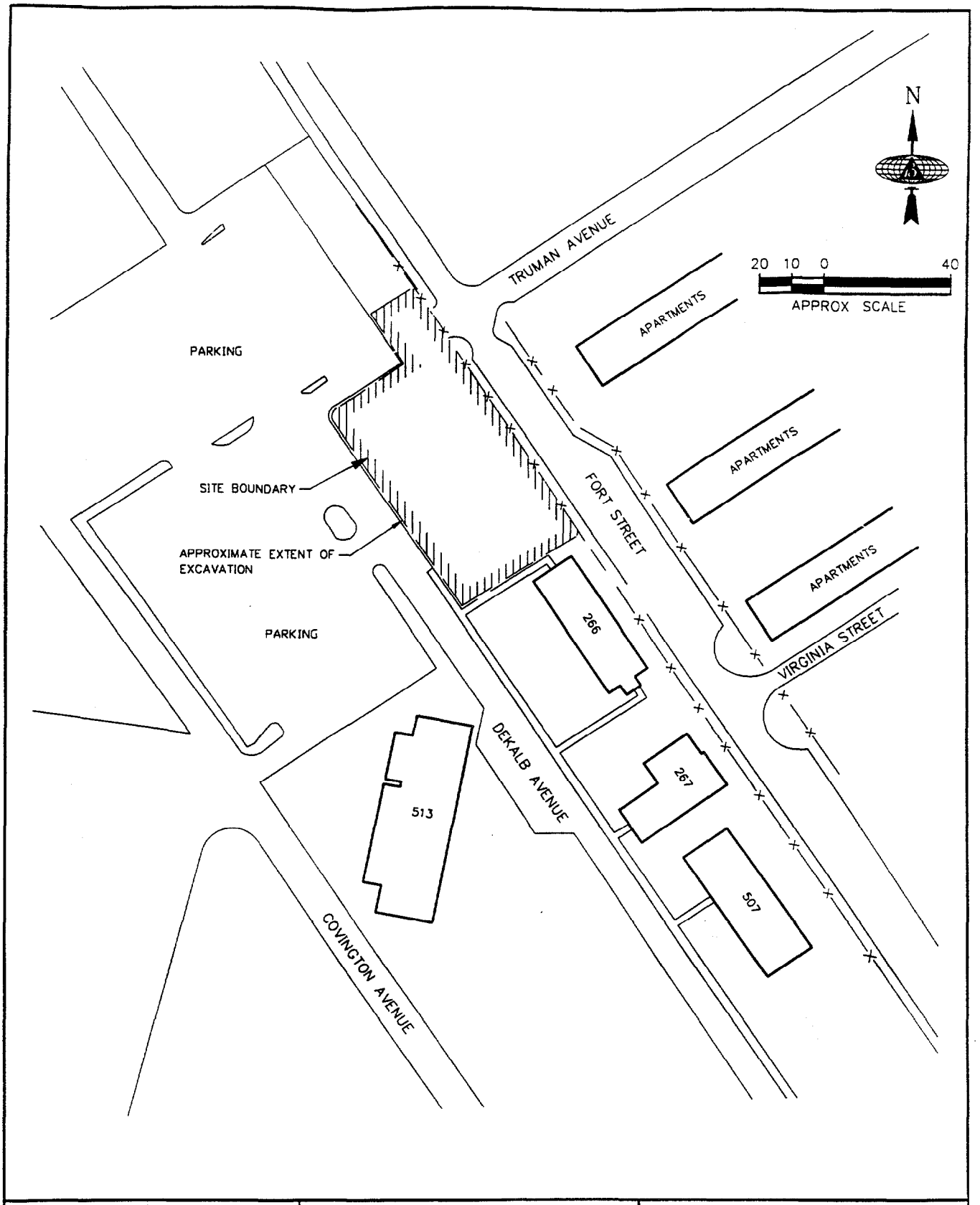
The Truman Annex DDT Mixing Area (IR 3) is located at the former site of NAS Building 265 (Figure 6-1). The site covers an area of about 1/4 acre and is located approximately 1,100 feet inland from the coastline in an area that is restricted to vehicular and pedestrian traffic. Fort Street, which is the westernmost street of an adjacent residential area, is located opposite the chain-link fence that marks the Navy's property boundary to the northeast of the site. The topography of the site is flat and turf grass covers most of the soils. The site is underlain by highly permeable soil with no surface-water drainage or holding features present. From the 1940s to the early 1970s, the location was used as a DDT mixing area. Powdered DDT concentrate was mixed with water and temporarily stored in 55-gallon drums both inside and outside the former building. The mixed solution was then transferred to trucks for dispersal. Discharges at the site were from accidental spills.

6.2 INVESTIGATION HISTORY

Several investigations have been performed at IR 3 since the mid-1980s to identify, confirm or delineate contamination. The previous investigations are summarized in Section 6.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 6.2.2.

6.2.1 Previous Investigations

An initial investigation of this site was conducted by Geraghty and Miller in 1986. Surface soil sampling was conducted and analyzed for pesticides. All these samples were collected from the area that was later excavated by BEI. Analytical results indicated that DDT and other pesticides such as BHC were present. In 1990, IT Corporation conducted a preliminary RI. Groundwater samples from the site indicated that



SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCM	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR361	PROJ. NO.: 7046

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FIGURE 6-1
SITE LOCATION MAP
IR 3
NAVAL AIR STATION
KEY WEST, FLORIDA

cadmium and seven different pesticide compounds were present in concentrations above established standards. The pesticide concentrations in the groundwater suggested that leaching could be occurring at the site.

Subsequently, IT Corporation conducted soil and groundwater sampling during the RFI/RI at this site in 1993. Characterization of contamination at the site indicated that surface soil and groundwater appeared to be impacted by metals (e.g., lead and arsenic) and pesticides. The source of groundwater contamination appeared to be the leaching of metals and pesticides from the soil (IT Corporation, 1994). The Final RFI/RI prepared by IT Corporation recommended installing new monitoring wells and additional soil sampling to further delineate the extent of groundwater contamination; conducting an IRA to remove or cap contaminated surface soils; and performing a preliminary feasibility study to determine appropriate remedial actions to prevent further migration of contaminants.

Subsequent to the submittal of the draft Supplemental RFI/RI workplan (ABB, 1995), BEI began implementation of IRAs at some of the sites at NAS Key West. Delineation and characterization sampling of soil focusing on certain pesticides was conducted at IR 3 to supplement the previous data. In 1996, BEI performed an IRA to excavate and dispose of pesticide contaminated soil. The IRA removed 735 cubic yards of DDT contaminated soil from the site for treatment and disposal, and reduced DDT concentrations from 60,000 µg/kg to 21,000 µg/kg.

6.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at IR 3 and the scope of those field activities performed from August to October 1996. In addition to the results from the Supplemental RFI/RI, soil data collected to verify the removal of impacted soils were obtained from the confirmation sampling conducted after the IRA. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 6-2 and 6-3 show the location of all soil and groundwater samples obtained during this investigation, as well as those from previous investigations.

6.2.2.1 Investigation Rationale

Additional sampling of soil and groundwater was conducted at IR 3 to provide more information upon which appropriate risk assessments can be based. Sampling of soil was performed on outlying areas to

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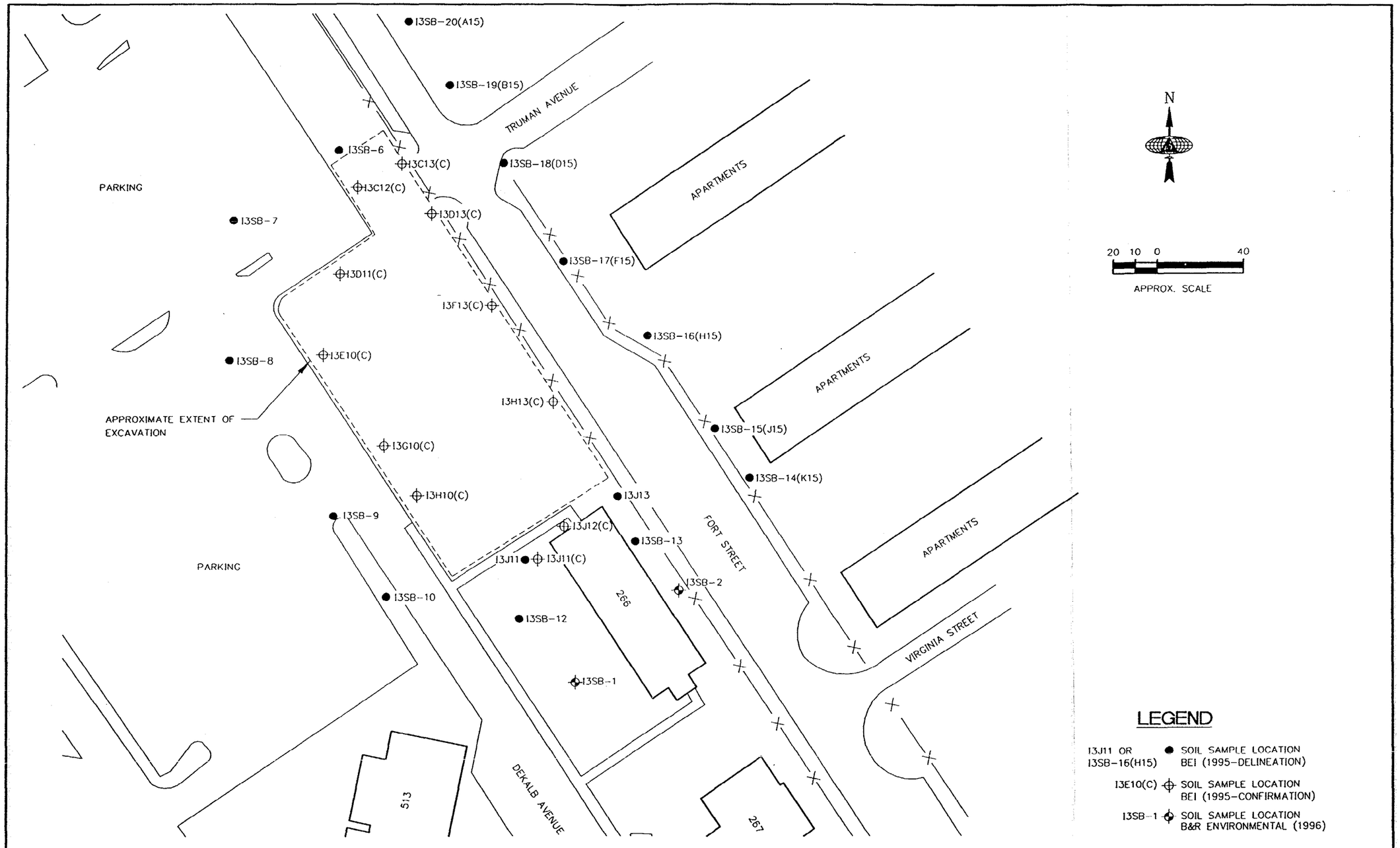

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DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR362	PROJ. NO.: 7046

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FIGURE 6-2
SOIL SAMPLE LOCATIONS
IR 3
NAVAL AIR STATION
KEY WEST, FLORIDA

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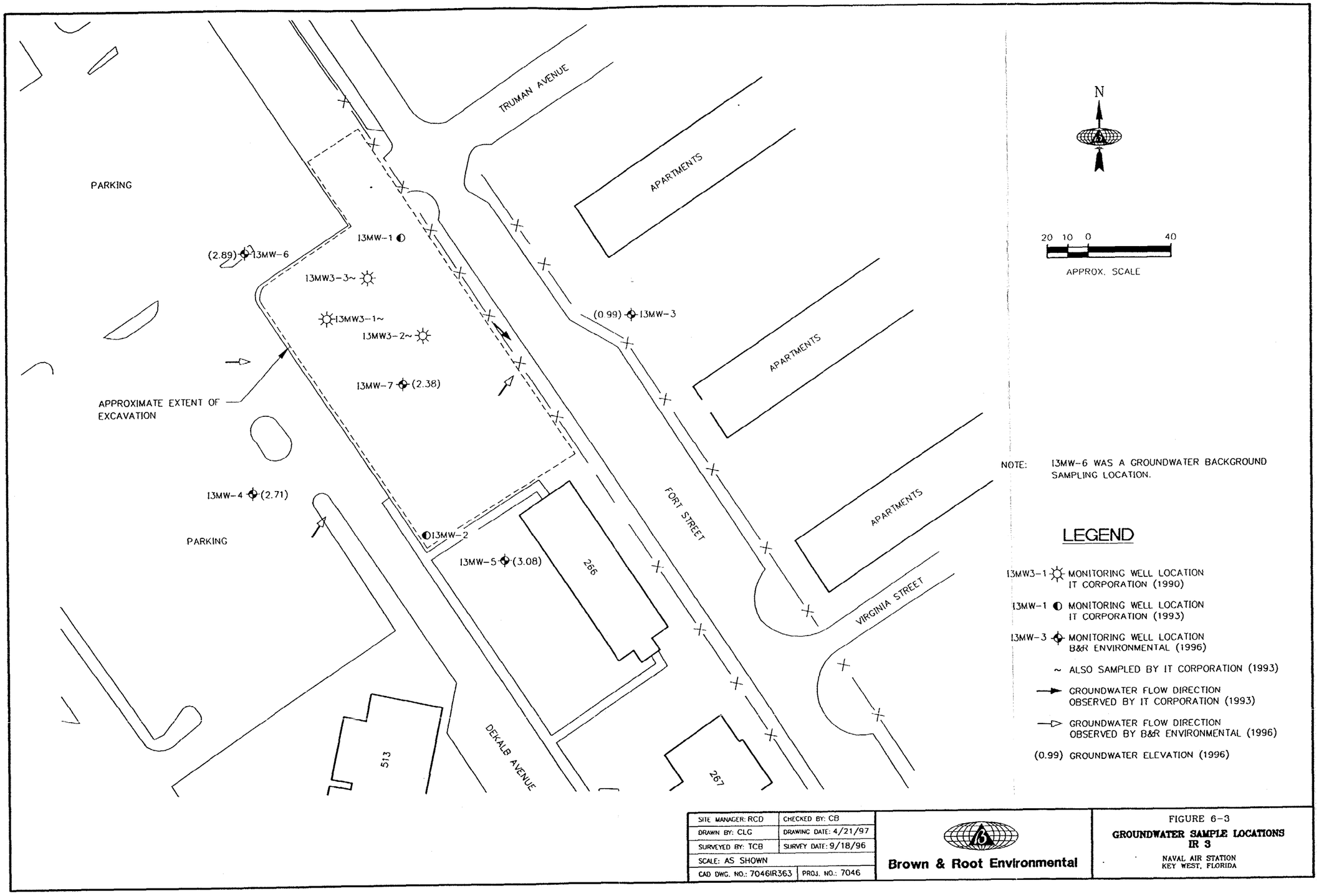

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR363	PROJ. NO.: 7046

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FIGURE 6-3
GROUNDWATER SAMPLE LOCATIONS IR 3
NAVAL AIR STATION KEY WEST, FLORIDA

further assess the aerial extent of pesticide contamination within the Navy property and to determine if existing outlying surface soil may reflect background conditions. Additional monitoring wells were installed and sampled to complete the delineation of pesticides in groundwater.

6.2.2.2 Scope of Current Field Investigation

Supplemental field activities at IR 3 included the collection of soil samples to further delineate contaminated areas based on earlier sampling activities, monitoring well installation, and groundwater sampling to characterize previously-detected levels of contamination.

6.2.2.2.1 Surface Soil

Soil sampling data was obtained from the characterization sampling conducted by BEI during the IRA. This data was accepted and used in the analyses to provide a more comprehensive analysis of data for making decisions about IR 3. Previous sampling at IR 3 had not sufficiently characterized surface soil after the interim removal action. Therefore, additional surface soil samples were taken to supplement previous soil sampling results. All IR 3 soil samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals

6.2.2.2.2 Surface Water and Sediment

No surface-water and sediment sampling was conducted during this investigation. There is no surface water or sediment at or near the site.

6.2.2.2.3 Groundwater

Groundwater sampling was conducted to determine the presence of pesticides, PCBs, herbicides, and metals in groundwater at IR 3. Additional monitoring wells were installed on and offsite to assess the

groundwater conditions following the interim removal action. All IR 3 groundwater samples were analyzed for the following parameters:

- Appendix IX herbicides Appendix IX pesticides
- Appendix IX PCBs
- TAL metals

6.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at NAS Key West is included in Section 1.4 (Base Environmental Setting) of this document. Applicable unit specific physical characteristics are discussed below.

6.3.1 Hydrogeology

Five additional wells (I3MW-3 through I3MW-7) were installed by B&R Environmental during this investigation. The well construction logs are presented in Appendix E. The depth to groundwater at the site ranged from approximately 0.99 feet to 1.28 feet above msl, and the primary hydrogeologic unit underlying the site is the surficial oolite limestone aquifer. The direction of groundwater flow as determined during the Supplemental RFI/RI was generally toward the east with a gradient of approximately 0.010 foot/foot. This was consistent with the observations made by IT Corporation in 1993. The groundwater flow directions are indicated on Figure 6-3. Recharge of the aquifer appeared to be through direct infiltration of precipitation; however, variation in groundwater levels in monitoring wells during the investigation suggests the possibility of tidal influence on the groundwater at the site (IT Corporation, 1994).

6.3.2 Soils

During the Preliminary RI in 1990, geotechnical data were obtained from analysis of a composite soil sample collected from ground surface to approximately 2 feet bls. Grain size analysis indicated a well-graded material with grain sizes ranging from gravel to clay. The pH was 8.35 due to the abundance of carbonate soils and rock. The total organic content of 8,700 mg/kg was high, indicating an abundance of organic matter which could act to adsorb some contaminants. The permeability of the composite soil sample was 6.55 x E-07 cm/sec, which is characteristic of a very impermeable material.

6.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from surface soil and groundwater in the vicinity of the Truman Annex DDT Mixing Area. The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including

background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various state and federal agencies and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media, in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix H contains the full data set used in site characterization and assessment. Appendix I contains the analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI.

6.4.1 Surface Soil

Data from a number of sampling efforts including the 1995 BEI Delineation Study, the 1995-96 BEI Confirmatory Study, and this Supplemental RFI/RI were considered in the analysis of surface soil contamination at IR 3. Chemicals that were detected in surface soil samples are listed in Table 6-1. This table includes analytical results from all applicable historical sampling events as well as the Supplemental RFI/RI. Figures 6-4 and 6-5 show the occurrence of compounds that exceeded screening values in surface soil. Metals accounted for most of the chemicals detected in the surface soil at the Truman Annex DDT Mixing Area although certain pesticides, particularly 4,4'-DDT and its degradation products, were also frequently detected.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

6.4.1.1 Volatile Organic Compounds

VOCs were not analyzed in surface soil at IR 3.

6.4.1.2 Semivolatile Organic Compounds

SVOCs were not analyzed in surface soil at IR 3.

TABLE 6-1

CHEMICALS DETECTED IN SURFACE SOIL AT IR 3
NAS KEY WEST
PAGE 1 OF 9

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
I3SB-13	BEI(D) 1995	Aluminum	3,370	E_1
I3SB-18(D15)	BEI(D) 1995	Aluminum	2,780	E_1
I3E10(C)	BEI(C) 1995	Aluminum	2,540	
I3H13(C)	BEI(C) 1995	Aluminum	2,460	
I3SB-2	B&RE 1996	Aluminum	2,250	
I3SB-12	BEI(D) 1995	Aluminum	2,025	E_1
I3SB-17(F15)	BEI(D) 1995	Aluminum	1,690	E_1
I3J12(C)	BEI(C) 1995	Aluminum	1,650	
I3SB-16(H15)	BEI(D) 1995	Aluminum	1,460	E_1
I3F13(C)	BEI(C) 1995	Aluminum	1,410	
I3SB-20(A15)	BEI(D) 1995	Aluminum	1,350	E_1
I3SB-19(B15)	BEI(D) 1995	Aluminum	1,200	E_1
I3D11(C)	BEI(C) 1995	Aluminum	1,110	
I3SB-14(K15)	BEI(D) 1995	Aluminum	1,040	E_1
I3J11(C)	BEI(C) 1995	Aluminum	1,030	
I3D13(C)	BEI(C) 1995	Aluminum	934	
I3SB-10	BEI(D) 1995	Aluminum	836	E_1
I3SB-15(J15)	BEI(D) 1995	Aluminum	795	E_1
I3SB-8	BEI(D) 1995	Aluminum	736	E_1
I3SB-6	BEI(D) 1995	Aluminum	718	E_1
I3SB-7	BEI(D) 1995	Aluminum	693	E_1
I3SB-9	BEI(D) 1995	Aluminum	687	E_1
I3C13(C)	BEI(C) 1995	Aluminum	489	
I3SB-1	B&RE 1996	Aluminum	482	
I3G10(C)	BEI(C) 1995	Aluminum	459	
I3C12(C)	BEI(C) 1995	Aluminum	456	
I3H10(C)	BEI(C) 1995	Aluminum	265	
I3H13(C)	BEI(C) 1995	Antimony	4.4	
I3J12(C)	BEI(C) 1995	Antimony	3.3	
I3SB-17(F15)	BEI(D) 1995	Antimony	3	B_3
I3SB-18(D15)	BEI(D) 1995	Antimony	1.6	B_3
I3SB-14(K15)	BEI(D) 1995	Antimony	1.5	B_3
I3SB-15(J15)	BEI(D) 1995	Antimony	1.3	B_3
I3SB-19(B15)	BEI(D) 1995	Antimony	1.2	B_3
I3SB-20(A15)	BEI(D) 1995	Antimony	1.2	B_3
I3SB-16(H15)	BEI(D) 1995	Antimony	1.1	B_3
I3E10(C)	BEI(C) 1995	Antimony	0.84	B_2
I3F13(C)	BEI(C) 1995	Antimony	0.72	B_2
I3SB-6	BEI(D) 1995	Antimony	0.55	B_3
I3SB-13	BEI(D) 1995	Antimony	0.53	B_3
I3D13(C)	BEI(C) 1995	Antimony	0.42	B_2
I3SB-12	BEI(D) 1995	Antimony	0.4	B_3
I3SB-8	BEI(D) 1995	Antimony	0.38	B_3
I3SB-7	BEI(D) 1995	Antimony	0.38	B_3
I3SB-9	BEI(D) 1995	Antimony	0.33	B_3
I3SB-10	BEI(D) 1995	Antimony	0.3	B_3
I3J11(C)	BEI(C) 1995	Antimony	0.19	B_2
I3C13(C)	BEI(C) 1995	Antimony	0.18	B_2
I3C12(C)	BEI(C) 1995	Antimony	0.18	B_2
I3H10(C)	BEI(C) 1995	Antimony	0.15	B_2
I3D11(C)	BEI(C) 1995	Antimony	0.12	B_2
I3E10(C)	BEI(C) 1995	Arsenic	13	
I3D11(C)	BEI(C) 1995	Arsenic	5.4	
I3SB-17(F15)	BEI(D) 1995	Arsenic	4.5	N_1
I3D13(C)	BEI(C) 1995	Arsenic	4.4	
I3SB-18(D15)	BEI(D) 1995	Arsenic	3.9	N_1
I3SB-14(K15)	BEI(D) 1995	Arsenic	3.7	N_1
I3SB-13	BEI(D) 1995	Arsenic	3.3	N_1
I3SB-9	BEI(D) 1995	Arsenic	2.9	N_1
I3SB-19(B15)	BEI(D) 1995	Arsenic	2.9	N_1
I3J12(C)	BEI(C) 1995	Arsenic	2.8	

TABLE 6-1

CHEMICALS DETECTED IN SURFACE SOIL AT IR 3
NAS KEY WEST
PAGE 2 OF 9

Location	Source[1]	Parameter	Result	Qual.[2]
I3H13(C)	BEI(C) 1995	Arsenic	2.7	
I3SB-2	B&RE 1996	Arsenic	2.6	
I3SB-10	BEI(D) 1995	Arsenic	2.5	N_1
I3SB-15(J15)	BEI(D) 1995	Arsenic	2.4	N_1
I3F13(C)	BEI(C) 1995	Arsenic	2.3	
I3J13	BEI(D) 1995	Arsenic	2.2	
I3H10(C)	BEI(C) 1995	Arsenic	2.1	
I3SB-16(H15)	BEI(D) 1995	Arsenic	2	N_1
I3SB-20(A15)	BEI(D) 1995	Arsenic	1.9	N_1
I3SB-8	BEI(D) 1995	Arsenic	1.5	N_1
I3J11(C)	BEI(C) 1995	Arsenic	1.5	
I3SB-12	BEI(D) 1995	Arsenic	1.5	N_1
I3C12(C)	BEI(C) 1995	Arsenic	1	B_2
I3SB-7	BEI(D) 1995	Arsenic	0.97	B_3N_1
I3J11	BEI(D) 1995	Arsenic	0.97	
I3C13(C)	BEI(C) 1995	Arsenic	0.96	B_2
I3G10(C)	BEI(C) 1995	Arsenic	0.89	B_2
I3SB-6	BEI(D) 1995	Arsenic	0.89	B_3N_1
I3SB-1	B&RE 1996	Arsenic	0.66	
I3SB-17(F15)	BEI(D) 1995	Barium	409	E_1
I3SB-18(D15)	BEI(D) 1995	Barium	381	E_1
I3SB-15(J15)	BEI(D) 1995	Barium	192	E_1
I3SB-16(H15)	BEI(D) 1995	Barium	179	E_1
I3SB-20(A15)	BEI(D) 1995	Barium	164	E_1
I3SB-19(B15)	BEI(D) 1995	Barium	146	E_1
I3SB-2	B&RE 1996	Barium	73.3	
I3SB-14(K15)	BEI(D) 1995	Barium	69.3	E_1
I3F13(C)	BEI(C) 1995	Barium	66.8	
I3SB-13	BEI(D) 1995	Barium	49.9	E_1
I3D13(C)	BEI(C) 1995	Barium	49.2	
I3H13(C)	BEI(C) 1995	Barium	37.6	

Location	Source[1]	Parameter	Result	Qual.[2]
I3J12(C)	BEI(C) 1995	Barium	35.5	
I3D11(C)	BEI(C) 1995	Barium	34.4	
I3C12(C)	BEI(C) 1995	Barium	32.6	
I3E10(C)	BEI(C) 1995	Barium	31.1	
I3SB-6	BEI(D) 1995	Barium	26.1	E_1
I3SB-12	BEI(D) 1995	Barium	23.6	E_1
I3C13(C)	BEI(C) 1995	Barium	20.8	
I3SB-7	BEI(D) 1995	Barium	20.1	E_1
I3J11(C)	BEI(C) 1995	Barium	17	
I3SB-9	BEI(D) 1995	Barium	16.2	B_3E_1
I3SB-10	BEI(D) 1995	Barium	16.1	B_3E_1
I3SB-8	BEI(D) 1995	Barium	15	B_3E_1
I3G10(C)	BEI(C) 1995	Barium	13.9	
I3SB-1	B&RE 1996	Barium	12.8	
I3H10(C)	BEI(C) 1995	Barium	11.4	
I3SB-13	BEI(D) 1995	Beryllium	0.17	B_3
I3SB-17(F15)	BEI(D) 1995	Beryllium	0.15	B_3
I3SB-18(D15)	BEI(D) 1995	Beryllium	0.14	B_3
I3SB-12	BEI(D) 1995	Beryllium	0.14	B_3
I3SB-16(H15)	BEI(D) 1995	Beryllium	0.12	B_3
I3SB-14(K15)	BEI(D) 1995	Beryllium	0.12	B_3
I3SB-20(A15)	BEI(D) 1995	Beryllium	0.12	B_3
I3SB-19(B15)	BEI(D) 1995	Beryllium	0.11	B_3
I3SB-10	BEI(D) 1995	Beryllium	0.1	B_3
I3SB-9	BEI(D) 1995	Beryllium	0.1	B_3
I3SB-6	BEI(D) 1995	Beryllium	0.1	B_3
I3SB-7	BEI(D) 1995	Beryllium	0.1	B_3
I3SB-15(J15)	BEI(D) 1995	Beryllium	0.1	B_3
I3SB-8	BEI(D) 1995	Beryllium	0.09	B_3
I3H13(C)	BEI(C) 1995	Beryllium	0.07	B_2
I3E10(C)	BEI(C) 1995	Beryllium	0.06	B_2

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Location	Source[1]	Parameter	Result	Qual.[2]
I3J12(C)	BEI(C) 1995	Beryllium	0.04	B_2
I3F13(C)	BEI(C) 1995	Beryllium	0.03	B_2
I3D11(C)	BEI(C) 1995	Beryllium	0.02	B_2
I3D13(C)	BEI(C) 1995	Beryllium	0.02	B_2
I3J11(C)	BEI(C) 1995	Beryllium	0.01	B_2
I3SB-17(F15)	BEI(D) 1995	Cadmium	1.9	
I3F13(C)	BEI(C) 1995	Cadmium	1.4	
I3SB-18(D15)	BEI(D) 1995	Cadmium	1.1	
I3SB-15(J15)	BEI(D) 1995	Cadmium	0.9	
I3SB-20(A15)	BEI(D) 1995	Cadmium	0.81	
I3SB-16(H15)	BEI(D) 1995	Cadmium	0.78	
I3SB-14(K15)	BEI(D) 1995	Cadmium	0.72	
I3SB-19(B15)	BEI(D) 1995	Cadmium	0.66	
I3SB-13	BEI(D) 1995	Cadmium	0.65	
I3H13(C)	BEI(C) 1995	Cadmium	0.45	B_2
I3J12(C)	BEI(C) 1995	Cadmium	0.37	B_2
I3D13(C)	BEI(C) 1995	Cadmium	0.37	
I3SB-12	BEI(D) 1995	Cadmium	0.32	B_3
I3SB-9	BEI(D) 1995	Cadmium	0.31	B_3
I3SB-6	BEI(D) 1995	Cadmium	0.26	B_3
I3E10(C)	BEI(C) 1995	Cadmium	0.21	B_2
I3J11(C)	BEI(C) 1995	Cadmium	0.2	B_2
I3SB-10	BEI(D) 1995	Cadmium	0.16	B_3
I3SB-7	BEI(D) 1995	Cadmium	0.16	B_3
I3C13(C)	BEI(C) 1995	Cadmium	0.15	B_2
I3SB-8	BEI(D) 1995	Cadmium	0.14	B_3
I3D11(C)	BEI(C) 1995	Cadmium	0.11	B_2
I3C12(C)	BEI(C) 1995	Cadmium	0.1	B_2
I3G10(C)	BEI(C) 1995	Cadmium	0.1	B_2
I3H10(C)	BEI(C) 1995	Cadmium	0.09	B_2
I3SB-18(D15)	BEI(D) 1995	Chromium	15.1	E_1N_1*1
I3SB-17(F15)	BEI(D) 1995	Chromium	14.8	E_1N_1*1
I3SB-16(H15)	BEI(D) 1995	Chromium	14.3	E_1N_1*1
I3SB-15(J15)	BEI(D) 1995	Chromium	10.7	E_1N_1*1
I3SB-13	BEI(D) 1995	Chromium	10.2	E_1N_1*1
I3SB-20(A15)	BEI(D) 1995	Chromium	10	E_1N_1*1
I3SB-14(K15)	BEI(D) 1995	Chromium	9.8	E_1N_1*1
I3F13(C)	BEI(C) 1995	Chromium	8.8	
I3SB-2	B&RE 1996	Chromium	7.8	
I3H13(C)	BEI(C) 1995	Chromium	7.7	
I3SB-19(B15)	BEI(D) 1995	Chromium	6.9	E_1N_1*1
I3J12(C)	BEI(C) 1995	Chromium	6.3	
I3D13(C)	BEI(C) 1995	Chromium	5.9	
I3SB-12	BEI(D) 1995	Chromium	5.8	E_1N_1*1
I3E10(C)	BEI(C) 1995	Chromium	5.6	
I3SB-9	BEI(D) 1995	Chromium	5.3	E_1N_1*1
I3SB-10	BEI(D) 1995	Chromium	5	E_1N_1*1
I3J11(C)	BEI(C) 1995	Chromium	4.7	
I3SB-8	BEI(D) 1995	Chromium	4	E_1N_1*1
I3SB-7	BEI(D) 1995	Chromium	3.4	E_1N_1*1
I3SB-6	BEI(D) 1995	Chromium	3.3	E_1N_1*1
I3SB-1	B&RE 1996	Chromium	3.3	
I3H10(C)	BEI(C) 1995	Chromium	3.2	
I3C12(C)	BEI(C) 1995	Chromium	2.9	
I3D11(C)	BEI(C) 1995	Chromium	2.8	
I3G10(C)	BEI(C) 1995	Chromium	2.8	
I3C13(C)	BEI(C) 1995	Chromium	2.8	
I3SB-17(F15)	BEI(D) 1995	Cobalt	2.1	B_3
I3SB-18(D15)	BEI(D) 1995	Cobalt	1.3	B_3
I3F13(C)	BEI(C) 1995	Cobalt	0.84	B_2
I3SB-13	BEI(D) 1995	Cobalt	0.79	B_3
I3SB-15(J15)	BEI(D) 1995	Cobalt	0.78	B_3

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Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-20(A15)	BEI(D) 1995	Cobalt	0.77	B_3
I3SB-19(B15)	BEI(D) 1995	Cobalt	0.74	B_3
I3SB-14(K15)	BEI(D) 1995	Cobalt	0.63	B_3
I3SB-16(H15)	BEI(D) 1995	Cobalt	0.59	B_3
I3J12(C)	BEI(C) 1995	Cobalt	0.56	B_2
I3SB-9	BEI(D) 1995	Cobalt	0.55	B_3
I3H13(C)	BEI(C) 1995	Cobalt	0.52	B_2
I3E10(C)	BEI(C) 1995	Cobalt	0.47	B_2
I3SB-2	B&RE 1996	Cobalt	0.41	
I3D13(C)	BEI(C) 1995	Cobalt	0.39	B_2
I3SB-12	BEI(D) 1995	Cobalt	0.36	B_3
I3J11(C)	BEI(C) 1995	Cobalt	0.29	B_2
I3C12(C)	BEI(C) 1995	Cobalt	0.26	B_2
I3D11(C)	BEI(C) 1995	Cobalt	0.23	B_2
I3C13(C)	BEI(C) 1995	Cobalt	0.2	B_2
I3SB-6	BEI(D) 1995	Cobalt	0.18	B_3
I3SB-10	BEI(D) 1995	Cobalt	0.15	B_3
I3SB-7	BEI(D) 1995	Cobalt	0.14	B_3
I3G10(C)	BEI(C) 1995	Cobalt	0.14	B_2
I3SB-8	BEI(D) 1995	Cobalt	0.12	B_3
I3H10(C)	BEI(C) 1995	Cobalt	0.08	B_2
I3SB-17(F15)	BEI(D) 1995	Copper	53.8	N_1*1
I3SB-18(D15)	BEI(D) 1995	Copper	46.7	N_1*1
I3F13(C)	BEI(C) 1995	Copper	35.8	
I3SB-16(H15)	BEI(D) 1995	Copper	35	N_1*1
I3SB-15(J15)	BEI(D) 1995	Copper	33.8	N_1*1
I3SB-14(K15)	BEI(D) 1995	Copper	31.1	N_1*1
I3D13(C)	BEI(C) 1995	Copper	29.9	
I3SB-20(A15)	BEI(D) 1995	Copper	28.2	N_1*1
I3SB-13	BEI(D) 1995	Copper	26.2	N_1*1

Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-19(B15)	BEI(D) 1995	Copper	25.3	N_1*1
I3SB-2	B&RE 1996	Copper	22.9	
I3H13(C)	BEI(C) 1995	Copper	20.5	
I3SB-8	BEI(D) 1995	Copper	18.1	N_1*1
I3J12(C)	BEI(C) 1995	Copper	18	
I3J11(C)	BEI(C) 1995	Copper	13.3	
I3C12(C)	BEI(C) 1995	Copper	11.9	
I3SB-9	BEI(D) 1995	Copper	11.5	N_1*1
I3SB-12	BEI(D) 1995	Copper	10.1	N_1*1
I3E10(C)	BEI(C) 1995	Copper	10	
I3SB-1	B&RE 1996	Copper	9.6	
I3SB-6	BEI(D) 1995	Copper	8.7	N_1*1
I3C13(C)	BEI(C) 1995	Copper	8.6	
I3H10(C)	BEI(C) 1995	Copper	8	
I3D11(C)	BEI(C) 1995	Copper	7.6	
I3SB-10	BEI(D) 1995	Copper	7.3	N_1*1
I3SB-7	BEI(D) 1995	Copper	5.4	N_1*1
I3G10(C)	BEI(C) 1995	Copper	5.3	
I3F13(C)	BEI(C) 1995	Cyanide	4.8	
I3D13(C)	BEI(C) 1995	Cyanide	3.1	
I3J11(C)	BEI(C) 1995	Cyanide	2.3	X
I3J12(C)	BEI(C) 1995	Cyanide	2.2	
I3G10(C)	BEI(C) 1995	Cyanide	1.7	
I3H13(C)	BEI(C) 1995	Cyanide	1.4	
I3C13(C)	BEI(C) 1995	Cyanide	1	
I3E10(C)	BEI(C) 1995	Cyanide	0.93	B_2
I3C12(C)	BEI(C) 1995	Cyanide	0.36	B_2
I3H10(C)	BEI(C) 1995	Cyanide	0.32	B_2
I3D11(C)	BEI(C) 1995	Cyanide	0.3	B_2
I3SB-14(K15)	BEI(D) 1995	Iron	10,700	E_1*1
I3SB-17(F15)	BEI(D) 1995	Iron	9,040	E_1*1
I3SB-18(D15)	BEI(D) 1995	Iron	6,610	E_1*1

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Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-19(B15)	BEI(D) 1995	Iron	5,970	E_1*1
I3SB-16(H15)	BEI(D) 1995	Iron	3,970	E_1*1
I3SB-15(J15)	BEI(D) 1995	Iron	3,360	E_1*1
I3SB-13	BEI(D) 1995	Iron	3,350	E_1*1
I3SB-2	B&RE 1996	Iron	2,890	
I3J12(C)	BEI(C) 1995	Iron	2,650	
I3SB-20(A15)	BEI(D) 1995	Iron	2,600	E_1*1
I3F13(C)	BEI(C) 1995	Iron	2,430	
I3H13(C)	BEI(C) 1995	Iron	2,240	
I3J11(C)	BEI(C) 1995	Iron	2,040	
I3E10(C)	BEI(C) 1995	Iron	1,630	
I3SB-12	BEI(D) 1995	Iron	1,585	E_1*1
I3D13(C)	BEI(C) 1995	Iron	1,130	
I3D11(C)	BEI(C) 1995	Iron	1,080	
I3SB-7	BEI(D) 1995	Iron	954	E_1*1
I3SB-6	BEI(D) 1995	Iron	923	E_1*1
I3C12(C)	BEI(C) 1995	Iron	851	
I3SB-9	BEI(D) 1995	Iron	694	E_1*1
I3G10(C)	BEI(C) 1995	Iron	657	
I3SB-10	BEI(D) 1995	Iron	632	E_1*1
I3SB-8	BEI(D) 1995	Iron	629	E_1*1
I3C13(C)	BEI(C) 1995	Iron	527	
I3SB-1	B&RE 1996	Iron	438	
I3H10(C)	BEI(C) 1995	Iron	319	
I3SB-17(F15)	BEI(D) 1995	Lead	566	E_1*1
I3SB-18(D15)	BEI(D) 1995	Lead	558	E_1*1
I3SB-15(J15)	BEI(D) 1995	Lead	366	E_1*1
I3F13(C)	BEI(C) 1995	Lead	337	
I3SB-16(H15)	BEI(D) 1995	Lead	301	E_1*1
I3SB-13	BEI(D) 1995	Lead	250	E_1*1
I3SB-19(B15)	BEI(D) 1995	Lead	234	E_1*1

Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-20(A15)	BEI(D) 1995	Lead	225	E_1*1
I3D13(C)	BEI(C) 1995	Lead	224	
I3J12(C)	BEI(C) 1995	Lead	197	
I3J13	BEI(D) 1995	Lead	164	
I3SB-14(K15)	BEI(D) 1995	Lead	157	E_1*1
I3H13(C)	BEI(C) 1995	Lead	141.5	
I3SB-12	BEI(D) 1995	Lead	131.5	E_1*1
I3SB-2	B&RE 1996	Lead	121	
I3C13(C)	BEI(C) 1995	Lead	85.3	
I3SB-6	BEI(D) 1995	Lead	72.7	E_1*1
I3C12(C)	BEI(C) 1995	Lead	59.7	
I3E10(C)	BEI(C) 1995	Lead	56.7	
I3SB-9	BEI(D) 1995	Lead	56.4	E_1*1
I3J11	BEI(D) 1995	Lead	51.9	
I3SB-7	BEI(D) 1995	Lead	36.1	E_1*1
I3D11(C)	BEI(C) 1995	Lead	34.8	
I3J11(C)	BEI(C) 1995	Lead	34.2	
I3SB-1	B&RE 1996	Lead	27.3	
I3SB-10	BEI(D) 1995	Lead	24	E_1*1
I3H10(C)	BEI(C) 1995	Lead	22.9	
I3G10(C)	BEI(C) 1995	Lead	20.6	
I3SB-8	BEI(D) 1995	Lead	16.6	E_1*1
I3SB-17(F15)	BEI(D) 1995	Manganese	115	E_1N_1*1
I3SB-19(B15)	BEI(D) 1995	Manganese	112	E_1N_1*1
I3SB-18(D15)	BEI(D) 1995	Manganese	111	E_1N_1*1
I3D11(C)	BEI(C) 1995	Manganese	103	
I3E10(C)	BEI(C) 1995	Manganese	100	
I3SB-13	BEI(D) 1995	Manganese	99.4	E_1N_1*1
I3SB-14(K15)	BEI(D) 1995	Manganese	68.3	E_1N_1*1
I3SB-16(H15)	BEI(D) 1995	Manganese	63	E_1N_1*1
I3SB-15(J15)	BEI(D) 1995	Manganese	59.6	E_1N_1*1
I3SB-2	B&RE 1996	Manganese	58.1	

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Location	Source[1]	Parameter	Result	Qual.[2]
I3J12(C)	BEI(C) 1995	Manganese	54.7	
I3D13(C)	BEI(C) 1995	Manganese	53.2	
I3F13(C)	BEI(C) 1995	Manganese	44.8	
I3SB-20(A15)	BEI(D) 1995	Manganese	43.6	E_1N_1*1
I3H13(C)	BEI(C) 1995	Manganese	43.1	
I3SB-12	BEI(D) 1995	Manganese	41	E_1N_1*1
I3SB-7	BEI(D) 1995	Manganese	26.8	E_1N_1*1
I3C12(C)	BEI(C) 1995	Manganese	23.6	
I3J11(C)	BEI(C) 1995	Manganese	21.1	
I3SB-6	BEI(D) 1995	Manganese	19.4	E_1N_1*1
I3SB-10	BEI(D) 1995	Manganese	17.7	E_1N_1*1
I3SB-9	BEI(D) 1995	Manganese	14.4	E_1N_1*1
I3C13(C)	BEI(C) 1995	Manganese	13.6	
I3G10(C)	BEI(C) 1995	Manganese	13.2	
I3SB-8	BEI(D) 1995	Manganese	11.1	E_1N_1*1
I3SB-1	B&RE 1996	Manganese	10.4	
I3H10(C)	BEI(C) 1995	Manganese	6.5	
I3SB-17(F15)	BEI(D) 1995	Mercury	4.1	
I3J12(C)	BEI(C) 1995	Mercury	2.4	D
I3SB-15(J15)	BEI(D) 1995	Mercury	1.8	
I3SB-7	BEI(D) 1995	Mercury	1.5	
I3SB-18(D15)	BEI(D) 1995	Mercury	1.4	
I3SB-16(H15)	BEI(D) 1995	Mercury	1.1	
I3SB-19(B15)	BEI(D) 1995	Mercury	0.73	
I3SB-2	B&RE 1996	Mercury	0.72	
I3SB-20(A15)	BEI(D) 1995	Mercury	0.5	
I3SB-14(K15)	BEI(D) 1995	Mercury	0.43	
I3E10(C)	BEI(C) 1995	Mercury	0.38	
I3H13(C)	BEI(C) 1995	Mercury	0.32	
I3C13(C)	BEI(C) 1995	Mercury	0.29	
I3F13(C)	BEI(C) 1995	Mercury	0.28	
I3D13(C)	BEI(C) 1995	Mercury	0.24	
I3SB-12	BEI(D) 1995	Mercury	0.2	

Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-13	BEI(D) 1995	Mercury	0.16	
I3SB-8	BEI(D) 1995	Mercury	0.12	
I3SB-6	BEI(D) 1995	Mercury	0.11	
I3G10(C)	BEI(C) 1995	Mercury	0.11	
I3D11(C)	BEI(C) 1995	Mercury	0.1	
I3J11(C)	BEI(C) 1995	Mercury	0.09	
I3SB-10	BEI(D) 1995	Mercury	0.08	
I3SB-1	B&RE 1996	Mercury	0.08	
I3C12(C)	BEI(C) 1995	Mercury	0.07	
I3SB-9	BEI(D) 1995	Mercury	0.05	B_3
I3H10(C)	BEI(C) 1995	Mercury	0.04	
I3SB-20(A15)	BEI(D) 1995	Nickel	20.5	
I3SB-17(F15)	BEI(D) 1995	Nickel	6.7	
I3SB-18(D15)	BEI(D) 1995	Nickel	4.8	
I3F13(C)	BEI(C) 1995	Nickel	3.6	
I3SB-13	BEI(D) 1995	Nickel	2.9	B_3
I3SB-15(J15)	BEI(D) 1995	Nickel	2.4	B_3
I3SB-19(B15)	BEI(D) 1995	Nickel	2.3	B_3
I3H13(C)	BEI(C) 1995	Nickel	2.3	
I3SB-2	B&RE 1996	Nickel	2.2	
I3SB-16(H15)	BEI(D) 1995	Nickel	2.1	B_3
I3SB-14(K15)	BEI(D) 1995	Nickel	2	B_3
I3D13(C)	BEI(C) 1995	Nickel	1.9	
I3C12(C)	BEI(C) 1995	Nickel	1.8	
I3J12(C)	BEI(C) 1995	Nickel	1.8	
I3J11(C)	BEI(C) 1995	Nickel	1.7	
I3SB-12	BEI(D) 1995	Nickel	1.6	B_3
I3E10(C)	BEI(C) 1995	Nickel	1.6	
I3SB-1	B&RE 1996	Nickel	1.3	
I3SB-9	BEI(D) 1995	Nickel	1.1	B_3
I3D11(C)	BEI(C) 1995	Nickel	1.1	B_2
I3SB-8	BEI(D) 1995	Nickel	0.95	B_3

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Location	Source[1]	Parameter	Result	Qual.[2]
I3G10(C)	BEI(C) 1995	Nickel	0.89	B_2
I3C13(C)	BEI(C) 1995	Nickel	0.87	B_2
I3SB-10	BEI(D) 1995	Nickel	0.84	B_3
I3H10(C)	BEI(C) 1995	Nickel	0.82	B_2
I3SB-6	BEI(D) 1995	Nickel	0.72	B_3
I3SB-7	BEI(D) 1995	Nickel	0.67	B_3
I3SB-13	BEI(D) 1995	Selenium	0.89	
I3SB-18(D15)	BEI(D) 1995	Selenium	0.88	
I3SB-12	BEI(D) 1995	Selenium	0.75	
I3E10(C)	BEI(C) 1995	Selenium	0.62	B_2
I3SB-17(F15)	BEI(D) 1995	Selenium	0.58	
I3SB-15(J15)	BEI(D) 1995	Selenium	0.53	
I3SB-20(A15)	BEI(D) 1995	Selenium	0.47	B_3
I3SB-16(H15)	BEI(D) 1995	Selenium	0.46	
I3SB-6	BEI(D) 1995	Selenium	0.44	B_3
I3SB-14(K15)	BEI(D) 1995	Selenium	0.39	B_3
I3F13(C)	BEI(C) 1995	Selenium	0.37	B_2
I3H13(C)	BEI(C) 1995	Selenium	0.36	B_2
I3SB-19(B15)	BEI(D) 1995	Selenium	0.3	B_3
I3J12(C)	BEI(C) 1995	Selenium	0.28	B_2
I3SB-8	BEI(D) 1995	Selenium	0.27	B_3
I3D13(C)	BEI(C) 1995	Silver	0.43	B_2
I3J12(C)	BEI(C) 1995	Silver	0.3	B_2
I3F13(C)	BEI(C) 1995	Silver	0.28	B_2
I3SB-17(F15)	BEI(D) 1995	Silver	0.27	B_3
I3SB-16(H15)	BEI(D) 1995	Silver	0.26	B_3
I3SB-18(D15)	BEI(D) 1995	Silver	0.2	B_3
I3SB-14(K15)	BEI(D) 1995	Tin	79.7	E_1N_1*1
I3SB-18(D15)	BEI(D) 1995	Tin	39.3	E_1N_1*1
I3SB-16(H15)	BEI(D) 1995	Tin	30.1	E_1N_1*1

Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-13	BEI(D) 1995	Tin	29.7	E_1N_1*1
I3SB-17(F15)	BEI(D) 1995	Tin	25.8	E_1N_1*1
I3SB-15(J15)	BEI(D) 1995	Tin	17.6	E_1N_1*1
I3SB-20(A15)	BEI(D) 1995	Tin	14.4	E_1N_1*1
I3SB-19(B15)	BEI(D) 1995	Tin	14.1	E_1N_1*1
I3SB-6	BEI(D) 1995	Tin	7.3	$B_3E_1N_1$*1
I3SB-12	BEI(D) 1995	Tin	6.9	$B_3E_1N_1$*1
I3SB-7	BEI(D) 1995	Tin	3.6	$B_3E_1N_1$*1
I3SB-9	BEI(D) 1995	Tin	1.8	$B_3E_1N_1$*1
I3SB-10	BEI(D) 1995	Tin	1.8	$B_3E_1N_1$*1
I3SB-8	BEI(D) 1995	Tin	1.3	$B_3E_1N_1$*1
I3SB-13	BEI(D) 1995	Vanadium	9.4	
I3SB-18(D15)	BEI(D) 1995	Vanadium	8	
I3H13(C)	BEI(C) 1995	Vanadium	6.5	
I3F13(C)	BEI(C) 1995	Vanadium	6.5	
I3SB-12	BEI(D) 1995	Vanadium	5.9	
I3SB-17(F15)	BEI(D) 1995	Vanadium	5.4	
I3SB-14(K15)	BEI(D) 1995	Vanadium	5.4	
I3J12(C)	BEI(C) 1995	Vanadium	4.9	
I3SB-16(H15)	BEI(D) 1995	Vanadium	4.6	
I3SB-15(J15)	BEI(D) 1995	Vanadium	4.3	B_3
I3SB-1	B&RE 1996	Vanadium	4.2	
I3SB-9	BEI(D) 1995	Vanadium	4.1	B_3
I3J11(C)	BEI(C) 1995	Vanadium	4.1	
I3SB-2	B&RE 1996	Vanadium	4	
I3SB-20(A15)	BEI(D) 1995	Vanadium	4	B_3
I3SB-19(B15)	BEI(D) 1995	Vanadium	4	
I3D11(C)	BEI(C) 1995	Vanadium	3.7	
I3E10(C)	BEI(C) 1995	Vanadium	3.5	
I3C12(C)	BEI(C) 1995	Vanadium	3.3	
I3D13(C)	BEI(C) 1995	Vanadium	3.3	
I3SB-8	BEI(D) 1995	Vanadium	2.9	B_3

TABLE 6-1

CHEMICALS DETECTED IN SURFACE SOIL AT IR 3
NAS KEY WEST
PAGE 8 OF 9

Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-10	BEI(D) 1995	Vanadium	2.6	B_3
I3SB-7	BEI(D) 1995	Vanadium	2.4	B_3
I3C13(C)	BEI(C) 1995	Vanadium	2.2	
I3SB-6	BEI(D) 1995	Vanadium	2	B_3
I3G10(C)	BEI(C) 1995	Vanadium	1.9	
I3H10(C)	BEI(C) 1995	Vanadium	1.7	
I3F13(C)	BEI(C) 1995	Zinc	1,430	D
I3SB-17(F15)	BEI(D) 1995	Zinc	1,280	E_1
I3SB-18(D15)	BEI(D) 1995	Zinc	1,130	E_1
I3SB-15(J15)	BEI(D) 1995	Zinc	960	E_1
I3SB-13	BEI(D) 1995	Zinc	838	E_1
I3SB-16(H15)	BEI(D) 1995	Zinc	708	E_1
I3SB-20(A15)	BEI(D) 1995	Zinc	586	E_1
I3SB-19(B15)	BEI(D) 1995	Zinc	496	E_1
I3D13(C)	BEI(C) 1995	Zinc	485	
I3H13(C)	BEI(C) 1995	Zinc	437.5	
I3SB-14(K15)	BEI(D) 1995	Zinc	244	E_1
I3SB-9	BEI(D) 1995	Zinc	170	E_1
I3J12(C)	BEI(C) 1995	Zinc	165	
I3SB-2	B&RE 1996	Zinc	162	
I3SB-6	BEI(D) 1995	Zinc	104	E_1
I3C13(C)	BEI(C) 1995	Zinc	65.7	
I3SB-12	BEI(D) 1995	Zinc	65.3	E_1
I3J11(C)	BEI(C) 1995	Zinc	53.8	
I3C12(C)	BEI(C) 1995	Zinc	52	
I3SB-7	BEI(D) 1995	Zinc	49.4	E_1
I3E10(C)	BEI(C) 1995	Zinc	47.4	
I3SB-10	BEI(D) 1995	Zinc	45.8	E_1
I3SB-8	BEI(D) 1995	Zinc	37	E_1
I3D11(C)	BEI(C) 1995	Zinc	35.6	
I3SB-1	B&RE 1996	Zinc	21.3	

Location	Source[1]	Parameter	Result	Qual.[2]
I3H10(C)	BEI(C) 1995	Zinc	18.3	
I3G10(C)	BEI(C) 1995	Zinc	17.2	
PESTICIDES/PCBs (µg/kg)				
I3D13(C)	BEI(C) 1995	4,4'-DDD	7,500	EPD
I3F13(C)	BEI(C) 1995	4,4'-DDD	6,700	EPD
I3J12(C)	BEI(C) 1995	4,4'-DDD	730	PD
I3E10(C)	BEI(C) 1995	4,4'-DDD	710	PD
I3J11(C)	BEI(C) 1995	4,4'-DDD	180	JDP
I3D11(C)	BEI(C) 1995	4,4'-DDD	160	JPD
I3G10(C)	BEI(C) 1995	4,4'-DDD	120	JDP
I3F13(C)	BEI(C) 1995	4,4'-DDE	19,000	D
I3D13(C)	BEI(C) 1995	4,4'-DDE	7,400	ED
I3E10(C)	BEI(C) 1995	4,4'-DDE	2,100	ED
I3H10(C)	BEI(C) 1995	4,4'-DDE	1,700	ED
I3C12(C)	BEI(C) 1995	4,4'-DDE	1,400	D
I3J11(C)	BEI(C) 1995	4,4'-DDE	1,300	D
I3D11(C)	BEI(C) 1995	4,4'-DDE	1,300	D
I3J12(C)	BEI(C) 1995	4,4'-DDE	1,200	JD
I3G10(C)	BEI(C) 1995	4,4'-DDE	1,000	D
I3SB-9	BEI(D) 1995	4,4'-DDE	980	
I3SB-16(H15)	BEI(D) 1995	4,4'-DDE	410	D_1
I3H13(C)	BEI(C) 1995	4,4'-DDE	265	D
I3SB-20(A15)	BEI(D) 1995	4,4'-DDE	190	
I3SB-8	BEI(D) 1995	4,4'-DDE	140	
I3SB-6	BEI(D) 1995	4,4'-DDE	130	
I3SB-10	BEI(D) 1995	4,4'-DDE	130	E_1
I3SB-7	BEI(D) 1995	4,4'-DDE	97	
I3SB-15(J15)	BEI(D) 1995	4,4'-DDE	86	
I3SB-2	B&RE 1996	4,4'-DDE	83	J_1
I3SB-13	BEI(D) 1995	4,4'-DDE	63	
I3SB-17(F15)	BEI(D) 1995	4,4'-DDE	59	E_1
I3SB-18(D15)	BEI(D) 1995	4,4'-DDE	31	
I3SB-1	B&RE 1996	4,4'-DDE	20.3	J_1

TABLE 6-1

CHEMICALS DETECTED IN SURFACE SOIL AT IR 3
NAS KEY WEST
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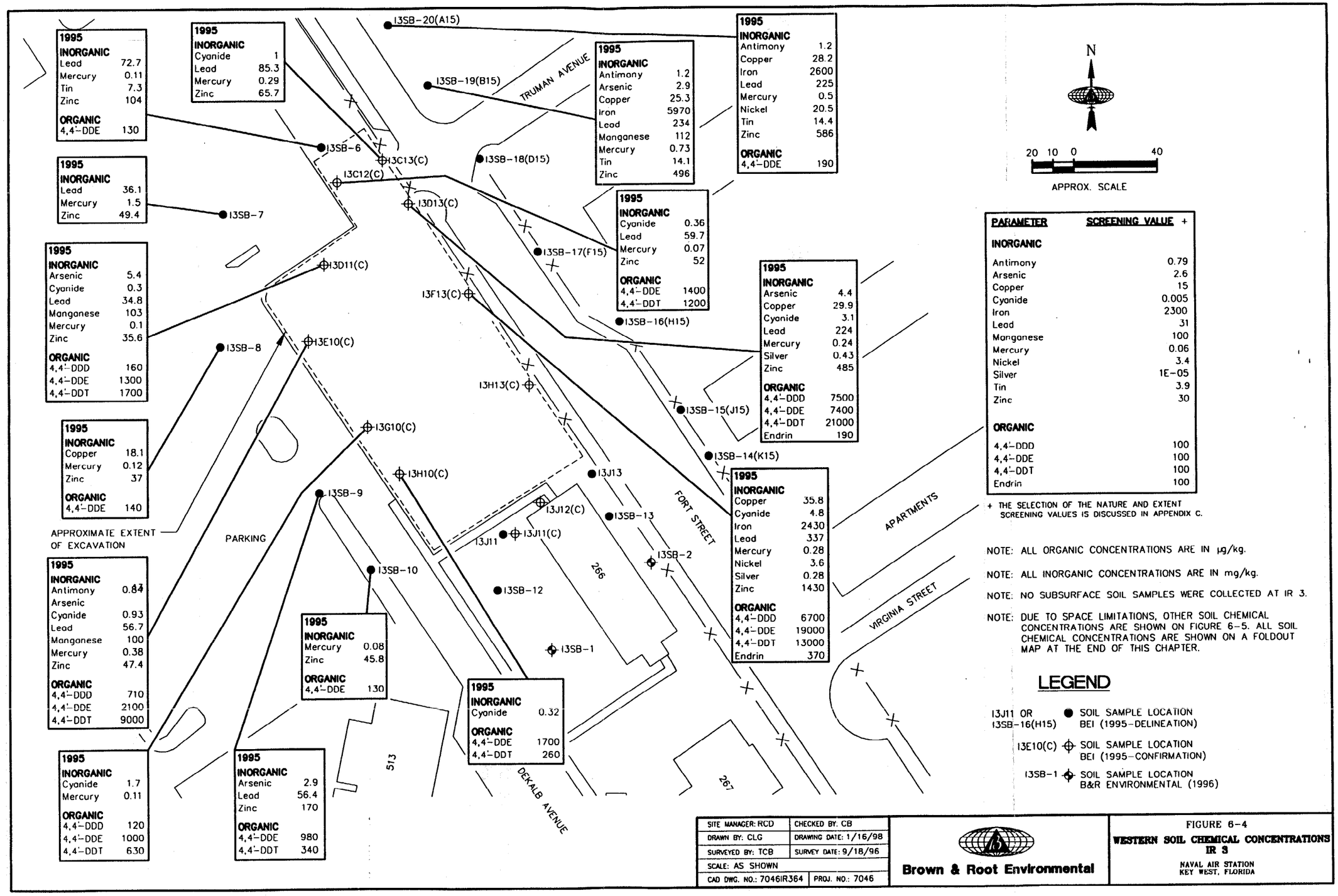
Location	Source[1]	Parameter	Result	Qual.[2]
I3SB-12	BEI(D) 1995	4,4'-DDE	18	
I3SB-19(B15)	BEI(D) 1995	4,4'-DDE	11	
I3C13(C)	BEI(C) 1995	4,4'-DDE	4.6	JD
I3D13(C)	BEI(C) 1995	4,4'-DDT	21,000	D
I3F13(C)	BEI(C) 1995	4,4'-DDT	13,000	D
I3E10(C)	BEI(C) 1995	4,4'-DDT	9,000	D
I3J12(C)	BEI(C) 1995	4,4'-DDT	8,200	D
I3D11(C)	BEI(C) 1995	4,4'-DDT	1,700	ED
I3C12(C)	BEI(C) 1995	4,4'-DDT	1,200	D
I3J11(C)	BEI(C) 1995	4,4'-DDT	790	D
I3G10(C)	BEI(C) 1995	4,4'-DDT	630	D
I3SB-9	BEI(D) 1995	4,4'-DDT	340	
I3H10(C)	BEI(C) 1995	4,4'-DDT	260	JD
I3H13(C)	BEI(C) 1995	4,4'-DDT	160	JD
I3SB-16(H15)	BEI(D) 1995	4,4'-DDT	120	D_1
I3SB-13	BEI(D) 1995	4,4'-DDT	99	D_1
I3SB-20(A15)	BEI(D) 1995	4,4'-DDT	56	
I3SB-2	B&RE 1996	4,4'-DDT	52.1	J_1
I3SB-8	BEI(D) 1995	4,4'-DDT	51	
I3SB-6	BEI(D) 1995	4,4'-DDT	44	
I3SB-10	BEI(D) 1995	4,4'-DDT	40	D_1
I3SB-7	BEI(D) 1995	4,4'-DDT	22	
I3SB-17(F15)	BEI(D) 1995	4,4'-DDT	20	D_1
I3SB-18(D15)	BEI(D) 1995	4,4'-DDT	16	
I3SB-19(B15)	BEI(D) 1995	4,4'-DDT	13	
I3SB-1	B&RE 1996	4,4'-DDT	12.8	J_1
I3SB-12	BEI(D) 1995	4,4'-DDT	11.2	
I3SB-15(J15)	BEI(D) 1995	4,4'-DDT	6.7	J_1
I3C13(C)	BEI(C) 1995	4,4'-DDT	6	JDP
I3F13(C)	BEI(C) 1995	Endrin	370	PD
I3D13(C)	BEI(C) 1995	Endrin	190	PD
I3SB-18(D15)	BEI(D) 1995	Endrin aldehyde	5.2	
I3SB-17(F15)	BEI(D) 1995	Endrin aldehyde	4.8	
I3SB-16(H15)	BEI(D) 1995	Methoxychlor	29	

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

1 Data Sources:
BEI(D) 1995 - Delineation Study (BEI, 1995) conducted in 1995 by BEI
BEI(C) 1995-96 - Confirmation Study (BEI, 1997) conducted in 1995 and 1996 by BEI
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
- E_1 - Qualifier definition not available.
- B_3 - Qualifier definition not available.
- B_2 - Analyte was found in the blank as well as the sample.
- N_1 - Qualifier definition not available.
- *1 - Qualifier definition not available.
- X - Qualifier definition not available.
- D - Compound analyzed at the secondary dilution factor.
- E - The concentration of the analyte exceeds the calibrated range of the instrument.
- P - Pesticide/PCB target analyte that is greater than 25 percent difference for the detected concentrations between the two GC columns.
- J - The associated value is an estimated quantity.
- D_1 - Qualifier definition not available.
- J_1 - Qualifier definition not available.



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Copper	15
Cyanide	0.005
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Silver	1E-05
Tin	3.9
Zinc	30
ORGANIC	
4,4'-DDD	100
4,4'-DDE	100
4,4'-DDT	100
Endrin	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: NO SUBSURFACE SOIL SAMPLES WERE COLLECTED AT IR 3.

NOTE: DUE TO SPACE LIMITATIONS, OTHER SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON FIGURE 6-5. ALL SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON A FOLDOUT MAP AT THE END OF THIS CHAPTER.

LEGEND

I3J11 OR I3SB-16(H15) ● SOIL SAMPLE LOCATION BEI (1995-DELINEATION)

I3E10(C) ⊕ SOIL SAMPLE LOCATION BEI (1995-CONFIRMATION)

I3SB-1 ⊕ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR364	PROJ. NO.: 7046

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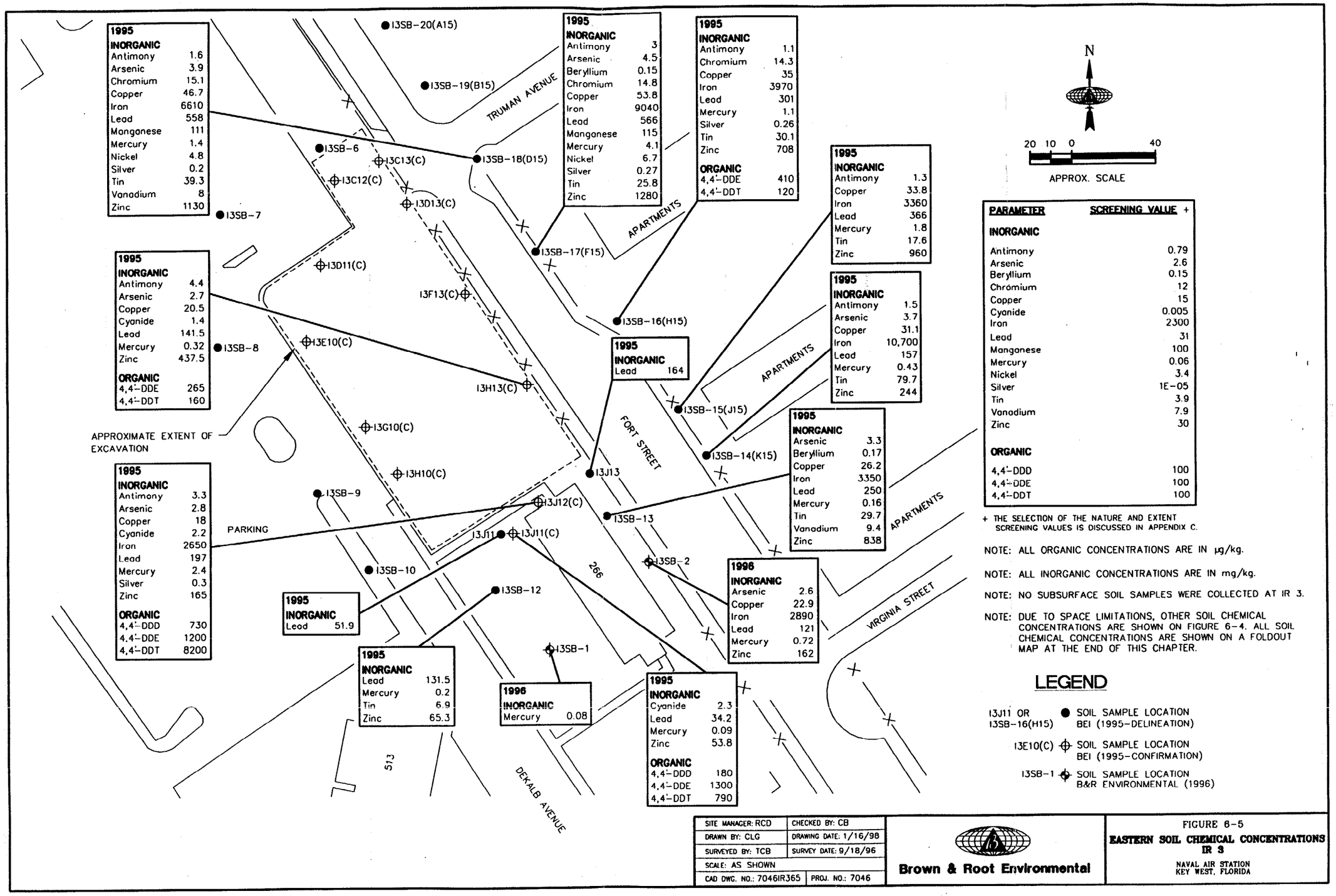
FIGURE 6-4
WESTERN SOIL CHEMICAL CONCENTRATIONS IR 3
NAVAL AIR STATION
KEY WEST, FLORIDA

010LFB282



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Chromium	12
Copper	15
Cyanide	0.005
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Silver	1E-05
Tin	3.9
Vanadium	7.9
Zinc	30
ORGANIC	
4,4'-DDD	100
4,4'-DDE	100
4,4'-DDT	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: NO SUBSURFACE SOIL SAMPLES WERE COLLECTED AT IR 3.

NOTE: DUE TO SPACE LIMITATIONS, OTHER SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON FIGURE 6-4. ALL SOIL CHEMICAL CONCENTRATIONS ARE SHOWN ON A FOLDOUT MAP AT THE END OF THIS CHAPTER.

LEGEND

13J11 OR 13SB-16(H15) ● SOIL SAMPLE LOCATION BEI (1995-DELINEATION)

13E10(C) ⊕ SOIL SAMPLE LOCATION BEI (1995-CONFIRMATION)

13SB-1 ⊕ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR365	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 6-5
EASTERN SOIL CHEMICAL CONCENTRATIONS IR 3
NAVAL AIR STATION KEY WEST, FLORIDA

6.4.1.3 Pesticides

A number of pesticides were detected in surface soil at IR 3. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected at a number of sample locations in the vicinity of the Truman Annex DDT Mixing Area. Maximum concentrations were consistently detected in one of two samples from the northeastern edge of the excavated area. The maximum concentrations of 4,4'-DDD (7,500 µg/kg) and 4,4'-DDT (21,000 µg/kg) were detected at I3D13(C). The maximum concentration of 4,4'-DDE was located slightly to the southeast at I3F13(C) (19,000 µg/kg). 4,4'-DDE and 4,4'-DDT were detected at 26 of 29 sample locations. 4,4'-DDE was detected in excess of its 100 µg/kg-screening value at 16 of those 26 sample locations. 4,4'-DDT was detected in excess of its 100 µg/kg-screening value at 12 of those 26 sample locations. 4,4'-DDD was detected at fewer sample locations (seven); however, it was in excess of its screening value at each sample location where it was detected. Endrin was detected in excess of its 100-µg/kg screening value at two sample locations on the northeastern edge of the excavated area [I3F13(C) (370 µg/kg) and I3D13(C) (190 µg/kg)]. Other compounds detected, but not in excess of screening criteria, included endrin aldehyde and methoxychlor.

6.4.1.4 Polychlorinated Biphenyls

No PCBs were detected in surface soil at IR 3. PCBs were tested for during the BEI 1995 Delineation Investigation and the Supplemental RFI/RI, but were not tested for during the BEI Confirmation Investigation.

6.4.1.5 Inorganics

Inorganics were detected at several sample locations in the vicinity of the Truman Annex DDT Mixing Area. The maximum concentrations commonly occurred in samples adjacent to Fort Street. The maximum concentrations were divided among eight sample locations along Fort Street, although the greatest number (four) occurred at I3SB-17(F15), directly east of the excavated area on the opposite side of Fort Street. The maximum concentrations of antimony (4.4 mg/kg), beryllium (0.17 mg/kg), chromium (15.1 mg/kg), copper (53.8 mg/kg), cyanide (4.8 mg/kg), iron (10,700 mg/kg), lead (566 mg/kg), mercury (4.1 mg/kg), manganese (115 mg/kg), nickel (20.5 mg/kg), silver (0.43 mg/kg), tin (79.7 mg/kg), vanadium (9.4 mg/kg), and zinc (1,430 mg/kg), which all exceeded their respective screening values, were detected at sampling locations along either side of Fort Street. The maximum concentration of arsenic was detected beyond the western edge of the excavated area at I3E10(C) (13 mg/kg). The inorganics that most commonly exceeded screening values included mercury, which was detected in excess of its 0.06-mg/kg screening criteria at 25 of 29 sample locations, and lead and zinc, which were detected in

excess of their screening values at 24 of 29 sample locations. Inorganics detected at IR 3 at levels below the screening value included aluminum, barium, cadmium, cobalt, and selenium. Overall detection was most frequent for arsenic (detected at 29 of 32 sample locations), lead (detected at 29 of 29 sample locations), and aluminum, barium, chromium, copper, manganese, mercury, nickel, vanadium, and zinc (all detected at 27 of 29 sample locations).

6.4.2 Groundwater

Data from a number of sampling efforts including the 1990 Preliminary RI, the 1993 Preliminary RFI/RI, and this Supplemental RFI/RI were considered in the analysis of groundwater contamination at IR 3. Chemicals that were detected in groundwater samples are listed in Table 6-2. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Figures 6-6 and 6-7 show the occurrence of analytes that exceeded screening values and indicate possible groundwater contamination. Groundwater contamination beneath the site is predominantly attributable to inorganics and pesticides.

Screening values were obtained from a variety of sources including: SDWA, MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3.4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

6.4.2.1 Volatile Organic Compounds

VOCs were identified in the groundwater underlying the site in 1990. During the 1990 Preliminary RI, 1,1-dichloroethane, acetone, chlorobenzene, and methylene chloride were detected in several monitoring wells. Methylene chloride was detected in all three wells that were sampled. 1,1-Dichloroethane and acetone were each detected in two of the wells, while chlorobenzene was detected in a single well. None of the detections exceeded screening values. In 1993, IT Corporation tested for VOCs in two of the wells where they had been detected previously and in two newly installed wells. No VOCs were detected in any of these wells in 1993. VOCs were not analyzed in B&R Environmental's 1996 sampling as per the approved Sampling and Analysis Plan (ABB, 1995).

TABLE 6-2

CHEMICALS DETECTED IN GROUNDWATER AT IR 3
NAS KEY WEST
PAGE 1 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
I3MW-1	IT 1993	Aluminum	2830	
I3MW3-3	IT 1990	Aluminum	981	
I3MW3-1	IT 1990	Aluminum	711	
I3MW3-3	IT 1993	Aluminum	424	
I3MW3-2	IT 1990	Aluminum	64.8	B_1
I3MW-1	IT 1993	Antimony	83.2	
I3MW3-2	IT 1993	Antimony	49.9	B_1
I3MW3-1	IT 1993	Antimony	43.7	B_1
I3MW3-3	IT 1993	Antimony	37.6	B_1
I3MW3-3	IT 1993	Arsenic	36.5	B_1
I3MW3-1	IT 1993	Arsenic	30.8	
I3MW3-2	IT 1990	Arsenic	20.4	
I3MW3-3	IT 1990	Arsenic	18.1	
I3MW-1	IT 1993	Arsenic	11.1	
I3MW-2	IT 1993	Arsenic	10.1	S
I3MW3-1	IT 1990	Arsenic	5.6	B_1
I3MW3-2	IT 1993	Arsenic	2.8	B_1W
I3MW-1	IT 1993	Barium	47.4	B_1
I3MW3-1	IT 1993	Barium	44.3	B_1
I3MW3-1	IT 1990	Barium	41.2	B_1
I3MW-2	IT 1993	Barium	39.3	B_1
I3MW3-3	IT 1990	Barium	35.8	B_1
I3MW3-3	IT 1993	Barium	26.2	B_1
I3MW-3	B&RE 1996	Barium	21.8	
I3MW3-2	IT 1990	Barium	19.6	B_1
I3MW3-2	IT 1993	Barium	10.8	B_1
I3MW3-3	IT 1990	Cadmium	13.6	
I3MW3-1	IT 1990	Cadmium	11.4	
I3MW3-1	IT 1993	Chromium	22.2	
I3MW-2	IT 1993	Chromium	21	
I3MW-1	IT 1993	Chromium	16.3	

Location	Source[1]	Parameter	Result	Qual.[2]
I3MW3-3	IT 1993	Chromium	14.35	
I3MW3-1	IT 1990	Copper	25.4	
I3MW3-3	IT 1990	Copper	15.7	B_1
I3MW3-2	IT 1990	Iron	895	
I3MW-1	IT 1993	Iron	805	
I3MW3-3	IT 1990	Iron	640	
I3MW3-3	IT 1993	Iron	430.5	
I3MW3-1	IT 1990	Iron	425	
I3MW-1	IT 1993	Lead	26.9	
I3MW-2	IT 1993	Lead	17.7	S
I3MW3-3	IT 1990	Lead	15.8	
I3MW3-3	IT 1993	Lead	13.5	
I3MW3-1	IT 1993	Lead	9.7	
I3MW3-1	IT 1990	Lead	8.4	
I3MW3-2	IT 1990	Lead	5.6	
I3MW-5	B&RE 1996	Lead	3.7	
I3MW-1	IT 1993	Manganese	12.6	B_1
I3MW3-3	IT 1990	Manganese	9.6	B_1E
I3MW3-2	IT 1990	Manganese	5.8	B_1E
I3MW3-1	IT 1990	Manganese	5.6	B_1E
I3MW3-3	IT 1993	Manganese	3.4	B_1
I3MW-1	IT 1993	Mercury	0.27	
I3MW3-3	IT 1990	Mercury	0.22	
I3MW-3	B&RE 1996	Mercury	0.12	
I3MW3-2	IT 1990	Silver	7.6	B_1
I3MW3-1	IT 1993	Tin	31.3	B_1
I3MW-7	B&RE 1996	Vanadium	13.9	
I3MW-3	B&RE 1996	Vanadium	4.8	
I3MW-4	B&RE 1996	Vanadium	3.2	
I3MW-5	B&RE 1996	Vanadium	2.4	
I3MW3-3	IT 1990	Zinc	357	
I3MW3-1	IT 1990	Zinc	336	
I3MW-7	B&RE 1996	Zinc	110	

TABLE 6-2

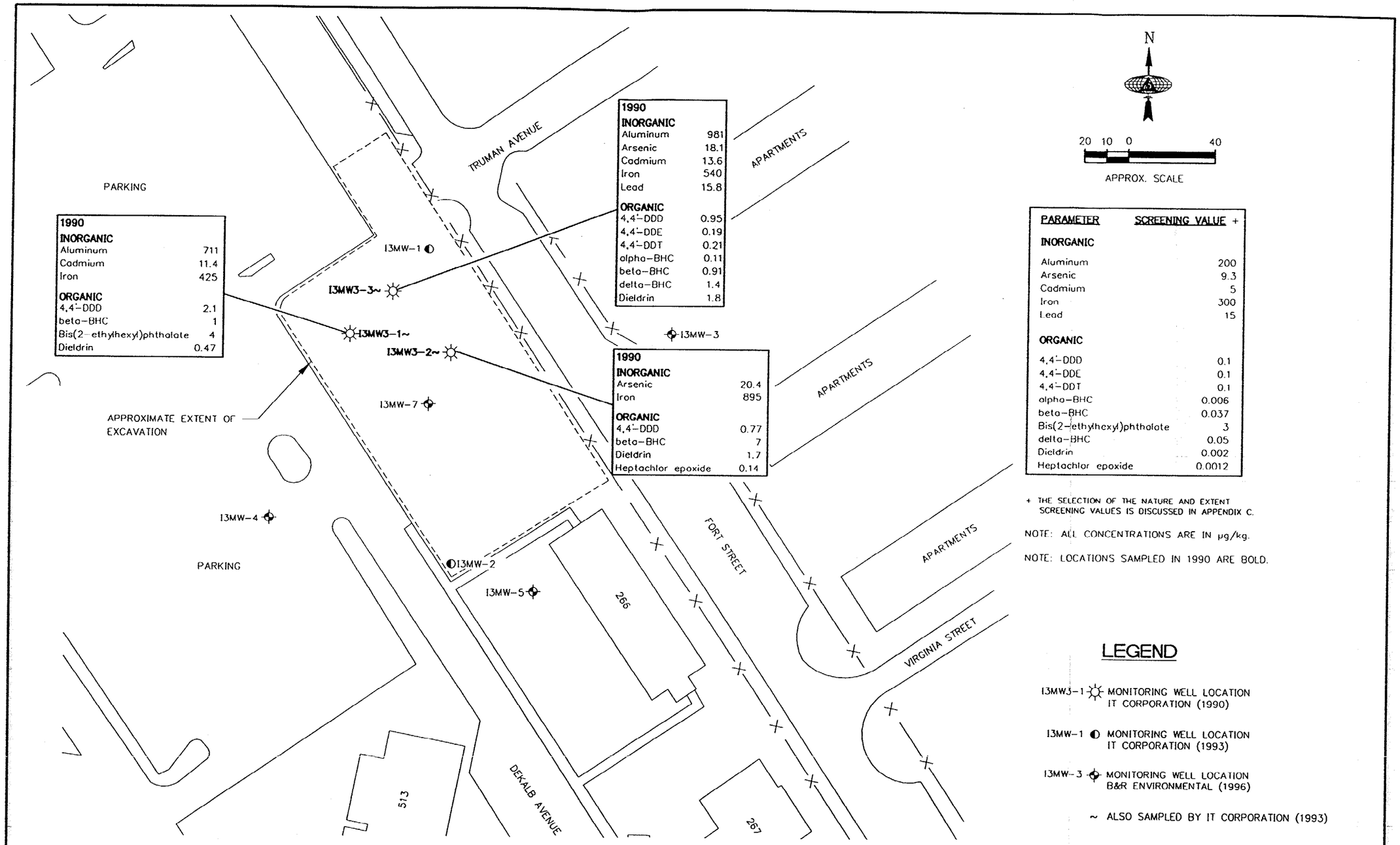
CHEMICALS DETECTED IN GROUNDWATER AT IR 3
NAS KEY WEST
PAGE 2 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
I3MW-1	IT 1993	Zinc	61.4	
I3MW3-2	IT 1990	Zinc	46.1	
I3MW-2	IT 1993	Zinc	38.7	
I3MW3-2	IT 1993	Zinc	16.4	B_1
I3MW3-3	IT 1993	Zinc	14.6	B_1
I3MW3-1	IT 1993	Zinc	12.8	B_1
PESTICIDES/PCBs (µg/L)				
I3MW3-2	IT 1993	4,4'-DDD	2.7	C_1
I3MW3-1	IT 1990	4,4'-DDD	2.1	D
I3MW3-3	IT 1990	4,4'-DDD	0.95	DJ
I3MW3-2	IT 1990	4,4'-DDD	0.77	
I3MW3-3	IT 1993	4,4'-DDD	0.3	
I3MW3-2	IT 1993	4,4'-DDE	0.84	C_1
I3MW-1	IT 1993	4,4'-DDE	0.27	
I3MW3-3	IT 1990	4,4'-DDE	0.19	
I3MW-2	IT 1993	4,4'-DDE	0.17	C_1
I3MW3-2	IT 1993	4,4'-DDT	0.5	C_1
I3MW3-3	IT 1990	4,4'-DDT	0.21	
I3MW-1	IT 1993	4,4'-DDT	0.16	
I3MW3-3	IT 1990	alpha-BHC	0.11	
I3MW3-3	IT 1993	alpha-BHC	0.07	
I3MW3-2	IT 1990	beta-BHC	7	D
I3MW3-1	IT 1990	beta-BHC	1	D
I3MW3-3	IT 1990	beta-BHC	0.91	D
I3MW3-2	IT 1993	beta-BHC	0.7	C_1
I3MW3-3	IT 1993	beta-BHC	0.58	
I3MW-1	IT 1993	beta-BHC	0.15	
I3MW3-2	IT 1993	Chlordane	1.9	+
I3MW3-3	IT 1993	delta-BHC	1.5	
I3MW3-3	IT 1990	delta-BHC	1.4	D
I3MW-1	IT 1993	delta-BHC	0.87	
I3MW3-3	IT 1990	Dieldrin	1.8	D
I3MW3-2	IT 1990	Dieldrin	1.7	DJ
I3MW-1	IT 1993	Dieldrin	1.2	
I3MW3-3	IT 1993	Dieldrin	1.2	
I3MW3-2	IT 1993	Dieldrin	0.84	C_1
I3MW3-1	IT 1990	Dieldrin	0.47	
I3MW3-1	IT 1993	Dieldrin	0.12	C_1
I3MW3-2	IT 1990	Heptachlor epoxide	0.14	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
I3MW3-1	IT 1990	Bis(2-ethylhexyl)phthalate	4	J
VOLATILE ORGANIC COMPOUNDS (µg/L)				
I3MW3-1	IT 1990	1,1-dichloroethane	2	J
I3MW3-3	IT 1990	1,1-dichloroethane	1	J
I3MW3-2	IT 1990	Acetone	6	J
I3MW3-1	IT 1990	Acetone	6	J
I3MW3-3	IT 1990	Chlorobenzene	4	J
I3MW3-2	IT 1990	Methylene chloride	2	B_2J
I3MW3-3	IT 1990	Methylene chloride	1	B_2J
I3MW3-1	IT 1990	Methylene chloride	1	B_2J

Shading indicates a concentration in excess of the screening values (See Table C.3-4).

1 Data Sources:
- IT 1990 - RI (IT Corporation, 1991) conducted in 1990 by IT Corporation
- IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation (1994)
- B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
- B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
- S - The reported value was determined by method of standard additions.
- W - Post-digestion spike for GFAA was out of control limits (85-115 percent), while sample absorbance was less than 50 percent of spike absorbance.
- E - The reported value is estimated because of the presence of interference.
- C_1 - Confirmed on secondary column.
- D - Compound analyzed at the secondary dilution factor.
- J - The associated value is an estimated quantity.
- + - Altered pattern.
- B_2 - Analyte was found in the blank as well as the sample.

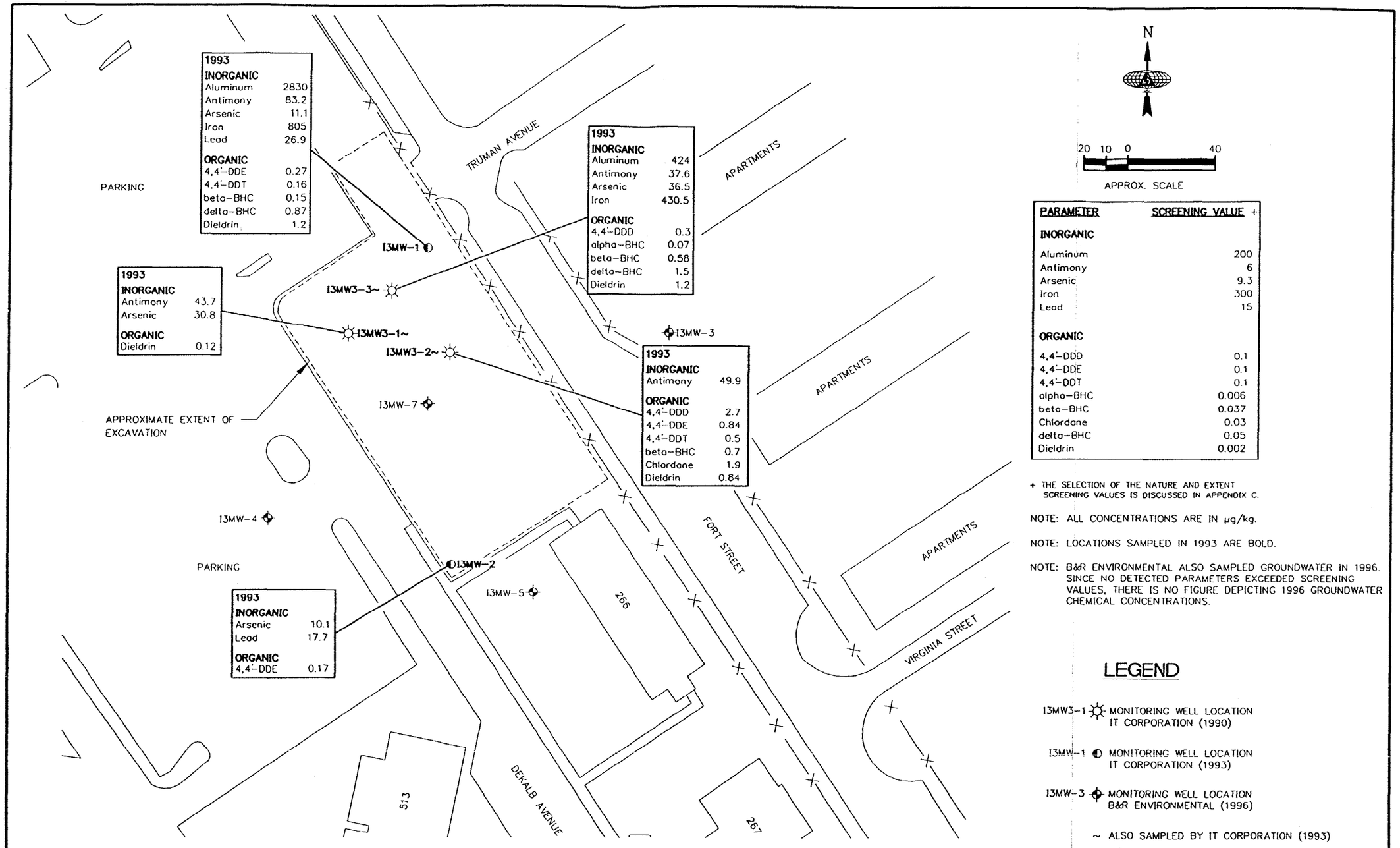


SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR366	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 6-6
1990 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 3
NAVAL AIR STATION
KEY WEST, FLORIDA

01015793



PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	200
Antimony	6
Arsenic	9.3
Iron	300
Lead	15
ORGANIC	
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
alpha-BHC	0.006
beta-BHC	0.037
Chlordane	0.03
delta-BHC	0.05
Dieldrin	0.002

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/kg.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

NOTE: B&R ENVIRONMENTAL ALSO SAMPLED GROUNDWATER IN 1996. SINCE NO DETECTED PARAMETERS EXCEEDED SCREENING VALUES, THERE IS NO FIGURE DEPICTING 1996 GROUNDWATER CHEMICAL CONCENTRATIONS.

LEGEND

I3MW3-1 MONITORING WELL LOCATION IT CORPORATION (1990)

I3MW-1 MONITORING WELL LOCATION IT CORPORATION (1993)

I3MW-3 MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)

~ ALSO SAMPLED BY IT CORPORATION (1993)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR367	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 6-7
1993 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 3
NAVAL AIR STATION
KEY WEST, FLORIDA

6.4.2.3 Pesticides

A number of pesticides were detected in excess of their screening values in the groundwater at IR 3 in IT Corporation's 1990 and 1993 sampling efforts. In 1990, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC, delta-BHC, dieldrin, and heptachlor epoxide were detected in excess of their screening values at IR 3 in the area that was later excavated north of Building 266. 4,4'-DDD was detected in excess of its 0.1-µg/L screening value at all three monitoring wells sampled by IT Corporation in 1990. 4,4'-DDE and 4,4'-DDT were detected in excess of their 0.1-µg/L screening value at a single monitoring well, I3MW3-3 (0.19 µg/L and 0.21 µg/L, respectively) and were not detected elsewhere in groundwater at IR 3 in 1990. Alpha-BHC and delta-BHC were both detected in excess of their screening values in the same well. Beta-BHC and dieldrin were detected in excess of screening values at all three monitoring wells sampled in 1990. Heptachlor epoxide was detected in excess of its screening value at a single well, I3MW3-2 (0.14 µg/L). In IT Corporation's 1993 sampling effort, the same pesticides were detected in excess of their respective screening values, except heptachlor epoxide, which was not detected. Additionally, chlordane was detected in excess of its 0.03-µg/L screening value at a single monitoring well, I3MW3-2 (1.9 µg/L), where it was not detected in 1990 sampling. 4,4'-DDD was detected in excess of its screening value at two wells which were also sampled in 1990. Concentrations of 4,4'-DDD decreased at I3MW3-3, but increased at I3MW3-2. 4,4'-DDD was not detected at I3MW3-1, where it had previously been detected. In IT Corporation's 1993 sampling, 4,4'-DDE was detected in excess of its 0.1-µg/L screening value in three monitoring wells: I3MW-1 and I3MW-2, both new wells, and I3MW3-2, where it was not detected in 1990. It was not detected in I3MW3-3, where it had previously been detected. 4,4'-DDT was detected in excess of its screening value at two monitoring wells: I3MW3-2, where it was not detected in 1990, and I3MW-1, a new monitoring well. 4,4'-DDT contamination was no longer in evidence at I3MW3-3. Lower concentrations of alpha-BHC, beta-BHC, and dieldrin were detected in 1993 than in 1990; however, the concentrations were still in excess of screening values. Dieldrin was detected in several wells in which it was not found in 1990 and concentrations were greater than the single 1990 detection of dieldrin in groundwater. Dieldrin was also detected in 1993 at the same location where it occurred in 1990, but the concentration had decreased. No pesticides were detected in groundwater samples collected during B&R Environmental's 1996 Supplemental RFI/RI.

6.4.2.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at IR 3.

6.4.2.5 Inorganics

A number of inorganics were detected in groundwater at IR 3. During the 1990 Preliminary RI, aluminum, arsenic, and iron were detected in all three wells sampled, although aluminum and arsenic exceeded screening values in only two wells where as iron exceeded screening values in all three wells. Cadmium was detected in two wells and exceeded its screening value in both cases. The maximum 1990 concentrations of aluminum and cadmium occurred at I3MW3-3 (981 µg/L and 13.6 µg/L, respectively), while the maximum concentration of arsenic (20.4 µg/L) and iron (895 µg/L) was detected at I3MW3-2. Lead was detected in excess of its screening value at a single monitoring well [I3MW3-3 (15.8 µg/L)] in 1990. Other inorganics detected below screening values in the 1990 investigation included barium, copper, manganese, mercury, silver, and zinc. In 1993, IT Corporation detected antimony and arsenic in excess of their screening criteria at four of five monitoring wells. Two of the 1993 arsenic detections [I3MW3-3 (36.5 µg/L) and I3MW3-1 (30.8 µg/L)] occurred in wells where arsenic was also detected in 1990, and the concentrations had increased. However, the 1993 concentration of arsenic at I3MW3-2 (2.8 µg/L) decreased from the 1990 level (20.4 µg/L). Aluminum, iron, and lead were also detected in excess of their screening values in 1993 in two wells. Other inorganics detected in IT Corporation's 1993 sampling included barium, chromium, manganese, mercury, tin, and zinc. B&R Environmental detected no inorganics in excess of screening values during the 1996 sampling effort. Inorganics detected at levels below the screening values at IR 3 in 1996 include barium, lead, mercury, vanadium, and zinc. Vanadium was the only inorganic detected in multiple wells in 1996, other inorganic detections were isolated and scattered among the four wells sampled. Vanadium was also the only inorganic parameter detected in 1996 that was not detected in any previous investigation.

6.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at IR 3. Section 6.5.1 presents those chemicals detected in excess of the screening values discussed in nature and extent sections, along with apparent temporal and spatial trends. Section 6.5.2 addresses the potential routes of migration, and Section 6.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. Section 3.1.5.1 of Appendix C quantifies the physical and chemical properties of the detected contaminants.

6.5.1 Summary of Contaminant Release

From the 1940's to the 1970's, IR 3 was used as a DDT mixing area. Powdered DDT concentrate was mixed with water and temporarily stored in 55-gallon drums both inside and outside the building that was formerly located on the site. The mixed solution was then transferred to trucks for dispersal. Discharges at the site were from accidental spills or possibly mixing and rinsing activities.

Inorganics and pesticides were the most prevalent contaminants at IR 3. Although both contaminant classes were detected in soil and groundwater at the site (sediment and surface water were not present), they were generally more widespread in soil. Pesticide contamination was expected due to the site's previous use as a DDT mixing area, and some inorganic contamination may be due to the metals content of some pesticides, but not all inorganic contamination falls within this category. No other inorganic contaminant source has been identified based on known site activities.

A number of inorganic compounds were consistently detected in soil at IR 3; however, some parameters never approached the nature and extent screening criteria (aluminum, barium, cadmium, cobalt, and selenium), while others (beryllium, chromium, manganese, nickel, and vanadium) were detected in excess of screening values only at a limited number of locations. Lead, mercury, and zinc most frequently exceeded soil screening values and are potentially the most widespread soil contaminants. Other inorganics (antimony, arsenic, copper, cyanide, iron, silver, and tin) were frequently detected in excess of screening values, but were also common at lower concentrations or were not detected in some samples. Although inorganic soil contamination was not limited to any particular portion of the site, concentrations were generally highest on the eastern edge of the area that was used for DDT mixing and due east of that area, on the opposite side of Fort Street.

Many of the same inorganics detected in soil were also detected in groundwater; however, few inorganics exceeded groundwater screening values. Aluminum, antimony, arsenic, cadmium, iron, and lead were the only inorganics detected in excess of groundwater screening values. Although there was no obvious reduction in concentration between the 1990 and the 1993 groundwater samples, the magnitude and extent of inorganic groundwater contamination appeared greatly reduced in the 1996 samples.

Pesticides, particularly 4,4'-DDT and its degradation products, were common in soil at IR 3 and were detected to a lesser extent in groundwater. Pesticide soil concentrations were highest in samples from the northeastern edge of the excavated area, and pesticide contamination was generally limited to the immediate vicinity of the excavation. Samples collected outside the excavation and on the opposite side of Fort Street contained lower or non-detectable pesticide concentrations. A wider variety of pesticides, including DDT and its degradation products, BHC isomers, and dieldrin were detected in multiple

groundwater samples. There did not appear to be any consistent spatial or temporal change in groundwater pesticide concentrations between 1990 and 1993. Concentrations of some parameters increased in a given well, while others decreased. However, by 1996, pesticide concentrations in groundwater from IR 3 were reduced to non-detectable levels.

6.5.2 Potential Routes of Migration

The major contaminant source at IR 3 is contaminated soil from historical pesticide mixing activities. However, a large area of contaminated soil (735 cubic yards) was removed in an interim remedial action conducted in 1996. Groundwater data collected prior to the interim remedial action indicated shallow groundwater contamination, suggesting migration of contaminants from subsurface soils to the water table. Groundwater investigations in 1993 indicated that groundwater flow was toward the east-southeast (IT Corporation, 1994). Data from the Supplemental RFI/RI groundwater sampling indicates flow toward the north and east (Figure 6-3). The nearest surface water in the direction of groundwater flow is approximately 2,000 feet to the east-southeast and 6,000 feet to the north or east of the site. Thus, groundwater to surface water and groundwater to sediment contaminant migration pathways are not applicable at this site. The interim remedial action has removed contaminated surface soil from the area where pesticide mixing operations were believed to have been conducted. The remediated area was then backfilled and re-sodded, significantly reducing potential exposure via the surface soil migration pathway. Contaminant release mechanisms and migration pathways from surface water and sediment are absent at IR 3.

6.5.3 Contaminant Transport Potential and Persistence

Inorganics, the predominant parameters detected at IR 3, were commonly detected in soil, but were present in groundwater to a lesser degree. This observation is consistent with the physical and chemical properties of inorganic compounds (discussed in Section 3.1.5.1 of Appendix C). Metals are generally adsorbed onto soil, greatly reducing both mobility and potential for transport in the aqueous phase. Although many metals are water-insoluble, the solubility of some species like arsenic, chromium, and mercury is heavily influenced by factors such as pH and speciation. The transport of lead in the environment is strongly influenced by the speciation of the ion. Since sorption appears to exert a dominant effect on the distribution of lead in the environment, lead is strongly complexed to organic materials in soil (Clement Associates, 1985). Although sorption tends to reduce the mobility of inorganics in the subsurface, strong associations with soil particles may increase the persistence of inorganic contamination. Contaminants that persist in the solid media may also continue to be present in

groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations will remain low.

Pesticides, particularly 4,4'-DDT and its degradation products, were commonly detected in soil at IR 3 and to a lesser extent in groundwater. Additional pesticides, including several isomers of BHC were detected only in groundwater. Soil/water partition coefficients (discussed in Appendix C) are five to six orders of magnitude greater for the DDT compounds than for BHC isomers. As shown by the analytical data, DDT compounds are expected to have a high affinity for the solid phase and exhibit low groundwater mobility relative to the BHC compounds.

4,4'-DDT degrades in soil and groundwater to 4,4'-DDE and 4,4'-DDD, which may persist in the environment for a considerable time before being further degraded. The ultimate fate process for 4,4'-DDT generally occurs very slowly and involves biotransformation to bis(2-chlorophenyl)methanone (Clement Associates, 1985). Half-lives for the decomposition of 4,4'-DDT have been reported in the range of 10 to 14 years (Neely and Blau, 1985).

In 1996, an interim remedial action was conducted at IR 3, removing contaminated soil from the site. Since groundwater contaminant levels were relatively constant prior to the interim remedial action and subsequently dropped, it would appear that groundwater contamination resulted from contact with contaminated soil at IR 3 and that there is little potential for further measurable impacts caused by the migration of these substances.

6.6 BASELINE HUMAN HEALTH RISK ASSESSMENT - IR 3

This section presents the baseline human health risk assessment for IR 3. It describes a qualitative and quantitative assessment of actual or potential risks for IR 3. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and remedial goal options. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 6.6.8.

6.6.1 Preliminary Risk Evaluation

A PRE was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than

1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 6-3 and 6-4 summarize the preliminary risk evaluation for IR 3 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. The risk ratio calculated for the residential land use scenario is less than 1E-04 for carcinogenic effects. However, the risk ratio calculated for the residential land use scenario is greater than 1.0 for noncarcinogenic effects. Therefore, a baseline human health risk assessment is necessary for IR 3. The primary contributors to noncarcinogenic risk are in soil are antimony, arsenic, iron, manganese, mercury, and 4,4'-DDT.

6.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

6.6.2.1 Soils

Several pesticides and metals were detected in one or more of the surface soil samples collected at IR 3. No subsurface soil samples were collected at IR 3. The occurrence and distribution of chemicals in surface soils are presented in Tables 6-5 and 6-6. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in IR 3 soils are also presented in these tables. The following chemicals were selected as COPCs at IR 3 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
Antimony	4,4'-DDD	None Sampled	None Sampled
Arsenic	4,4'-DDE		
Beryllium	4,4'-DDT		
Iron			
Lead*			
Mercury			

Lead, identified with an asterisk (*), will be evaluated using the IEUBK Lead Model (v. 0.99) for surface soils only.

TABLE 6-3

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
IR 3
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	13	ND	ND	0.43	0.43	0.045	3.8	3E-05	NA	NA	3E-06
Beryllium	0.17	ND	ND	0.15	0.15	0.016	1.3	1E-06	NA	NA	1E-07
PESTICIDES/PCBs											
4,4'-DDD	7,500	ND	ND	2,700	2,700	0.28	24,000	3E-06	NA	NA	3E-07
4,4'-DDE	19,000	ND	ND	1,900	1,900	0.2	17,000	1E-05	NA	NA	1E-06
4,4'-DDT	21,000	ND	ND	1,900	1,900	0.2	17,000	1E-05	NA	NA	1E-06
							Risk Sums by Medium	**5E-05**	**NA**	**NA**	**6E-06**
							Risk Sums by Use Scenario	**5E-05**			**6E-06**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 6-4

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
IR 3
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	3,370	ND	ND	78,000	78,000	37,000	1,000,000	4E-01	NA	NA	3E-02
Antimony	4.4	ND	ND	31	31	15	820	1E+00	NA	NA	5E-02
Arsenic	13	ND	ND	23	23	11	610	6E+00	NA	NA	2E-01
Barium	409	ND	ND	5,500	5,500	2,600	140,000	7E-01	NA	NA	3E-02
Beryllium	0.17	ND	ND	390	390	180	1,000	4E-03	NA	NA	2E-03
Cadmium	1.9	ND	ND	39	39	18	1,000	5E-01	NA	NA	2E-02
Chromium VI	15.1	ND	ND	390	390	180	10,000	4E-01	NA	NA	2E-02
Cobalt	2.1	ND	ND	4,700	4,700	2,200	120,000	5E-03	NA	NA	2E-04
Copper	53.8	ND	ND	3,100	3,100	1,500	82,000	2E-01	NA	NA	7E-03
Cyanide	4.8	ND	ND	1,600	1,600	730	41,000	3E-02	NA	NA	1E-03
Iron	10,700	ND	ND	23,000	23,000	11,000	610,000	5E+00	NA	NA	2E-01
Manganese	115	ND	ND	390	390	180	10,000	3E+00	NA	NA	1E-01
Mercury	4.1	ND	ND	23	23	11	610	2E+00	NA	NA	7E-02
Nickel	20.5	ND	ND	1,600	1,600	730	41,000	1E-01	NA	NA	5E-03
Selenium	0.89	ND	ND	390	390	180	10,000	2E-02	NA	NA	9E-04
Silver	0.43	ND	ND	390	390	180	10,000	1E-02	NA	NA	4E-04
Vanadium	9.4	ND	ND	550	550	2,600	14,000	2E-01	NA	NA	7E-03
Zinc	1,430	ND	ND	23,000	23,000	11,000	610,000	6E-01	NA	NA	2E-02
PESTICIDES/PCBs											
4,4'-DDT	21,000	ND	ND	39,000	39,000	18	1,000,000	5E+00	NA	NA	2E-01
Endrin	370	ND	ND	23,000	23,000	11	610,000	2E-01	NA	NA	6E-03
Endrin Aldehyde	5.2	ND	ND	23,000	23,000	11	610,000	2E-03	NA	NA	9E-05
Methoxychlor	29	ND	ND	390,000	390,000	180	10,000,000	7E-04	NA	NA	3E-05
							Hazard Sums by Medium	**3E+01**	**NA**	**NA**	**1E00**
							Hazard Sums by Use Scenario	**3E+01**			**1E00**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 6-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT IR 3 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	14/14	120 - 4,250	1,887	27/27	265 - 3,370	1,293	1,293	7,800	1,710	N	A
Antimony	2/15	0.26 - 0.48	0.39	24/27	0.12 - 4.4	1.01	0.92	3.1	1.64	Y	C
Arsenic	6/15	0.63 - 2.7	1.29	29/29	0.66 - 13	2.7	2.7	0.43	3.46	Y	C
Barium	15/15	4.4 - 17.7	10.51	27/27	11.4 - 409	79.4	79.4	550	127	N	A
Beryllium	2/15	0.13 - 0.15	0.05	21/27	0.01 - 0.17	0.09	0.07	0.15	0.17	Y	C
Cadmium	4/15	0.11 - 0.45	0.15	25/27	0.09 - 1.9	0.50	0.47	3.9	0.791	N	A
Chromium**	15/15	1.9 - 15.5	6.02	27/27	2.8 - 15.1	6.78	6.78	39	8.44	N	A
Cobalt	7/15	0.22 - 0.51	0.29	26/27	0.08 - 2.1	0.52	0.51	470	0.745	N	A
Copper	14/15	1.3 - 15.6	5.43	27/27	5.3 - 53.8	20.09	20.09	310	27.1	N	A
Cyanide	0/15	Not detected	–	11/25	0.3 - 4.8	1.67	0.90	160	1.33	N	A
Iron	14/14	98.1 - 2,260	1,167	27/27	319 - 10,700	2,589	2,589	2,300	4,120	Y	C
Lead	14/15	0.65 - 48.3	15.66	29/29	16.6 - 566	157.66	157.66	400	278	Y	C
Manganese	14/14	2.6 - 33.7	17.65	27/27	6.5 - 115	49.91	49.91	180	77.5	N	A
Mercury	5/15	0.03 - 0.08	0.03	27/27	0.04 - 4.1	0.64	0.64	2.3	1.33	Y	C
Nickel	11/15	0.63 - 4.1	1.67	27/27	0.67 - 20.5	2.65	2.65	160	3.3	N	A
Selenium	5/15	0.46 - 1.8	0.65	15/27	0.27 - 0.89	0.51	0.34	39	0.509	N	A
Silver	0/15	Not detected	–	6/27	0.2 - 0.43	0.29	0.15	39	0.181	N	A
Tin	2/5	0.78 - 2.1	1.94	14/14	1.3 - 79.7	19.53	19.53	4,700	76.6	N	A
Vanadium	15/15	0.8 - 8.8	3.97	27/27	1.7 - 9.4	4.25	4.25	55	5.01	N	A
Zinc	12/15	0.63 - 89.1	15.22	27/27	17.2 - 1,430	359.42	359.42	2,300	1,000	N	A

Notes:
Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
**As Chromium VI

TABLE 6-6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT IR 3 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
4,4'-DDD	3/14	2 - 233	22.46	7/27	120 - 7,500	2,300	622.06	2,700	7,500	Y	B
4,4'-DDE	7/14	1.8 - 741	63.23	26/27	4.6 - 19,000	1,505	1,449	1,900	15,200	Y	B
4,4'-DDT	7/14	1.8 - 557	46.78	26/27	6 - 21,000	2,187	2,106	1,900	21,000	Y	B
Endrin	1/14	1.2 - 1.2	11.46	2/27	190 - 370	280	54.31	2,300	273	N	A
Endrin aldehyde	0/10	Not detected	–	2/16	4.8 - 5.2	5	7.38	2,300	5	N	A
Methoxychlor	1/14	13.2 - 13	57.94	1/27	29 - 29	29	384.29	39,000	29	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

B - COPC (Max>RBC, organics)

Metals were detected in surface soil at IR 3 at high frequencies (i.e., detected in greater than 80 percent of the samples analyzed except cyanide, selenium, and silver). The maximum and representative concentrations for these metals generally exceed RBCs developed for the residential land use scenario. Lead will be evaluated quantitatively using the IEUBK model (v. 0.99). 4,4'-DDE and 4,4'-DDT were detected in 26 out of 27 samples with maximum and representative concentrations exceeding residential RBC values. 4,4'-DDD was detected in 7 out of 27 samples with the maximum and representative concentrations exceeding its residential RBC screening value. Three other pesticides, endrin, endrin aldehyde, and methoxychlor, were detected at levels less than residential RBC values.

6.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at IR 3 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

6.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at IR 3 are presented in Section 6.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

6.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under an RME and CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if an HI (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in four parts:

- Carcinogenic risks
- Noncarcinogenic risks
- The results of the evaluation of lead in surface soils using the IEUBK model
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria, and in determining the need for environmental remediation,

respectively. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

6.6.5.1 Carcinogenic Risks

Table 6-7 lists the estimated cumulative carcinogenic RME risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers at IR 3. The estimated carcinogenic risk for the hypothetical future residents is 2E-04, which is greater than the EPA "target risk range" of 1E-04 to 1E-06, as well as the FDEP target risk of 1E-06. Dermal contact with surface soil for the future resident has an incremental cancer risk of 1E-04. The dermal exposure route contributes the most to the cumulative carcinogenic risk for the future resident. This exposure route is also associated with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPCs contributing to this cancer risk are 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and arsenic in surface soil. The estimated carcinogenic risks for trespasser adults (6E-06), trespasser adolescents (6E-06), maintenance workers (4E-06), and occupation workers (3E-05) are within the EPA target risk range, although they exceed the FDEP target risk. Chemical-specific risks for COPCs are presented in Section 6.6.8.

Table 6-8 lists the estimated cumulative carcinogenic CTE risks for future residents, trespasser adults and children, maintenance workers, and occupational workers at IR 3. The estimated carcinogenic risks for the hypothetical future residents and the occupational worker are 2E-05 and 3E-06, respectively, which are within the EPA "target risk range" of 1E-04 to 1E-06 and exceed the FDEP target risk of 1E-06. The carcinogenic risk for incidental ingestion of surface soil for the future resident is 1E-05 and for the occupational worker is 1E-06. The ingestion exposure route contributes the most to the cumulative carcinogenic risk for these receptors. The estimated carcinogenic risks to all other receptors are below the EPA target risk range and the FDEP target risk. Chemical-specific risks for COPCs are presented in Section 6.6.8.

6.6.5.2 Noncarconigenic Risks

Table 6-7 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and occupational workers at IR 3. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The principal COPC contributing to the noncarcinogenic risk is 4,4'-DDT in surface soils. The target organ for 4,4'-DDT is the central nervous system. The HI for 4,4'-DDT (via exposure to surface soil) is greater than 1.0. Besides, 4,4'-DDT no other COPC would have an HI greater than 1.0 for the surface soil ingestion exposure route. Additionally, no other HI based on the same target

TABLE 6-7

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
IR 3
NAS KEY WEST
PAGE 1 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	3E-05	5E-07	6E-07	4E-07	NA	4E-06
Dermal Contact	1E-04	5E-06	5E-06	4E-06	NA	3E-05
Inhalation of Fugitive Dust	8E-13	5E-15	4E-15	7E-15	NA	1E-13
Subtotal	2E-04	6E-06	6E-06	4E-06	NA	3E-05
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E-04	6E-06	6E-06	4E-06	**	3E-05
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	10E-01	7E-03	2E-02	4E-03	NA	4E-02
Dermal Contact	1E+00	6E-02	9E-02	3E-02	NA	2E-01
Inhalation of Fugitive Dust	2E-09	6E-12	7E-12	6E-12	NA	1E-10
Subtotal	2E+00	6E-02	1E-01	3E-02	NA	3E-01
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA

TABLE 6-7

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
IR 3
NAS KEY WEST
PAGE 2 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E+00	6E-02	1E-01	3E-02	**	3E-01

* = Chemical-Specific Risks are presented in Section 6.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
NA = Not Applicable; pathway is not applicable for the respective media.

TABLE 6-8

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
IR 3
NAS KEY WEST
PAGE 1 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	1E-05	5E-08	3E-08	6E-08	NA	1E-06
Dermal Contact	8E-06	2E-07	9E-08	3E-07	NA	2E-06
Inhalation of Fugitive Dust	3E-13	10E-16	3E-16	2E-15	NA	5E-14
Subtotal	2E-05	2E-07	1E-07	3E-07	NA	3E-06
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	2E-05	2E-07	1E-07	3E-07	**	3E-06
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	10E-01	2E-03	4E-03	2E-03	NA	4E-02
Dermal Contact	3E-01	6E-03	2E-03	6E-03	NA	5E-02
Inhalation of Fugitive Dust	2E-09	3E-12	4E-12	6E-12	NA	1E-10
Subtotal	1E+00	7E-03	6E-03	7E-03	NA	8E-02
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA

TABLE 6-8

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
IR 3
NAS KEY WEST
PAGE 2 OF 2

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
Shellfish						
Ingestion	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA
TOTAL	1E+00	7E-03	6E-03	7E-03	**	8E-02

* = Chemical-Specific Risks are presented in Section 6.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
NA = Not Applicable; pathway is not applicable for the respective

organ would be above 1.0 for the surface soil ingestion exposure route. The HIs for all other receptors at IR 3 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 6.6.8.

Table 6-8 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and children, maintenance workers, and occupational workers at IR 3. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The HI based on the same target organ would be less than 1.0 for the surface soil ingestion exposure route (future resident). The HIs for all other receptors at IR 3 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 6.6.8.

6.6.5.3 IEUBK Lead Risks

The IEUBK Lead Model (v. 0.99) was used to characterize risks from lead in soil, dust, and water for the hypothetical future residential children (ages 0 through 6), who are considered the most sensitive receptor group at IR 3. The simulated range of blood-lead values that might occur in a population as a result of exposures to lead was compared to a guideline level of 10 micrograms per deciliter (µg/dL).

Based on model results under an RME (See Appendix C), 22.4 percent of residential children exposed under similar conditions might have blood-lead levels exceeding 10 µg/dL. This exceeds a protective guideline of 5 percent for the maximum proportion of individuals with blood levels exceeding 10 µg/dL (EPA, 1994a). The model inputs were default parameter values and a site soils lead concentration of 566 mg/kg. The IEUBK population histograms for background and IR 3 (based on RME exposure) exposures are presented in Appendix A.

Based on model results under a CTE (See Appendix C), 0.8 percent of residential children exposed under similar conditions might have blood-lead levels exceeding 10 µg/dL. This is below a protective guideline of 5 percent for the maximum proportion of individuals with blood levels exceeding 10 µg/dL (EPA, 1994a). The model inputs were default parameter values and a site soils lead concentration of 157.7 mg/kg. The IEUBK population histograms for background and IR 3 (based on CTE exposure) exposures are presented in Appendix A.

6.6.5.4 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3 and in Section 3.2.2.2 of

Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the IR 3 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 6-9 and 6-10 for inorganics and organics, respectively. The results of this preliminary comparison for IR 3 are presented in this section.

The maximum values of antimony, cadmium, and lead exceeded both their respective MCL and RBC values. All four detections of antimony exceeded both MCLs and RBCs. Cadmium was detected in 2 out of 12 samples that exceeded MCLs and RBCs. Lead was detected in 8 out of 12 samples with the maximum detection of 26.9 µg/L exceeding both MCLs and RBCs. Arsenic and several pesticides including 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC, chlordane, dieldrin, and heptachlor epoxide all exceeded tap water RBCs. The presence of pesticides in groundwater is consistent with past activities at the site. Generally, these pesticides were detected in more than one groundwater sample at the IR 3 with most of the detections being above tap water RBC values.

6.6.6 Uncertainties for IR 3

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of IR 3 risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and HI (via surface soils and sediment) for the future residential receptors. The uncertainty associated with the dermal exposure route may overestimate the risk at IR 3.

- Arsenic is a major contributor to the cumulative carcinogenic risks in surface soil, but arsenic was detected at levels in IR 3 that slightly exceed background levels. The inclusion of arsenic as site-related surface soil COPC could overestimate the quantitative risk at IR 3 for the future residential

TABLE 6-9

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs
INORGANICS IN GROUNDWATER AT IR 3 (µg/L)
NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Maximum Contaminant Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	0/10	Not detected	–	5/9	64.8 - 2,830	1,002.16	564.04	–	NA	3,700	N
Antimony	0/12	Not detected	–	4/12	37.6 - 83.2	53.60	23.53	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	8/12	2.8 - 36.5	16.93	12.04	50	N	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	9/12	10.8 - 47.4	31.82	24.83	2,000	N	260	N
Cadmium	0/13	Not detected	–	2/12	11.4 - 13.6	12.50	3.40	5	Y	1.8	Y
Chromium*	3/13	0.71 - 13	2.51	4/12	14.35 - 22.2	18.46	8.16	100	N	3,700	N
Copper	1/13	3.15 - 3.15	2.45	2/12	15.7 - 25.4	20.55	7.61	1,300**	N	150	N
Iron	2/10	76.9 - 97.4	41.72	5/9	425 - 895	619	349.58	–	NA	1,100	N
Lead	1/12	2.5 - 2.5	1.39	8/12	3.7 - 26.9	12.66	8.90	15***	Y	15	Y
Manganese	7/10	2.2 - 10.3	3.78	5/9	3.4 - 12.6	7.40	4.56	–	NA	84	N
Mercury	4/13	0.13 - 0.24	0.1	3/12	0.12 - 0.27	0.20	0.14	2	N	1.1	N
Silver	1/13	3.3 - 3.3	1.37	1/12	7.6 - 7.6	7.6	2.43	–	NA	18	N
Tin	0/3	Not detected	–	1/5	31.3 - 31.3	31.3	18.26	–	NA	2,200	N
Vanadium	4/13	3.4 - 3.9	2.62	4/12	2.4 - 13.9	6.06	5.35	–	NA	26	N
Zinc	3/13	3.425 - 15.3	2.82	9/12	12.8 - 357	10.33	83	–	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
**Copper Action Level
***Lead Action Level

TABLE 6-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF COMPARISON WITH MCLs AND RBCs ORGANICS IN GROUNDWATER AT IR 3 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Maximum Contaminant Level	Maximum Contaminant MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
PESTICIDES/PCBs											
4,4'-DDD	0/10	Not detected	–	5/11	0.3 - 2.7	1.36	0.64	–	NA	0.28	Y
4,4'-DDE	0/10	Not detected	–	4/11	0.17 - 0.8	0.37	0.17	–	NA	0.2	Y
4,4'-DDT	0/10	Not detected	–	3/11	0.16 - 0.5	0.29	0.12	–	NA	0.2	Y
alpha-BHC	0/10	Not detected	–	2/11	0.07 - 0.1	0.09	0.04	–	NA	0.011	Y
beta-BHC	0/10	Not detected	–	6/12	0.15 - 7	1.72	0.87	–	NA	0.037	Y
Chlordane	0/7	Not detected	–	1/7	1.9 - 1.9	1.9	0.43	2	N	0.052	Y
delta-BHC	0/10	Not detected	–	3/12	0.87 - 1.5	1.26	0.34	–	NA	–	NA
Dieldrin	0/10	Not detected	–	7/12	0.12 - 1.8	1.05	0.63	–	NA	0.0042	Y
Heptachlor epoxide	0/10	Not detected	–	1/10	0.14 - 0.1	0.14	0.20	0.2	N	0.0012	Y
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	0/7	Not detected	–	1/3	4 - 4	4	4.67	6	N	4.8	N
VOLATILE ORGANIC COMPOUNDS											
1,1-dichloroethane	0/4	Not detected	–	2/6	1 - 2	1.5	1.09	–	NA	81	N
Acetone	1/4	5 - 5	5	2/3	6 - 6	6	5.67	–	NA	370	N
Chlorobenzene	0/4	Not detected	–	1/6	4 - 4	4	2.00	–	NA	3.9	N
Methylene chloride	2/4	1 - 1	1.75	3/6	1 - 2	1.33	4.42	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.

receptor. Furthermore, the carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Since arsenic is a major contributor to the risk, risks may be overstated.

6.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for IR 3.

6.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment (based on RME), a subset of chemicals, called COCs, was selected for the evaluation of RGOs. At IR 3, COCs were included in the RGO evaluation only if the COCs contribution to risk exceeds a cancer risk level of 1E-06 or a hazard quotient of 0.1. The COCs selected at IR 3 are as follows:

- Surface Soils
  - Arsenic
  - Beryllium
  - Iron
  - 4,4'-DDT
  - 4,4'-DDD
  - 4,4'-DDE

Arsenic and 4,4'-DDT are selected as a COCs in soil because their contribution to the cancer risk level is greater than 1E-06 and because their contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor). Beryllium, 4,4'-DDD, and 4,4'-DDE are selected as a COCs in soil because their contribution to the cancer risk is greater than 1E-06 (future residential receptor). Iron is selected as a COC in soil because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor).

6.6.7.2 Remedial Goal Options

RGOs based on generic FDEP and RCRA TBCs for COCs in surface soil are listed in Table 6-11 for the residential exposure scenarios. The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 6-12 (surface soil - future resident).

TABLE 6-11

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SOILS AT IR 3
NAS KEY WEST

COC	RCRA Subpart S Action Levels (mg/kg)	FDEP Residential Soil Cleanup Goals (mg/kg)
INORGANICS		
Arsenic	80	0.8
Beryllium	0.2	0.2
Iron	NA	NA
PESTICIDES/PCBs		
4,4'-DDD	3	4.5
4,4'-DDE	2	3
4,4'-DDT	2	3.1

NA = Not applicable

TABLE 6-12

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE SOIL AT IR 3
NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	0.088	0.88	8.8	0.93	9.3	28
Beryllium	0.13	1.3	13	–	–	–
Iron	–	–	–	2,200	22,000	67,000
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	460	4,600	46,000	–	–	–
4,4'-DDE	324	3,200	32,000	–	–	–
4,4'-DDT	324	3,200	32,000	1,300	13,000	39,000

These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

6.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 6-13 and 6-14. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium
- Representative concentration for each COPC in each applicable medium
- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use
- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents) receptors.

COPCs in IR 3 media were not present at sufficient concentrations to cause adverse noncarcinogenic health effects to any current potential receptors. The cancer risks estimated for the current potential receptors were below or within the 1E-04 to 1E-06 target risk range that is often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation. With the exception of the excavation worker, all receptors under the RME evaluation exceeded the FDEP target risk of 1E-06. Under the CTE evaluation, only the occupational worker and hypothetical future resident exceed FDEP's target risk.

COPCs at IR 3 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Additionally, cancer risks for this receptor were estimated at levels exceeding 1E-04. Furthermore, based on the results of the IEUBK Lead Model (v. 0.99), significant increases (greater than EPA's threshold of five percent) in the population of hypothetical future residential children with blood lead levels above 10 µg/dL are expected based on exposure to lead in groundwater and surface soil at IR 3. Arsenic, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT are the main contributors to the carcinogenic risk, and arsenic and 4,4'-DDT are the main contributors to the noncarcinogenic risk.

TABLE 6-13

RME - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	1,710	NA	NA	NA	NA	2.2E-02	1.0E-03	NA	2.3E-02
Antimony	4.00E-04	8.00E-05	–	–	–	–	1.64	NA	NA	NA	NA	5.2E-02	2.5E-03	NA	5.5E-02
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.46	8.1E-06	3.1E-05	5.2E-13	3.9E-05	1.5E-01	2.3E-01	NA	3.7E-01
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.17	1.1E-06	1.4E-07	3.4E-14	1.3E-06	4.3E-04	2.1E-05	NA	4.6E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	4,120	NA	NA	NA	NA	1.8E-01	8.4E-03	NA	1.8E-01
Lead	–	–	–	–	–	–	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	1.33	NA	NA	NA	NA	5.7E-02	2.7E-03	1.6E-09	5.9E-02
Pesticides/PCBs															
4,4'-DDD	–	–	–	2.40E-01	4.80E-01	–	7,500	2.8E-06	1.4E-05	NA	1.6E-05	NA	NA	NA	NA
4,4'-DDE	–	–	–	3.40E-01	6.80E-01	–	15,200	8.1E-06	3.9E-05	NA	4.7E-05	NA	NA	NA	NA
4,4'-DDT	–	–	–	3.40E-01	6.80E-01	1.70E+01	21,000	1.1E-05	5.4E-05	2.8E-13	6.5E-05	5.4E-01	1.0E+00	NA	1.6E+00
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.1E-05	1.4E-04	8.4E-13	1.7E-04	9.9E-01	1.3E+00	1.6E-09	2.3E+00

TABLE 6-13

RME - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 2 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	1,710	NA	NA	NA	NA	1.6E-04	4.6E-05	NA	2.1E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	1.64	NA	NA	NA	NA	3.9E-04	1.1E-04	NA	5.0E-04
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.46	1.3E-07	1.2E-06	3.3E-15	1.3E-06	1.1E-03	1.0E-02	NA	1.1E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.17	1.9E-08	5.4E-09	2.1E-16	2.4E-08	3.2E-06	9.2E-07	NA	4.1E-06
Iron	3.00E-01	6.00E-02	–	–	–	–	4,120	NA	NA	NA	NA	1.3E-03	3.7E-04	NA	1.7E-03
Lead	–	–	–	–	–	–	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	1.33	NA	NA	NA	NA	4.2E-04	1.2E-04	5.8E-12	5.4E-04
Pesticides/PCBs															
4,4'-DDD	–	–	–	2.40E-01	4.80E-01	–	7,500	4.6E-08	5.3E-07	NA	5.7E-07	NA	NA	NA	NA
4,4'-DDE	–	–	–	3.40E-01	6.80E-01	–	15,200	1.3E-07	1.5E-06	NA	1.6E-06	NA	NA	NA	NA
4,4'-DDT	–	–	–	3.40E-01	6.80E-01	1.70E+01	21,000	1.8E-07	2.1E-06	1.8E-15	2.3E-06	3.9E-03	4.5E-02	NA	4.9E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	5.1E-07	5.4E-06	5.2E-15	5.9E-06	7.3E-03	5.6E-02	5.8E-12	6.3E-02

TABLE 6-13

RME - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	1,710	NA	NA	NA	NA	3.5E-04	7.3E-05	NA	4.2E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	1.64	NA	NA	NA	NA	8.4E-04	1.7E-04	NA	1.0E-03
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.46	1.7E-07	1.1E-06	2.4E-15	1.3E-06	2.4E-03	1.6E-02	NA	1.8E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.17	2.4E-08	4.9E-09	1.5E-16	2.8E-08	7.0E-06	1.4E-06	NA	8.4E-06
Iron	3.00E-01	6.00E-02	–	–	–	–	4,120	NA	NA	NA	NA	2.8E-03	5.8E-04	NA	3.4E-03
Lead	–	–	–	–	–	–	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	1.33	NA	NA	NA	NA	9.1E-04	1.9E-04	7.2E-12	1.1E-03
Pesticides/PCBs															
4,4'-DDD	–	–	–	2.40E-01	4.80E-01	–	7,500	5.8E-08	4.8E-07	NA	5.4E-07	NA	NA	NA	NA
4,4'-DDE	–	–	–	3.40E-01	6.80E-01	–	15,200	1.7E-07	1.4E-06	NA	1.5E-06	NA	NA	NA	NA
4,4'-DDT	–	–	–	3.40E-01	6.80E-01	1.70E+01	21,000	2.3E-07	1.9E-06	1.3E-15	2.1E-06	8.6E-03	7.1E-02	NA	8.0E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	6.5E-07	4.9E-06	3.8E-15	5.5E-06	1.6E-02	8.8E-02	7.2E-12	1.0E-01

TABLE 6-13

RME - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	1,710	NA	NA	NA	NA	9.5E-05	2.3E-05	NA	1.2E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	1.64	NA	NA	NA	NA	2.3E-04	5.5E-05	NA	2.8E-04
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.46	1.0E-07	8.0E-07	4.3E-15	9.0E-07	6.4E-04	5.0E-03	NA	5.6E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.17	1.4E-08	3.5E-09	2.8E-16	1.8E-08	1.9E-06	4.6E-07	NA	2.3E-06
Iron	3.00E-01	6.00E-02	–	–	–	–	4,120	NA	NA	NA	NA	7.6E-04	1.9E-04	NA	9.5E-04
Lead	–	–	–	–	–	–	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	1.33	NA	NA	NA	NA	2.5E-04	6.0E-05	5.8E-12	3.1E-04
Pesticides/PCBs															
4,4'-DDD	–	–	–	2.40E-01	4.80E-01	–	7,500	3.6E-08	3.5E-07	NA	3.8E-07	NA	NA	NA	NA
4,4'-DDE	–	–	–	3.40E-01	6.80E-01	–	15,200	1.0E-07	1.0E-06	NA	1.1E-06	NA	NA	NA	NA
4,4'-DDT	–	–	–	3.40E-01	6.80E-01	1.70E+01	21,000	1.4E-07	1.4E-06	2.3E-15	1.5E-06	2.3E-03	2.3E-02	NA	2.5E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.0E-07	3.5E-06	6.9E-15	3.9E-06	4.3E-03	2.8E-02	5.8E-12	3.2E-02

TABLE 6-13

RME - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	1,710	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	1.64	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.46	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.17	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	4,120	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	1.33	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
4,4'-DDD	–	–	–	2.40E-01	4.80E-01	–	7,500	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	–	–	–	3.40E-01	6.80E-01	–	15,200	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	–	–	–	3.40E-01	6.80E-01	1.70E+01	21,000	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6-13

RME - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 6 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	1,710	NA	NA	NA	NA	8.4E-04	1.9E-04	NA	1.0E-03
Antimony	4.00E-04	8.00E-05	–	–	–	–	1.64	NA	NA	NA	NA	2.0E-03	4.6E-04	NA	2.5E-03
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.46	9.1E-07	6.7E-06	8.9E-14	7.6E-06	5.6E-03	4.2E-02	NA	4.7E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.17	1.3E-07	2.9E-08	5.8E-15	1.6E-07	1.7E-05	3.8E-06	NA	2.0E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	4,120	NA	NA	NA	NA	6.7E-03	1.5E-03	NA	8.3E-03
Lead	–	–	–	–	–	–	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	1.33	NA	NA	NA	NA	2.2E-03	5.0E-04	1.2E-10	2.7E-03
Pesticides/PCBs															
4,4'-DDD	–	–	–	2.40E-01	4.80E-01	–	7,500	3.1E-07	2.9E-06	NA	3.2E-06	NA	NA	NA	NA
4,4'-DDE	–	–	–	3.40E-01	6.80E-01	–	15,200	9.0E-07	8.3E-06	NA	9.2E-06	NA	NA	NA	NA
4,4'-DDT	–	–	–	3.40E-01	6.80E-01	1.70E+01	21,000	1.2E-06	1.1E-05	4.9E-14	1.3E-05	2.1E-02	1.9E-01	NA	2.1E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.5E-06	2.9E-05	1.4E-13	3.3E-05	3.8E-02	2.3E-01	1.2E-10	2.7E-01

1 Units are (mg/kg)/day.

2 Units are $[(mg/kg)/day]^{-1}$.

3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.

4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

TABLE 6-14

CTE - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 1 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1,710	NA	NA	NA	NA	2.2E-02	2.1E-04	NA	2.2E-02
Antimony	4.00E-04	8.00E-05	-	-	-	-	1.64	NA	NA	NA	NA	5.2E-02	5.0E-04	NA	5.3E-02
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.46	2.6E-06	1.9E-06	1.6E-13	4.5E-06	1.5E-01	4.5E-02	NA	1.9E-01
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	3.7E-07	8.3E-09	1.1E-14	3.8E-07	4.3E-04	4.1E-06	NA	4.4E-04
Iron	3.00E-01	6.00E-02	-	-	-	-	4,120	NA	NA	NA	NA	1.8E-01	1.7E-03	NA	1.8E-01
Lead	-	-	-	-	-	-	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	1.33	NA	NA	NA	NA	5.7E-02	5.4E-04	1.6E-09	5.7E-02
Pesticides/PCBs															
4,4'-DDD	-	-	-	2.40E-01	4.80E-01	-	7,500	9.0E-07	8.2E-07	NA	1.7E-06	NA	NA	NA	NA
4,4'-DDE	-	-	-	3.40E-01	6.80E-01	-	15,200	2.6E-06	2.3E-06	NA	4.9E-06	NA	NA	NA	NA
4,4'-DDT	-	-	-	3.40E-01	6.80E-01	1.70E+01	21,000	3.6E-06	3.2E-06	8.9E-14	6.8E-06	5.4E-01	2.0E-01	NA	7.4E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.0E-05	8.3E-06	2.6E-13	1.8E-05	9.9E-01	2.5E-01	1.6E-09	1.2E+00

TABLE 6-14

CTE - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 2 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1,710	NA	NA	NA	NA	4.0E-05	4.6E-06	NA	4.5E-05
Antimony	4.00E-04	8.00E-05	-	-	-	-	1.64	NA	NA	NA	NA	9.6E-05	1.1E-05	NA	1.1E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.46	1.2E-08	4.5E-08	6.0E-16	5.7E-08	2.7E-04	1.0E-03	NA	1.3E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.7E-09	2.0E-10	3.9E-17	1.9E-09	8.0E-07	9.2E-08	NA	8.9E-07
Iron	3.00E-01	6.00E-02	-	-	-	-	4,120	NA	NA	NA	NA	3.2E-04	3.7E-05	NA	3.6E-04
Lead	-	-	-	-	-	-	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	1.33	NA	NA	NA	NA	1.0E-04	1.2E-05	2.9E-12	1.2E-04
Pesticides/PCBs															
4,4'-DDD	-	-	-	2.40E-01	4.80E-01	-	7,500	4.2E-09	1.9E-08	NA	2.4E-08	NA	NA	NA	NA
4,4'-DDE	-	-	-	3.40E-01	6.80E-01	-	15,200	1.2E-08	5.6E-08	NA	6.8E-08	NA	NA	NA	NA
4,4'-DDT	-	-	-	3.40E-01	6.80E-01	1.70E+01	21,000	1.7E-08	7.7E-08	3.3E-16	9.4E-08	9.9E-04	4.5E-03	NA	5.5E-03
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.7E-08	2.0E-07	9.7E-16	2.4E-07	1.8E-03	5.6E-03	2.9E-12	7.4E-03

TABLE 6-14

CTE - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 3 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1,710	NA	NA	NA	NA	8.8E-05	1.4E-06	NA	8.9E-05
Antimony	4.00E-04	8.00E-05	-	-	-	-	1.64	NA	NA	NA	NA	2.1E-04	3.3E-06	NA	2.1E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.46	7.6E-09	2.1E-08	2.1E-16	2.8E-08	5.9E-04	2.9E-04	NA	8.9E-04
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	1.1E-09	9.1E-11	1.4E-17	1.2E-09	1.7E-06	2.7E-08	NA	1.8E-06
Iron	3.00E-01	6.00E-02	-	-	-	-	4,120	NA	NA	NA	NA	7.1E-04	1.1E-05	NA	7.2E-04
Lead	-	-	-	-	-	-	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	1.33	NA	NA	NA	NA	2.3E-04	3.5E-06	3.6E-12	2.3E-04
Pesticides/PCBs															
4,4'-DDD	-	-	-	2.40E-01	4.80E-01	-	7,500	2.6E-09	9.0E-09	NA	1.2E-08	NA	NA	NA	NA
4,4'-DDE	-	-	-	3.40E-01	6.80E-01	-	15,200	7.6E-09	2.6E-08	NA	3.3E-08	NA	NA	NA	NA
4,4'-DDT	-	-	-	3.40E-01	6.80E-01	1.70E+01	21,000	1.0E-08	3.6E-08	1.2E-16	4.6E-08	2.2E-03	1.3E-03	NA	3.5E-03
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.9E-08	9.1E-08	3.5E-16	1.2E-07	4.0E-03	1.6E-03	3.6E-12	5.6E-03

TABLE 6-14

CTE - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 4 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1,710	NA	NA	NA	NA	4.0E-05	4.6E-06	NA	4.5E-05
Antimony	4.00E-04	8.00E-05	-	-	-	-	1.64	NA	NA	NA	NA	9.6E-05	1.1E-05	NA	1.1E-04
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.46	1.6E-08	5.8E-08	1.5E-15	7.3E-08	2.7E-04	1.0E-03	NA	1.3E-03
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	2.2E-09	2.5E-10	1.0E-16	2.5E-09	8.0E-07	9.2E-08	NA	8.9E-07
Iron	3.00E-01	6.00E-02	-	-	-	-	4,120	NA	NA	NA	NA	3.2E-04	3.7E-05	NA	3.6E-04
Lead	-	-	-	-	-	-	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	1.33	NA	NA	NA	NA	1.0E-04	1.2E-05	5.8E-12	1.2E-04
Pesticides/PCBs															
4,4'-DDD	-	-	-	2.40E-01	4.80E-01	-	7,500	5.4E-09	2.5E-08	NA	3.0E-08	NA	NA	NA	NA
4,4'-DDE	-	-	-	3.40E-01	6.80E-01	-	15,200	1.6E-08	7.2E-08	NA	8.7E-08	NA	NA	NA	NA
4,4'-DDT	-	-	-	3.40E-01	6.80E-01	1.70E+01	21,000	2.2E-08	9.9E-08	8.4E-16	1.2E-07	9.9E-04	4.5E-03	NA	5.5E-03
TOTAL	NA	NA	NA	NA	NA	NA	NA	6.0E-08	2.5E-07	2.5E-15	3.1E-07	1.8E-03	5.6E-03	5.8E-12	7.4E-03

TABLE 6-14

CTE - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 5 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1,710	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	1.64	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.46	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	4,120	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	1.33	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
4,4'-DDD	-	-	-	2.40E-01	4.80E-01	-	7,500	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	-	-	-	3.40E-01	6.80E-01	-	15,200	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	-	-	-	3.40E-01	6.80E-01	1.70E+01	21,000	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 6-14

CTE - CHEMICAL SPECIFIC RISKS AT IR 3
NAS KEY WEST
PAGE 6 OF 6

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oran SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	1,710	NA	NA	NA	NA	8.4E-04	3.8E-05	NA	8.8E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	1.64	NA	NA	NA	NA	2.0E-03	9.2E-05	NA	2.1E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.46	3.3E-07	4.8E-07	3.2E-14	8.1E-07	5.6E-03	8.3E-03	NA	1.4E-02
Beryllium	5.00E-03	1.00E-03	-	4.30E+00	-	6.30E+00	0.17	4.6E-08	2.1E-09	2.1E-15	4.8E-08	1.7E-05	7.7E-07	NA	1.7E-05
Iron	3.00E-01	6.00E-02	-	-	-	-	4,120	NA	NA	NA	NA	6.7E-03	3.1E-04	NA	7.0E-03
Lead	-	-	-	-	-	-	278	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	-	-	-	1.33	NA	NA	NA	NA	2.2E-03	1.0E-04	1.2E-10	2.3E-03
Pesticides/PCBs															
4,4'-DDD	-	-	-	2.40E-01	4.80E-01	-	7,500	1.1E-07	2.1E-07	NA	3.2E-07	NA	NA	NA	NA
4,4'-DDE	-	-	-	3.40E-01	6.80E-01	-	15,200	3.3E-07	6.0E-07	NA	9.2E-07	NA	NA	NA	NA
4,4'-DDT	-	-	-	3.40E-01	6.80E-01	1.70E+01	21,000	4.5E-07	8.3E-07	1.8E-14	1.3E-06	2.1E-02	3.8E-02	NA	5.8E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.3E-06	2.1E-06	5.2E-14	3.4E-06	3.8E-02	4.7E-02	1.2E-10	8.5E-02

1 Units are (mg/kg)/day.

2 Units are $[(mg/kg)/day]^{-1}$.

3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.

4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.

6.7 ECOLOGICAL RISK ASSESSMENT

This section presents the results of the ecological risk assessment performed at IR 3, including a discussion of problem formulation and risk characterization.

6.7.1 Problem Formulation

This section presents the ecological problem formulation, including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, and exposure routes.

6.7.1.1 Habitat Types and Ecological Receptors

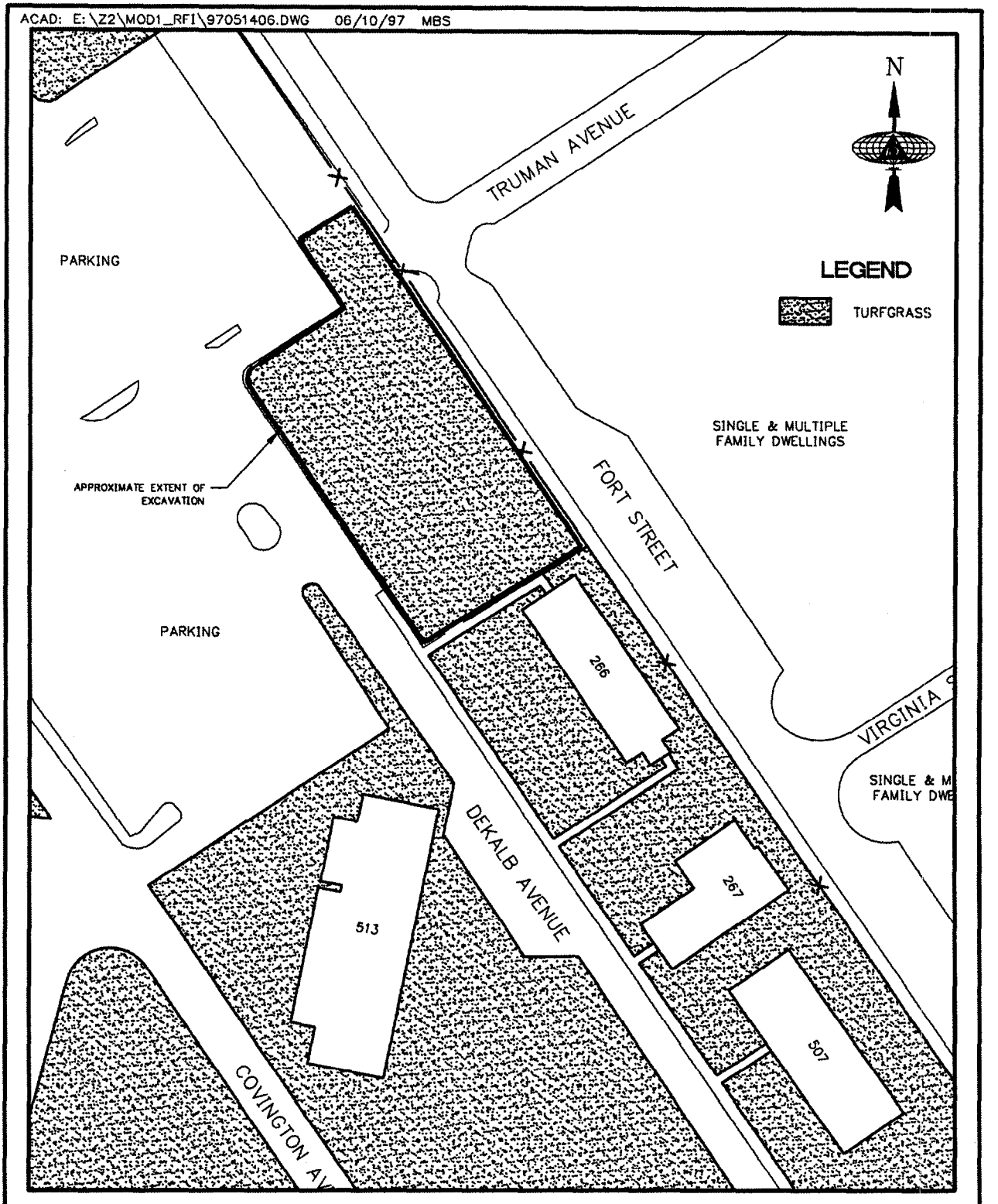
Section 6.1 (see Figure 6-8), describes the physical setting and historical background at IR 3. The site consists of an open, flat, rectangular area approximately 0.25 acre in size near downtown Key West. The site is covered with turf grass and is surrounded by parking lots, paved streets, residential areas, and other developed areas. Vegetation in the areas surrounding IR 3 consists of turf grass and scattered ornamental trees along streets and in residential areas. No surface water is present at IR 3, and the nearest surface water is approximately 1,100 feet to the south. Thus, IR 3 and the adjacent areas provide only limited terrestrial habitat of marginal quality in an urban and suburban setting. Ecological receptors in the vicinity of IR 3 consist of those typically found in urban areas, such as terrestrial invertebrates, lizards, songbirds, and exotic rodents such as the Norway rat, black rat, and house mouse.

6.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways is presented in Section 6.5.2.

6.7.1.3 Exposure Routes

As mentioned above, terrestrial habitat on and near IR 3 is limited to urban and suburban areas (roadsides, lawns, pavement, graveled areas, etc.). A substantial amount of contaminated soil has been removed. Therefore, terrestrial exposure routes and potential risks to terrestrial receptors are negligible and were not evaluated in this assessment. Furthermore, no aquatic habitat is located on or near IR 3, and hence, aquatic exposure routes are not directly applicable. The nearest surface water is 1,100 feet



SITE MANAGER: CB	CHECKED BY: DSF	BROWN & ROOT ENVIRONMENTAL	**FIGURE 6-8** HABITATS AT IR 3
DRAWN BY: TCB/SRM/MBS	DRAWING DATE:		NAVAL AIR STATION KEY WEST, FLORIDA
SURVEYED BY:	SURVEY DATE:		
SCALE: 1"=60'			
CAD DWG. NO.: 706A44_5/97051406			

south of the site. The flow of groundwater appears to be primarily toward the north and east, and the nearest surface water in that direction is approximately 6,000 feet from the site. As a result, it is unlikely that potentially contaminated groundwater could travel the distance necessary to discharge to surface water. For this reason, the groundwater exposure route is not applicable for ecological receptors.

A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. The source of contaminants was largely removed when interim remediation of soil was conducted in 1996. Groundwater contaminants remain at the site, but it is unlikely that the contaminant plume could travel the distance necessary to reach the coastline. Thus, aquatic receptors would not be exposed to groundwater contaminants from IR 3. Terrestrial receptors consist only of species acclimated to urban conditions, and a source of contaminant exposure to these species is largely absent. For these reasons, a complete exposure pathway does not exist at IR 3.

6.7.2 Ecological Risk Summary

The Phase I ecological risk assessment for IR 3 conducted by IT Corporation (1994) identified no contaminant exposure pathways for aquatic receptors, either in surface water or from groundwater discharge. Although terrestrial exposure pathways were identified, the assessment did not establish the presence of any terrestrial ecological receptors at the site other than domestic cats and dogs. This fact, combined with limited number of contaminants identified at IR 3 in that study, suggested that potential risks to terrestrial receptors were insignificant. For these reasons, the assessment concluded that IR 3 should be excluded from further investigations of potential ecological risks (IT Corporation, 1994).

This Phase II investigation also indicates the absence of a complete exposure pathway for ecological receptors at IR 3. Groundwater contaminants remain at the site, but it is unlikely that the contaminant plume could travel the distance necessary to reach the coastline. In addition, no pesticides were detected in 1996 groundwater samples (Table 6-2). This suggests that the majority of the source of pesticides at IR 3 was removed during interim remediation activities. For the reasons discussed above, the potential for ecological impacts from site-related contaminants does not exist. Therefore, additional ecological investigations or remediation based on ecological risks are not necessary, and therefore, are not recommended.

6.8 CONCLUSIONS AND RECOMMENDATIONS

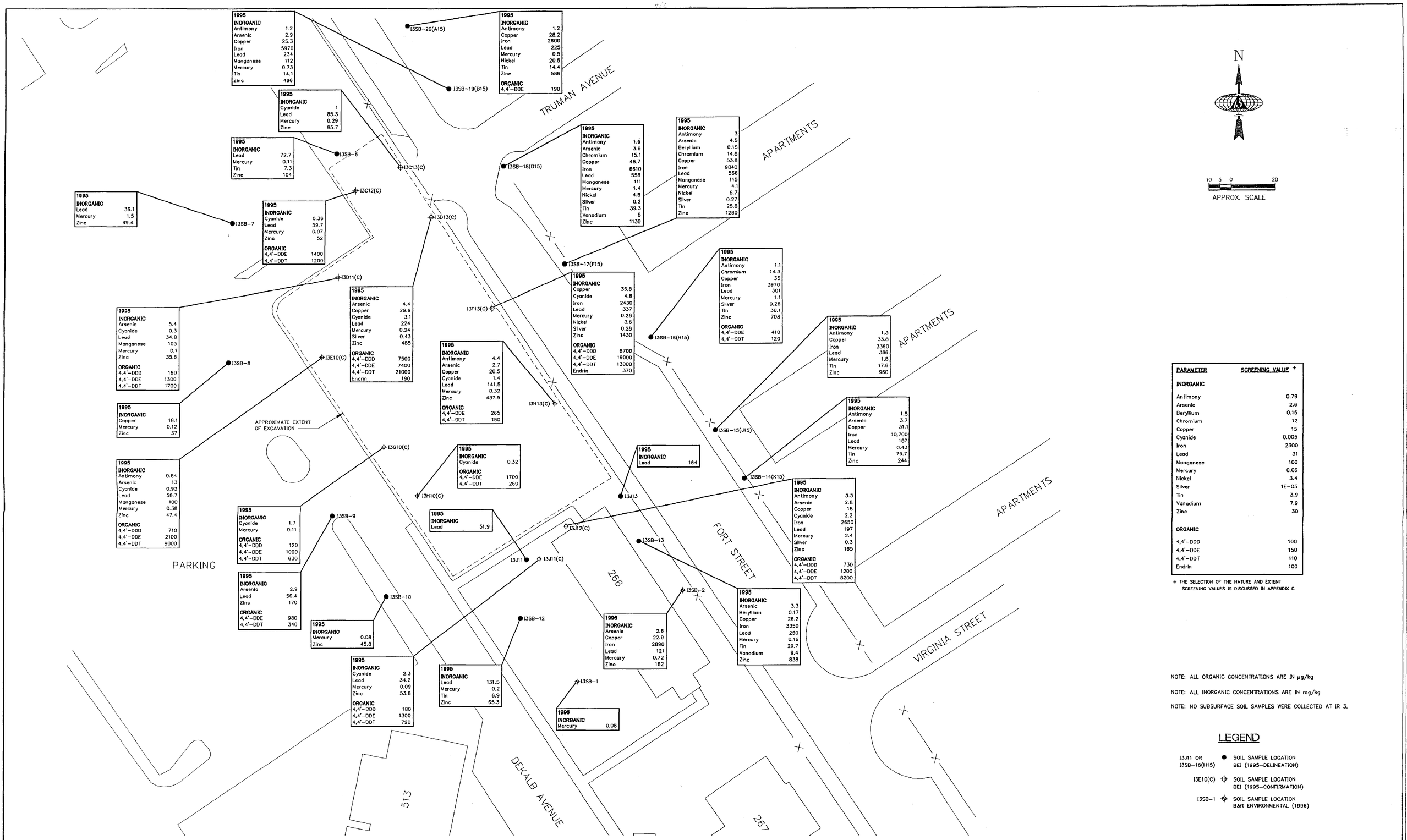
The primary objectives of investigation at IR 3 were to identify the existing nature and extent of contamination (after interim remedial action) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

The source of contamination at IR 3 was historical pesticide mixing activities. However, a large area of contaminated soil (735 cubic yards) was removed in an IRA conducted in 1996 which reduced the maximum concentration of 4,4'-DDT from 60 ppm to 21 ppm in surface soil. The pesticides 4,4'DDT, 4,4'-DDD, and 4,4'-DDE were frequently detected in the remaining surface soil at IR 3. In addition, inorganics were commonly detected in soil, and were present in groundwater to a lesser degree.

The human health risk assessment of the contaminants present at IR 3 indicates that contaminants are not present at sufficient concentrations to cause adverse noncarcinogenic health effects or carcinogenic health effects to any current potential receptors. However, contaminants are present in the surface soils at concentrations indicating adverse health effects might occur for the hypothetical future resident, and the risk to the occupational worker is within the EPA target risk range of 1.0E-06 to 1.0E-04 and exceeds the FDEP target cancer risk of 1E-06. Arsenic, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT are the main contributors to the carcinogenic risk, and arsenic and 4,4'-DDT are the main contributors to the noncarcinogenic risk. A significant increase in risk to future residential children is also expected based on the RME calculated for lead in the surface soil at IR 3.

The ecological risk assessment indicates the absence of a complete exposure pathway for ecological receptors at IR 3. Although groundwater contaminants remain, it is unlikely that the contaminant plume could travel the distance necessary to reach the coastline. No pesticides were detected in 1996 groundwater samples, suggesting that the majority of pesticide contamination was removed during the IRA. The potential for ecological impacts does not exist at IR 3.

Although minimal current human health risks and no ecological risks are posed by the site, the NAS Key West Partnering Team agreed (30 September 97) that a presumptive remedy using an asphalt cap is the appropriate action for this site. Thus, a feasibility study is not required.



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Beryllium	0.15
Chromium	12
Copper	15
Cyanide	0.005
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Silver	1E-05
Tin	3.9
Vanadium	7.9
Zinc	30
ORGANIC	
4,4'-DDD	100
4,4'-DDE	150
4,4'-DDT	110
Endrin	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg

NOTE: NO SUBSURFACE SOIL SAMPLES WERE COLLECTED AT IR 3.

LEGEND

I3J11 OR I3SB-18(H15)	●	SOIL SAMPLE LOCATION BEI (1995-DELINEATION)
I3E10(C)	⊕	SOIL SAMPLE LOCATION BEI (1995-CONFIRMATION)
I3SB-1	⊕	SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: LRH	DRAWING DATE: 5/12/97
SURVEYED BY: TCB	SURVEY DATE: 9/18/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR368	PROJ. NO.: 7046

Brown & Root Environmental

IR 3
SOIL CHEMICAL CONCENTRATIONS

NAVAL AIR STATION
KEY WEST, FLORIDA

7.0 INSTALLATION RESTORATION SITE 7 (IR 7)

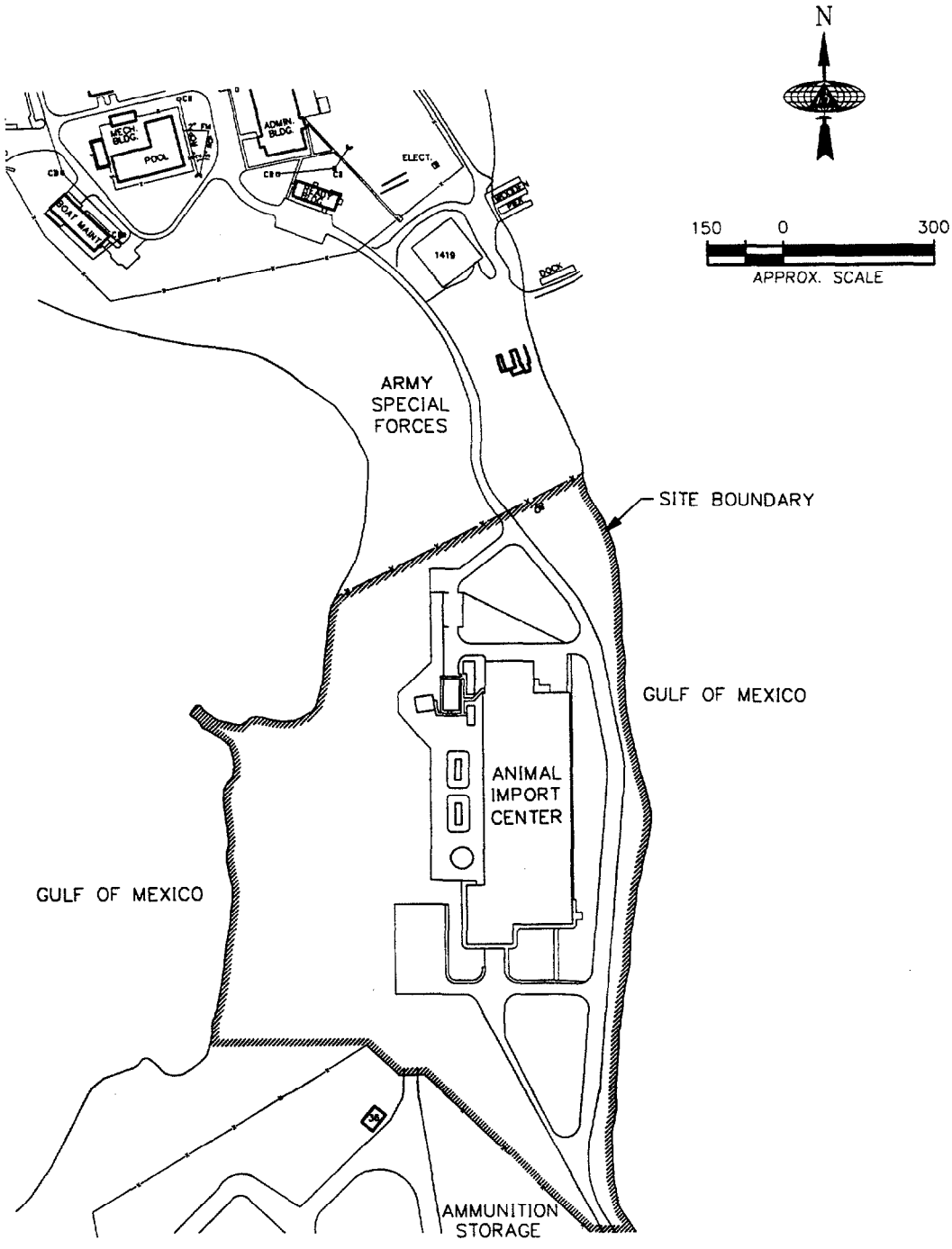
This Chapter describes the site-specific evaluation of data for IR 7 (Fleming Key North Landfill). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 7.8 presents a summary and conclusions with recommendations for IR 7.

7.1 UNIT DESCRIPTION

The Fleming Key North Landfill (IR 7) covers approximately 30 acres in the northern portion of Fleming Key (Figure 7-1). The site currently houses the U.S. Department of Agriculture (USDA) Animal Import Center. South of the site is a munitions storage area for NAS Key West. North of the site is a small Army Special Forces base. Docks are present on the northeastern edge of the island within the Army Special Forces base for launching and docking Army boats. The site is generally flat and vegetation consists of turfgrass, weeds, brush, and trees. The eastern shoreline has a grass cover and concrete rubble riprap for erosion protection. The northwestern part of the site is wooded, with Australian pine and Brazilian pepper as dominant species. A narrow strip of black mangroves is located along the western shoreline.

From 1952 to 1962, the site was used as the landfill for NAS Key West and the city of Key West. Approximately 4,000 to 5,000 tons of unknown wastes reportedly were disposed of annually. The wastes were placed in trenches typically 25 feet wide, 10 feet deep, and 500 to 1,000 feet long (IT Corporation, 1994).

In 1977, a building housing the USDA Animal Import Center was constructed over a portion of the landfill. During construction, wastes were excavated and transferred to an area immediately to the west of the construction site and buried under a soil and rock cover. Currently, the entire landfill area is covered with soil and is vegetated by either grass, weeds, or trees. BEI performed an IRA at IR 7 by importing clean topsoil, filling, and grading low areas to promote runoff of surface water and eliminate ponding.



SITE MANAGER: RCD	CHECKED BY: KJW	
DRAWN BY: LRH	DRAWING DATE: 4/22/97	
SURVEYED BY:	SURVEY DATE:	
SCALE: AS SHOWN		
CAD DWG. NO.: 7046IR771	PROJ. NO.: 7046	

Brown & Root Environmental

FIGURE 7-1
SITE LOCATION MAP
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA

7.2 INVESTIGATION HISTORY

Several investigations have been performed at IR 7 since the mid-1980s to identify, confirm or delineate contamination. The previous investigations are summarized in Section 7.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 7.2.2.

7.2.1 Previous Investigations

An initial investigation of this site was conducted by Geraghty and Miller in 1986. This investigation involved the installation of four shallow monitoring wells. Several organic compounds including base neutral extractables and VOCs were found in samples collected from the wells. Analyses for priority pollutant metals indicated concentrations of copper, mercury, and arsenic above detection limits. In 1990, IT Corporation conducted a preliminary RI, which included the installation of five soil borings (converted to monitoring wells) and the excavation of 21 test pits to characterize the waste type and distribution patterns. Waste consisted of household, construction, and electrical debris and scrap metal. The majority of the waste was household debris, including tires, glass, plastic, and basic household trash. Construction debris included concrete slabs, steel cables, and piping. Electrical debris consisted of electrical conduit, wire, and low voltage batteries. Scrap metal waste included sheet metal and refrigerator parts. Groundwater samples from the site indicated metals (e.g., antimony, chromium, cadmium, mercury, and lead) were present in concentrations above established standards. Wells located downgradient along the shoreline within the landfill area encountered the highest concentrations of metals.

Subsequently, IT Corporation conducted soil, sediment, surface-water, and groundwater sampling during the RFI/RI at this site in 1993. Characterization of contamination at the site indicated that groundwater appeared to be impacted by cyanide, metals (e.g., arsenic, cadmium, lead, and mercury), and pesticides. Mercury and cyanide were also detected in surface water at concentrations exceeding surface-water quality standards. The Final RFI/RI prepared by IT Corporation recommended continued monitoring of the site for possible migration of contaminants, grading the west side of the site to provide drainage and prevent ponding of water over the waste material and maintaining the soil and vegetative cover for the site, performing a Preliminary Ecological Risk Assessment, and conducting a baseline human health risk assessment based on monitoring data.

In September 1995, BEI performed an IRA at IR 7 to prevent ponding of rainwater and minimize infiltration through the waste. Clean topsoil was imported to fill low access and promote runoff. A vegetative cover was then established to prevent erosion.

7.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at IR 7 and the scope of those field activities performed from August to October 1996. In addition to the results from the Supplemental RFI/RI, soil data was obtained from the confirmation sampling conducted after the IRA. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 7-2 through 7-5 show the location of all soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as previous investigations.

7.2.2.1 Investigation Rationale

Additional sampling of sediment and groundwater was conducted at IR 7 to provide more information upon which appropriate risk assessments can be based. Resampling of sediments at the original RFI/RI field program locations, requested by regulators, was performed to confirm the presence or absence of contamination indicated in earlier findings. The additional data should provide a statistically representative data set for the risk assessment. All existing permanent monitoring wells were resampled to confirm previously-detected levels of contamination. It is believed that the concentration levels of metals in groundwater may have been influenced by turbidity.

7.2.2.2 Scope of Current Field Investigation

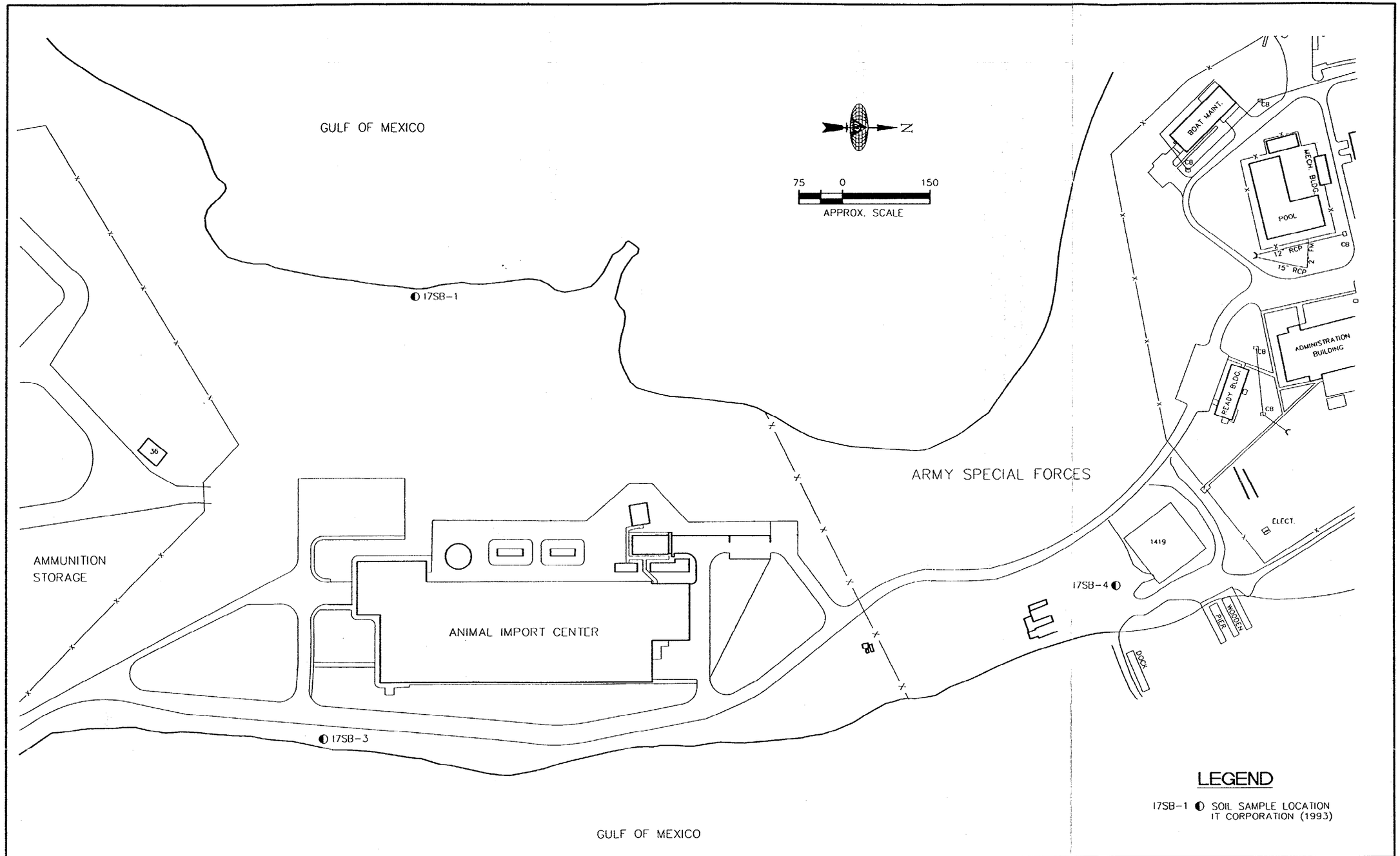
Supplemental field activities at IR 7 included the collection of sediment samples to add to the delineation from the earlier sampling activities and groundwater sampling to confirm and verify previously-detected levels of contamination.

7.2.2.2.1 Surface Soil

Previous sampling at IR 7 has sufficiently characterized surface soil according to the Workplan and Sampling and Analysis Plan (ABB, 1995).

7.2.2.2.2 Surface Water and Sediment

Surface-water samples were not collected during Supplemental RFI/RI sampling activities. Resampling of sediments at previous sample locations was performed to confirm and verify the presence of pesticides,

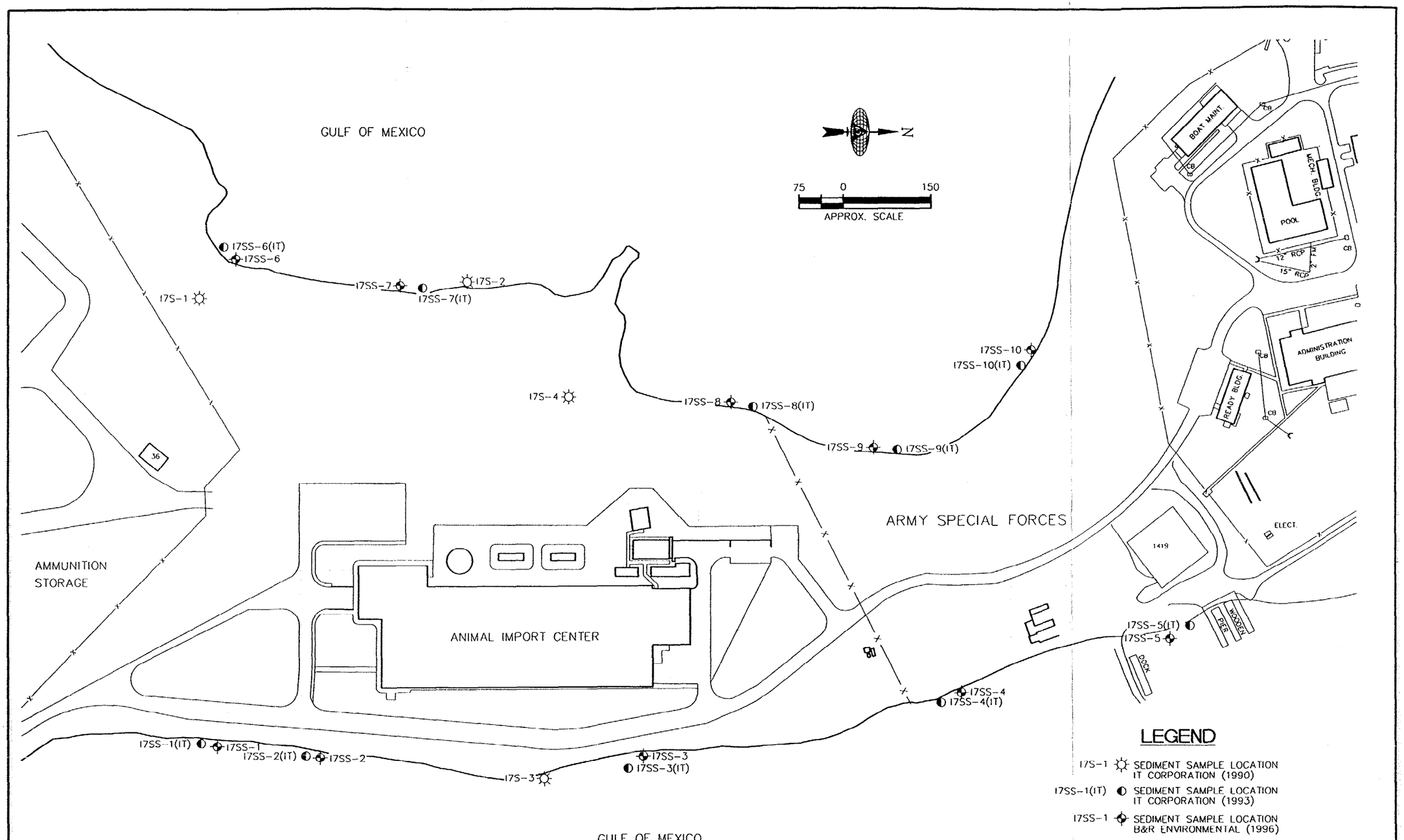


SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: CLC	DRAWING DATE: 4/22/97
SURVEYED BY:	SURVEY DATE:
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR772	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-2
SOIL SAMPLE LOCATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA

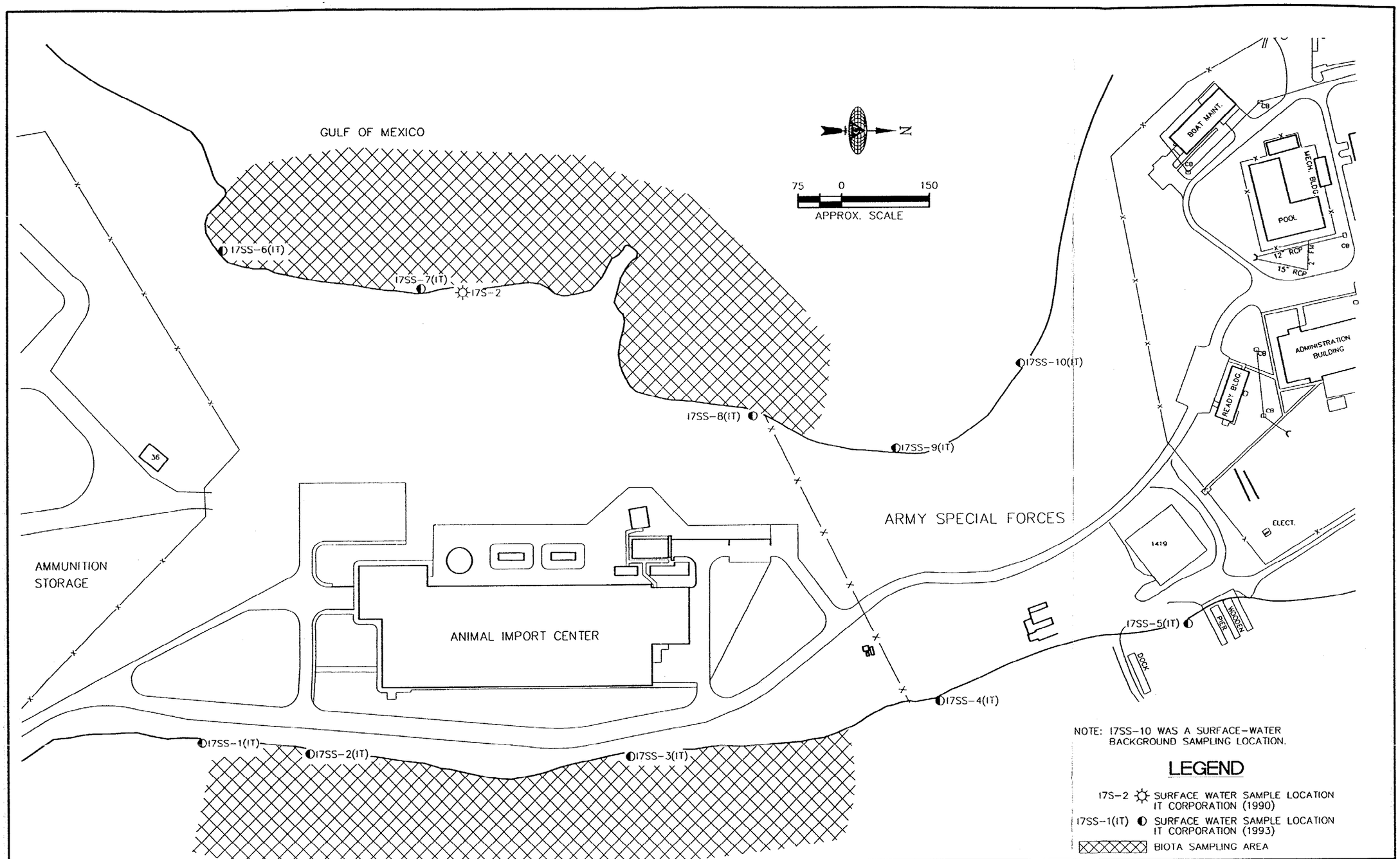
010LEB312



SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: CLG	DRAWING DATE: 4/22/97
SURVEYED BY:	SURVEY DATE:
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR773	PROJ. NO.: 7046

Brown & Root Environmental

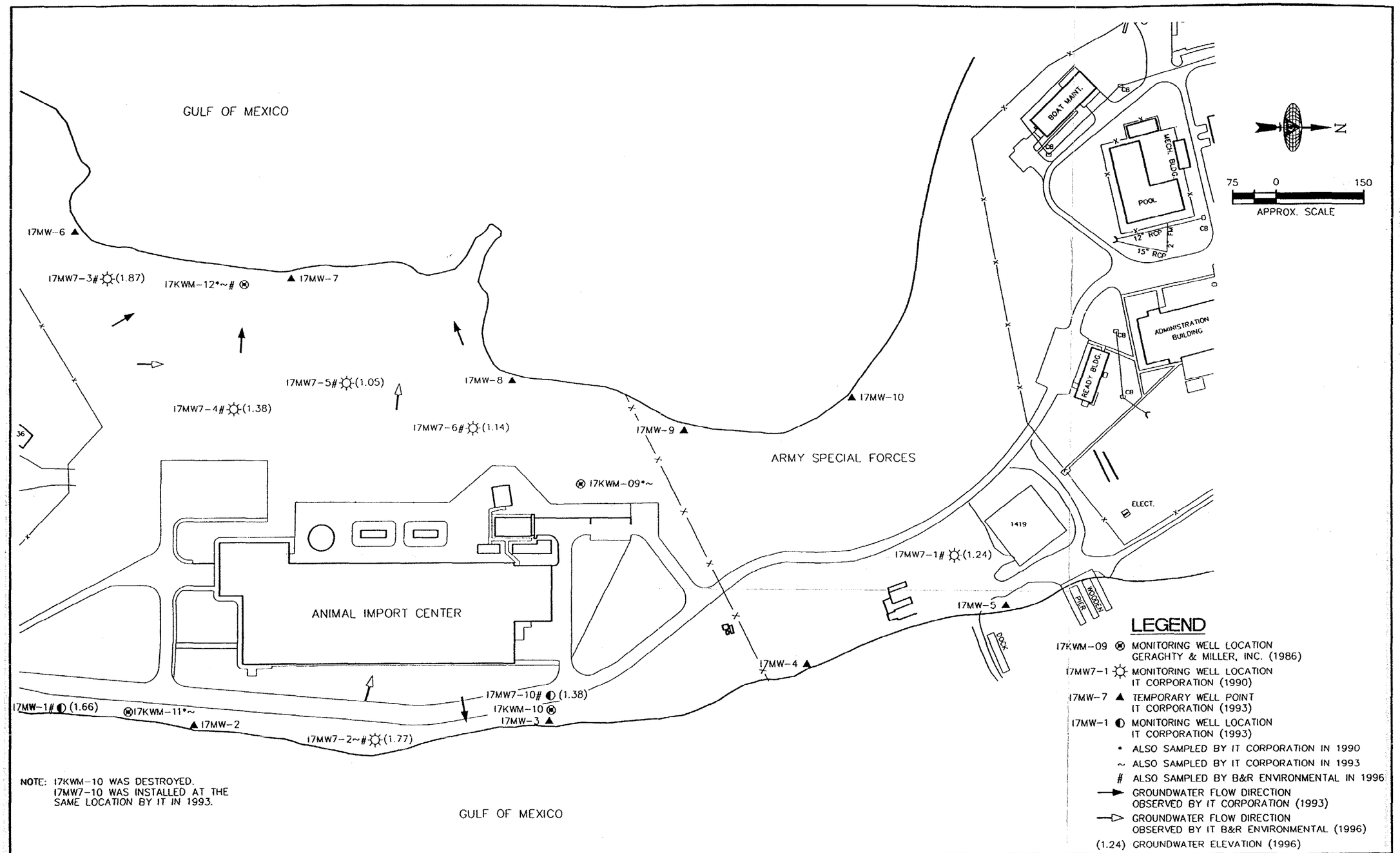
FIGURE 7-3
SEDIMENT SAMPLE LOCATIONS IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA



SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: CLG	DRAWING DATE: 4/22/97
SURVEYED BY: –	SURVEY DATE: –
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR774	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-4
SURFACE-WATER AND BIOTA SAMPLE LOCATIONS IR 7
NAVAL AIR STATION KEY WEST, FLORIDA



NOTE: 17KWM-10 WAS DESTROYED.
17MW7-10 WAS INSTALLED AT THE SAME LOCATION BY IT IN 1993.

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: TCB/SRM	DRAWING DATE: 2/24/97
SURVEYED BY: TCB	SURVEY DATE: 9/19/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR775	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-5
GROUNDWATER SAMPLE LOCATIONS IR 7
NAVAL AIR STATION KEY WEST, FLORIDA

PCBs, herbicides, metals and cyanide at IR 7. All IR 7 sediment samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

7.2.2.2.3 Groundwater

Resampling of groundwater at each of the permanent monitoring wells was performed to confirm and verify the presence of pesticides, PCBs, herbicides, metals, and cyanide at IR 7. The focus of the groundwater sampling was on reducing the levels of turbidity that may have previously attributed to elevated concentrations of metals. Therefore, low-flow pumping methods were used to control the levels of turbidity. All IR 7 groundwater samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

7.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at NAS Key West is included in Section 1.4 (Base Environmental Setting) of this document. Applicable site-specific physical characteristics are discussed below.

7.3.1 Hydrogeology

Groundwater elevation data obtained by IT Corporation in 1993 during water level measurements indicated that groundwater flow was significantly influenced by tides from the Gulf of Mexico located to the east and Man of War Harbor located to the west of the site. Groundwater flow directions were primarily towards and from the surface-water bodies. Information obtained during the original RFI/RI indicated that fluctuations in the groundwater level due to tides from the Gulf of Mexico extended throughout the site in

an east-west direction. Groundwater levels during the Supplemental RFI/RI at the site range from 0.42 feet bls to about 7 feet bls at the higher topographic areas of the site. Groundwater elevations varied from 1.05 feet to 1.82 feet above msl with groundwater flow generally toward the west at a gradient of 0.001 foot/foot. The direction of groundwater flow is indicated on Figure 7-5.

7.3.2 Soils

The material encountered during soil boring and monitoring well installation consisted of glass fragments, electrical wires, aluminum cans, plastic and wood interspersed with reworked limestone fill. The fill material and debris was encountered throughout the study area from land surface to about 17 feet bls in some areas of the site.

Geotechnical data obtained during the investigation conducted by IT Corporation in 1991 indicated a total organic carbon concentration of 6,600 mg/kg. The pH of the soil was 8.35 due to the carbonate nature of the fill materials (IT Corporation, 1991).

7.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from soil, sediment, surface water, and groundwater in the vicinity of the Fleming Key North Landfill (IR 7). The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various federal agencies, state agencies, and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix J contains the analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI. Appendix H contains the full data set used for site characterization and assessment in this report.

7.4.1 Subsurface Soil

Data from the 1993 IT Corporation RFI/RI were considered in the analysis of contamination in subsurface soil at IR 7. No other investigations tested for subsurface soil contamination at IR 7. Chemicals that were detected in subsurface soil samples are listed in Table 7-1. This table includes analytical results from the historical sampling event only, since no subsurface samples were collected during the Supplemental RFI/RI investigation, as per the Sampling and Analysis Plan (ABB, 1995). Of the two subsurface soil samples collected at IR 7, sample I7SB-1 was tested for inorganics, VOCs, SVOCs, and pesticides/PCBs. Only a limited set of results for each of these fractions was available for sample I7SB-4. All subsurface samples were taken at a depth of 4 feet. Figure 7-6 shows the occurrence of analytes that exceeded screening values and indicated possible subsurface soil contamination.

Metals accounted for most of the chemicals detected in the subsurface soil at the Fleming Key North Landfill. In general, subsurface metals and pesticides/PCBs were detected at sampling location I7SB-4 located towards the north end of the site near Building 1419. VOCs and SVOCs were also detected at I7SB-4, but did not exceed the screening criteria.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of subsurface soil samples.

7.4.1.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in either of the subsurface soil samples. Methylene chloride was detected at low levels in subsurface soil at sampling locations I7SB-1 (located west of the Animal Import Center near the shoreline) and I7SB-4. The maximum level of methylene chloride (38 µg/kg) was detected at sampling location I7SB-1 but was much less than the screening value of 300 µg/kg. Subsurface soil sampled at I7SB-1 and I7SB-4 contained detectable amounts of acetone (less than 100 µg/kg). These levels are well below the FDEP Residential Goal of 2.6E+05 µg/kg. 1,2-dichloroethene (2.8 µg/kg) was also detected at 17SB-1 at a level far below the 300 µg/kg screening value. No other VOCs were detected in subsurface soil at IR 7.

TABLE 7-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT IR 7
NAS KEY WEST

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
I7SB-4	4	IT 1993	Aluminum	422	
I7SB-1	4	IT 1993	Aluminum	384.5	
I7SB-4	4	IT 1993	Antimony	50.3	
I7SB-1	4	IT 1993	Antimony	3.1	B_1
I7SB-4	4	IT 1993	Arsenic	8.4	
I7SB-1	4	IT 1993	Arsenic	3.3	
I7SB-4	4	IT 1993	Barium	18.8	B_1
I7SB-1	4	IT 1993	Barium	6.1	B_1
I7SB-4	4	IT 1993	Cadmium	3.5	
I7SB-4	4	IT 1993	Chromium	26.4	
I7SB-1	4	IT 1993	Chromium	4.3	
I7SB-4	4	IT 1993	Cobalt	14.3	
I7SB-4	4	IT 1993	Copper	53.9	
I7SB-1	4	IT 1993	Copper	8.3	
I7SB-1	4	IT 1993	Iron	5500	
I7SB-4	4	IT 1993	Lead	337	
I7SB-1	4	IT 1993	Lead	15.3	
I7SB-4	4	IT 1993	Manganese	158	
I7SB-1	4	IT 1993	Manganese	26.6	
I7SB-4	4	IT 1993	Mercury	0.3	
I7SB-1	4	IT 1993	Mercury	0.1	
I7SB-4	4	IT 1993	Nickel	9.2	
I7SB-1	4	IT 1993	Nickel	2.9	B_1
I7SB-4	4	IT 1993	Vanadium	5.8	
I7SB-1	4	IT 1993	Vanadium	3.8	B_1
I7SB-4	4	IT 1993	Zinc	5940	
I7SB-1	4	IT 1993	Zinc	47.7	
PESTICIDES/PCBs (µg/kg)					
I7SB-4	4	IT 1993	4,4'-DDD	140	
I7SB-4	4	IT 1993	4,4'-DDE	300	
I7SB-4	4	IT 1993	4,4'-DDT	28	
I7SB-4	4	IT 1993	Aroclor-1242	970	
I7SB-4	4	IT 1993	Aroclor-1254	450	
I7SB-1	4	IT 1993	Endosulfan II	37.8	

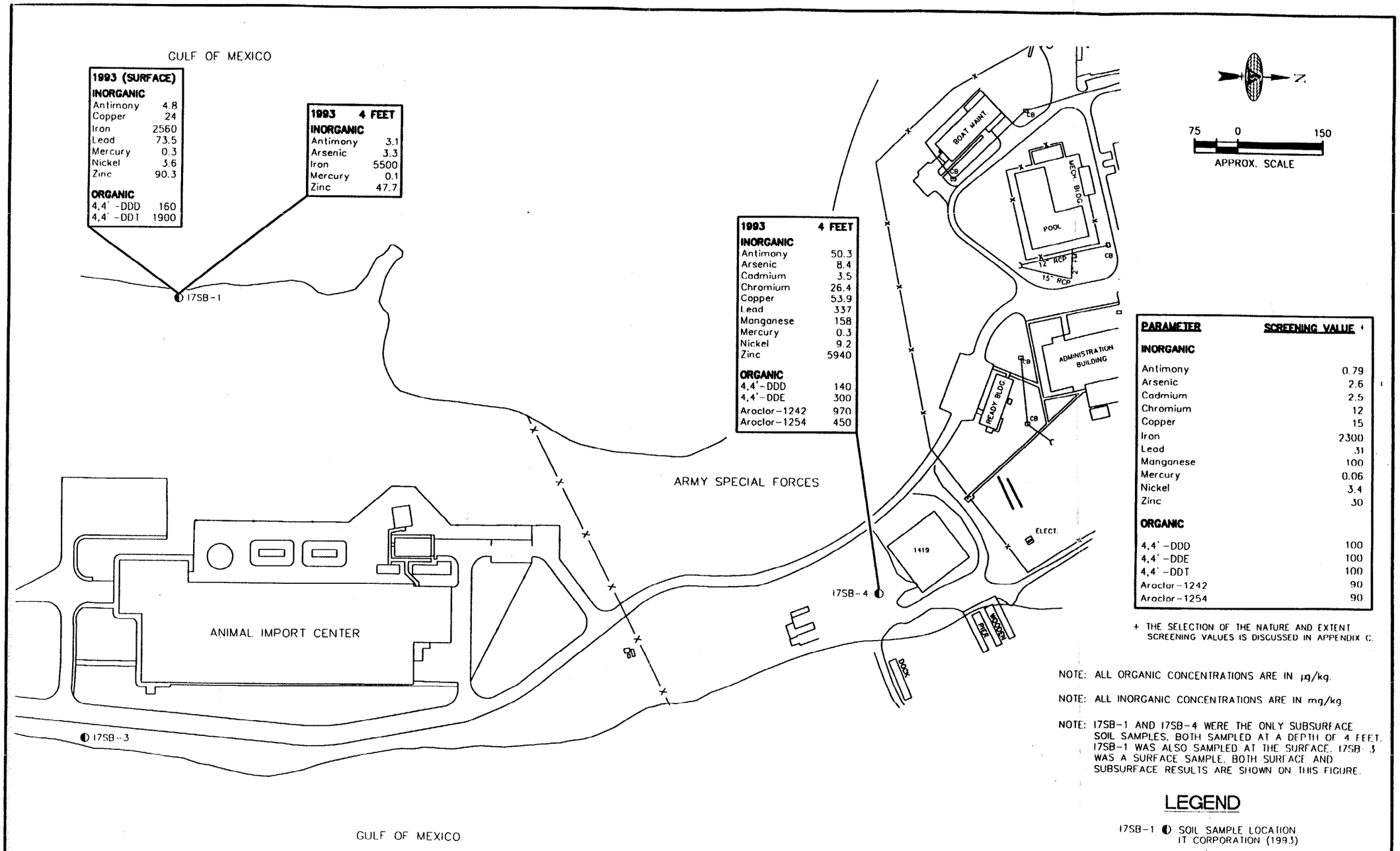
Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
I7SB-1	4	IT 1993	Bis(2-ethylhexyl)phthalate	1125	J
I7SB-4	4	IT 1993	Bis(2-ethylhexyl)phthalate	620	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)					
I7SB-1	4	IT 1993	1,2-dichloroethene	2.8	J
I7SB-1	4	IT 1993	Acetone	75	
I7SB-4	4	IT 1993	Acetone	44	
I7SB-1	4	IT 1993	Methylene chloride	38	B_2
I7SB-4	4	IT 1993	Methylene chloride	20	B_2

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

1 Depths are in feet and represent top of sampling interval.

2 Data Sources:
IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation

3 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.
B_2 - Analyte was found in the blank as well as the sample.



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Cadmium	2.5
Chromium	12
Copper	15
Iron	2300
Lead	31
Manganese	100
Mercury	0.06
Nickel	3.4
Zinc	30
ORGANIC	
4,4' -DDD	100
4,4' -DDE	100
4,4' -DDT	100
Aroclor-1242	90
Aroclor-1254	90

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: 17SB-1 AND 17SB-4 WERE THE ONLY SUBSURFACE SOIL SAMPLES, BOTH SAMPLED AT A DEPTH OF 4 FEET. 17SB-1 WAS ALSO SAMPLED AT THE SURFACE. 17SB-3 WAS A SURFACE SAMPLE. BOTH SURFACE AND SUBSURFACE RESULTS ARE SHOWN ON THIS FIGURE.

LEGEND

17SB-1 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 1/16/98
SURVEYED BY:	SURVEY DATE:
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR776	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-6
SOIL CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F 322

7.4.1.2 Semivolatile Organic Compounds

No SVOCs exceeded the screening criteria in either of the subsurface soil samples. Bis(2 ethylhexyl)phthalate was detected at I7SB-1 and I7SB-4 with the maximum level (1,125 µg/kg) occurring at I7SB-1. This is well below the FDEP residential goal used as a screening value (48,000 µg/kg). No other SVOCs were detected in subsurface soil at IR 7.

7.4.1.3 Pesticides

Four pesticides were detected in subsurface soil at IR 7. 4,4'-DDT and its degradation products were detected at I7SB-4, although only 4,4'-DDD and 4,4'-DDE exceeded their respective screening values. At 140 µg/kg and 300 µg/kg, respectively, 4,4'-DDD and 4,4'-DDE were only slightly in excess of the criteria. The concentration of 4,4'-DDT detected at I7SB-4 (28 µg/kg) was less than the screening value (110 µg/kg). Endosulfan II (37.8 µg/kg) was the only pesticide detected at I7SB-1, but no screening value is available.

7.4.1.4 Polychlorinated Biphenyls

Aroclor-1254 (450 µg/kg) and Aroclor-1242 (970 µg/kg) were detected at I7SB-4 at levels approximately 5 to 10 times the proposed RCRA action levels used as screening criteria.

7.4.1.5 Inorganics

Metals were detected in both of the subsurface soil samples collected by IT Corporation in 1993. Antimony, arsenic, mercury, and zinc exceeded the screening criteria at sampling locations I7SB-1 and I7SB-4. In each case, maximum concentration was detected at I7SB-4: antimony (50.3 mg/kg), arsenic (8.4 mg/kg), mercury (0.3 mg/kg), and zinc (5,940 mg/kg). Cadmium (3.5 mg/kg), chromium (26.4 mg/kg), copper (53.9 mg/kg), lead (337 mg/kg), manganese (158 mg/kg), and nickel (9.2 mg/kg) also exceeded the screening criteria at I7SB-4 and iron (5,500 mg/kg) exceeded the screening criteria at I7SB-1. Aluminum, barium, and vanadium were detected at both I7SB-1 and I7SB-4, but at levels less than the screening criteria. Low levels of cobalt were detected at I7SB-4, while low levels of chromium, copper, lead, manganese, and nickel were detected at I7SB-1.

7.4.2 Surface Soil

Data from the 1993 IT Corporation RFI/RI were considered in the analysis of surface soil contamination at IR 7. No other investigations tested surface soil at IR 7. Chemicals that were detected in surface soil samples are listed in Table 7-2. This table includes analytical results from the historical sampling event only, since no surface soil samples were collected during the Supplemental RFI/RI investigation, as per the Sampling and Analysis Plan (ABB, 1995). Of the two surface soil samples collected at IR 7, sample I7SB-1 was tested for inorganics, VOCs, SVOCs, and pesticides/PCBs. Only a limited set of results for each fraction was available for sample I7SB-3. Metals accounted for most of the chemicals detected in the surface soil at the Fleming Key North Landfill. Figure 7-6 shows the occurrence of analytes that exceeded screening values and indicated possible surface soil contamination.

Consistent with subsurface soil, metals and pesticides were most commonly detected at the north end of the site near Building 1419. VOCs and one SVOC were also detected but did not exceed the screening criteria.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

7.4.2.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the surface soil samples. Methylene chloride and 1,2-dichloroethene were detected at low levels in surface soil at I7SB-1 and I7SB-3 (located east of the Animal Import Center near the shoreline). The maximum concentration of methylene chloride (69 µg/kg) was detected at I7SB-1. Concentrations of 1,2-dichloroethene at I7SB-1 and I7SB-3 were low at 3 µg/kg as compared to the EPA Region III BTAG concentration used as the soil screening value (300 µg/kg). Also detected at I7SB-1 at levels below the screening criteria were 4-methyl-2-pentanone (0.3 µg/kg), acetone (15 µg/kg), toluene (1 µg/kg), and vinyl acetate (0.4 µg/kg).

TABLE 7-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 7
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
I7SB-3	IT 1993	Aluminum	599	
I7SB-1	IT 1993	Aluminum	547	
I7SB-1	IT 1993	Antimony	4.8	B_1
I7SB-1	IT 1993	Arsenic	1.6	
I7SB-3	IT 1993	Arsenic	1.4	
I7SB-3	IT 1993	Barium	5.6	B_1
I7SB-1	IT 1993	Barium	5.6	B_1
I7SB-1	IT 1993	Chromium	8.6	
I7SB-3	IT 1993	Chromium	4.5	
I7SB-1	IT 1993	Copper	24	
I7SB-3	IT 1993	Copper	9.3	
I7SB-1	IT 1993	Iron	2560	
I7SB-1	IT 1993	Lead	73.5	
I7SB-3	IT 1993	Lead	18.7	
I7SB-1	IT 1993	Manganese	23.8	
I7SB-3	IT 1993	Manganese	16.1	
I7SB-1	IT 1993	Mercury	0.3	
I7SB-1	IT 1993	Nickel	3.6	B_1
I7SB-3	IT 1993	Nickel	3.1	B_1
I7SB-1	IT 1993	Vanadium	2.9	B_1
I7SB-3	IT 1993	Vanadium	1.9	B_1
I7SB-1	IT 1993	Zinc	90.3	
I7SB-3	IT 1993	Zinc	21.7	
PESTICIDES/PCBs (µg/kg)				
I7SB-1	IT 1993	4,4'-DDD	160	
I7SB-3	IT 1993	4,4'-DDE	40	
I7SB-1	IT 1993	4,4'-DDT	1900	D
I7SB-3	IT 1993	4,4'-DDT	35	
I7SB-1	IT 1993	beta-BHC	59	DJ
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
I7SB-3	IT 1993	Bis(2-ethylhexyl)phthalate	290	J
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
I7SB-3	IT 1993	1,2-dichloroethene	3	J
I7SB-1	IT 1993	1,2-dichloroethene	3	J
I7SB-1	IT 1993	4-methyl-2-pentanone	0.3	J
I7SB-1	IT 1993	Acetone	15	
I7SB-1	IT 1993	Methylene chloride	69	B_2
I7SB-3	IT 1993	Methylene chloride	17	B_2
I7SB-1	IT 1993	Toluene	1	J
I7SB-1	IT 1993	Vinyl acetate	0.4	J

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
D - Compound analyzed at a secondary dilution factor.
J - The associated value is an estimated quantity.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. 4-methyl-2pentanone, acetone, and vinyl acetate were selected as ecological COPCs (see Section 7.7.4.1.2) because no suitable ecological thresholds were available. The selected nature and extent screening values for 4-methyl-2-pentanone, and vinyl acetate were not ecological screening levels.

7.4.2.2 Semivolatile Organic Compounds

No SVOCs exceeded the screening criteria in any of the surface soil samples. A low concentration of bis(2-ethylhexyl)phthalate (290 µg/kg) was detected at I7SB-3. This was the only SVOC detected in surface soil at IR 7.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Bis(2-ethylhexyl)phthalate was selected as an ecological COPC (see Section 7.7.4.1.2) because no suitable ecological threshold was available. The selected nature and extent screening value for bis(2-ethylhexyl)phthalate was not an ecological screening level.

7.4.2.3 Pesticides

The surface soil sample at I7SB-1 contained 4,4'-DDD (160 µg/kg) and 4,4'-DDT (1,900 µg/kg) at levels in excess of the screening criteria. The concentration of 4,4'-DDT was almost 17 times the background concentration used for screening. Beta-BHC (59 µg/kg) was also detected at I7SB-1. Low levels of 4,4'-DDE (40 µg/kg) and 4,4'-DDT (35 µg/kg) were detected at I7SB-3 but were well below screening values.

7.4.2.4 Polychlorinated Biphenyls

No PCBs were detected in surface soil at IR 7.

7.4.2.5 Inorganics

Metals were detected in surface soil at concentrations above screening values only at I7SB-1. Among them, antimony (4.8 mg/kg), iron (2,560 mg/kg), mercury (0.31 mg/kg), and zinc (90 mg/kg) were greater than three times the screening value. Copper (24 mg/kg), lead (73.5 mg/kg), and nickel (3.6 mg/kg) also exceeded screening values but to a lesser extent. Copper, lead, nickel, and zinc were also detected at

lower levels at I7SB-3. Other metals including aluminum, arsenic, barium, chromium, manganese, and vanadium were detected at both I7SB-1 and I7SB-3 but levels were less than the screening criteria.

7.4.3 Sediment

Data from a number of sampling efforts including the 1990 IT Corporation RI, 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of sediment contamination at IR 7. Chemicals that were detected in sediment samples are listed in Table 7-3. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Figure 7-7 shows the occurrence of analytes that exceeded screening values and indicated possible sediment contamination.

There were 24 sampling locations for sediment at IR 7. Of these 24, four are from the 1990 IT Corporation RI. These samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and inorganics. Ten of the 24 are from the 1993 IT Corporation RFI/RI. The 1993 RFI/RI samples were analyzed for VOCs, SVOCs, and inorganics. I7SS-7(IT) and I7SS-10(IT) also were analyzed for pesticides, PCBs, and additional SVOCs. Ten of the 24 samples are from this Supplemental RFI/RI. Sampling locations I7SS-1 through I7SS-10 were in the vicinity of the 1993 IT Corporation samples numbered similarly. These B&R Environmental samples were analyzed for pesticides, PCBs, and inorganics, as per the Sampling and Analysis Plan (ABB, 1995).

Several metals including arsenic, beryllium, copper, lead, mercury, and silver were detected several times at various sampling locations in sediment at IR 7. 4,4'-DDT and its degradation products were the pesticides detected most frequently. No VOCs exceeded the screening values. SVOCs were detected predominantly in 1990 samples where twelve exceeded their screening values.

Screening values were obtained from a variety of sources including FDEP SQAGs, EPA Region IV Screening Values, EPA SQCs for Marine and Freshwater Sediments, ER-L Criteria, ER-M Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples.

TABLE 7-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 7
NAS KEY WEST
PAGE 1 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
I7SS-8	B&RE 1996	Aluminum	1010	
I7SS-9	B&RE 1996	Aluminum	922	
I7SS-6	B&RE 1996	Aluminum	618	
I7SS-10	B&RE 1996	Aluminum	583	
I7S-4	IT 1990	Aluminum	531	
I7S-3	IT 1990	Aluminum	452	
I7S-2	IT 1990	Aluminum	415	
I7SS-2	B&RE 1996	Aluminum	372	
I7SS-10(IT)	IT 1993	Aluminum	345	
I7SS-3	B&RE 1996	Aluminum	309	
I7SS-1	B&RE 1996	Aluminum	298	
I7SS-5	B&RE 1996	Aluminum	297	
I7SS-7	B&RE 1996	Aluminum	281	
I7SS-7(IT)	IT 1993	Aluminum	276	
I7S-1	IT 1990	Aluminum	242	
I7SS-4	B&RE 1996	Aluminum	224.5	
I7SS-9	B&RE 1996	Arsenic	9.7	
I7SS-8	B&RE 1996	Arsenic	7.6	
I7SS-5(IT)	IT 1993	Arsenic	6	
I7SS-4(IT)	IT 1993	Arsenic	5.8	
I7SS-10	B&RE 1996	Arsenic	4.8	
I7SS-2(IT)	IT 1993	Arsenic	4	
I7SS-3(IT)	IT 1993	Arsenic	3.8	
I7SS-10(IT)	IT 1993	Arsenic	3.6	
I7S-3	IT 1990	Arsenic	3.6	
I7SS-6	B&RE 1996	Arsenic	3.6	
I7SS-1(IT)	IT 1993	Arsenic	3.1	
I7SS-1	B&RE 1996	Arsenic	2.7	
I7SS-7	B&RE 1996	Arsenic	2.5	
I7SS-7(IT)	IT 1993	Arsenic	2.1	B_1
I7SS-4	B&RE 1996	Arsenic	1.9	
I7SS-3	B&RE 1996	Arsenic	1.7	
I7SS-5	B&RE 1996	Arsenic	1.6	

Location	Source[1]	Parameter	Result	Qual.[2]
I7SS-2	B&RE 1996	Arsenic	1.3	
I7SS-8(IT)	IT 1993	Arsenic	0.92	B_1
I7SS-9(IT)	IT 1993	Arsenic	0.66	B_1
I7SS-4(IT)	IT 1993	Barium	16.8	B_1
I7SS-9	B&RE 1996	Barium	16.3	
I7SS-8	B&RE 1996	Barium	14.9	
I7SS-10	B&RE 1996	Barium	10.9	
I7SS-2	B&RE 1996	Barium	9.3	
I7SS-6	B&RE 1996	Barium	8.6	
I7SS-5(IT)	IT 1993	Barium	8.2	B_1
I7SS-7	B&RE 1996	Barium	7.5	
I7S-2	IT 1990	Barium	7.1	B_1
I7SS-4	B&RE 1996	Barium	6.4	
I7SS-1	B&RE 1996	Barium	6.4	
I7SS-2(IT)	IT 1993	Barium	6.1	B_1
I7SS-1(IT)	IT 1993	Barium	6	B_1
I7SS-3(IT)	IT 1993	Barium	5.6	B_1
I7SS-5	B&RE 1996	Barium	5.5	
I7SS-3	B&RE 1996	Barium	5.4	
I7S-3	IT 1990	Barium	5.3	B_1
I7SS-10(IT)	IT 1993	Barium	4.7	B_1
I7SS-7(IT)	IT 1993	Barium	4.4	B_1
I7S-4	IT 1990	Barium	4.2	B_1
I7SS-9(IT)	IT 1993	Barium	3.8	B_1
I7SS-8(IT)	IT 1993	Barium	3.6	B_1
I7SS-6(IT)	IT 1993	Barium	3.4	B_1
I7S-1	IT 1990	Barium	3.3	B_1
I7SS-6(IT)	IT 1993	Beryllium	0.24	B_1
I7SS-7(IT)	IT 1993	Beryllium	0.2	B_1
I7SS-9(IT)	IT 1993	Beryllium	0.16	B_1
I7SS-8(IT)	IT 1993	Cadmium	1.1	
I7S-2	IT 1990	Cadmium	1.1	
I7SS-5(IT)	IT 1993	Chromium	8.7	
I7SS-4(IT)	IT 1993	Chromium	6.3	

TABLE 7-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 7
NAS KEY WEST
PAGE 2 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I7SS-10(IT)	IT 1993	Chromium	5.7	
I7SS-2(IT)	IT 1993	Chromium	5	
I7SS-8(IT)	IT 1993	Chromium	4.9	
I7SS-3(IT)	IT 1993	Chromium	4.8	
I7SS-1	B&RE 1996	Chromium	4.8	
I7SS-6(IT)	IT 1993	Chromium	4.8	
I7S-3	IT 1990	Chromium	4.5	
I7SS-1(IT)	IT 1993	Chromium	4.3	
I7SS-9(IT)	IT 1993	Chromium	4.3	
I7SS-7(IT)	IT 1993	Chromium	4.3	
I7S-4	IT 1990	Chromium	4.1	
I7S-2	IT 1990	Chromium	3.6	
I7SS-4	B&RE 1996	Chromium	3.4	
I7S-1	IT 1990	Chromium	3.3	
I7SS-5	B&RE 1996	Cobalt	0.35	
I7SS-10(IT)	IT 1993	Copper	115	
I7SS-8(IT)	IT 1993	Copper	46	
I7SS-5	B&RE 1996	Copper	35.4	
I7S-1	IT 1990	Copper	23.8	
I7SS-1	B&RE 1996	Copper	21.5	
I7SS-5(IT)	IT 1993	Copper	21.2	
I7S-2	IT 1990	Copper	21.1	
I7SS-9(IT)	IT 1993	Copper	18.3	
I7S-4	IT 1990	Copper	15.9	
I7SS-7	B&RE 1996	Copper	15.1	
I7SS-8	B&RE 1996	Copper	13	
I7SS-4	B&RE 1996	Copper	11.7	
I7SS-3	B&RE 1996	Copper	10.4	
I7SS-4(IT)	IT 1993	Copper	9.7	
I7SS-2	B&RE 1996	Copper	9.1	
I7SS-9	B&RE 1996	Copper	9	
I7S-3	IT 1990	Copper	7.5	
I7SS-10	B&RE 1996	Copper	6.8	
I7SS-6	B&RE 1996	Copper	6.3	

Location	Source[1]	Parameter	Result	Qual.[2]
I7SS-6(IT)	IT 1993	Copper	4	B_1
I7SS-7(IT)	IT 1993	Copper	3.4	B_1
I7SS-3(IT)	IT 1993	Copper	3.4	B_1
I7SS-2(IT)	IT 1993	Copper	2.8	B_1
I7SS-1(IT)	IT 1993	Copper	2.4	B_1
I7SS-10(IT)	IT 1993	Cyanide	23	
I7SS-1	B&RE 1996	Iron	2080	
I7SS-3	B&RE 1996	Iron	1380	
I7S-4	IT 1990	Iron	1140	
I7SS-8	B&RE 1996	Iron	1070	
I7SS-9	B&RE 1996	Iron	978	
I7S-1	IT 1990	Iron	949	
I7S-2	IT 1990	Iron	772	
I7SS-10	B&RE 1996	Iron	624	
I7SS-6	B&RE 1996	Iron	576	
I7SS-10(IT)	IT 1993	Iron	542	
I7SS-2	B&RE 1996	Iron	482	
I7SS-7	B&RE 1996	Iron	448	
I7SS-7(IT)	IT 1993	Iron	390	
I7S-3	IT 1990	Iron	342	
I7SS-4	B&RE 1996	Iron	310	
I7SS-5	B&RE 1996	Iron	17.4	
I7SS-4	B&RE 1996	Lead	42.2	
I7S-1	IT 1990	Lead	38	
I7SS-5(IT)	IT 1993	Lead	32.5	
I7S-2	IT 1990	Lead	27.2	
I7SS-5	B&RE 1996	Lead	19.6	
I7SS-7	B&RE 1996	Lead	16.5	
I7S-4	IT 1990	Lead	15.8	
I7SS-8	B&RE 1996	Lead	15.4	
I7SS-3	B&RE 1996	Lead	14.9	
I7SS-9	B&RE 1996	Lead	14	
I7SS-1	B&RE 1996	Lead	12.9	
I7SS-8(IT)	IT 1993	Lead	12.6	

TABLE 7-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 7
NAS KEY WEST
PAGE 3 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I7SS-9(IT)	IT 1993	Lead	12	
I7SS-2	B&RE 1996	Lead	11.7	
I7SS-6(IT)	IT 1993	Lead	9.7	
I7SS-10	B&RE 1996	Lead	9.6	
I7SS-6	B&RE 1996	Lead	8.8	
I7SS-4(IT)	IT 1993	Lead	8.7	
I7SS-3(IT)	IT 1993	Lead	6.2	
I7SS-2(IT)	IT 1993	Lead	6.1	
I7SS-10(IT)	IT 1993	Lead	5.9	
I7SS-7(IT)	IT 1993	Lead	5.3	
I7SS-1(IT)	IT 1993	Lead	4.6	
I7S-2	IT 1990	Manganese	29.2	
I7S-4	IT 1990	Manganese	21.6	
I7SS-1	B&RE 1996	Manganese	13.3	
I7SS-8	B&RE 1996	Manganese	12.6	
I7SS-9	B&RE 1996	Manganese	10.3	
I7SS-5	B&RE 1996	Manganese	10.1	
I7SS-3	B&RE 1996	Manganese	9.2	
I7SS-6	B&RE 1996	Manganese	8.3	
I7S-1	IT 1990	Manganese	8.2	
I7SS-10	B&RE 1996	Manganese	7.8	
I7SS-2	B&RE 1996	Manganese	7.7	
I7S-3	IT 1990	Manganese	6.4	
I7SS-4	B&RE 1996	Manganese	6.4	
I7SS-7	B&RE 1996	Manganese	4.9	
I7SS-10(IT)	IT 1993	Manganese	4.5	
I7SS-7(IT)	IT 1993	Manganese	3.2	B_1
I7SS-8	B&RE 1996	Mercury	0.14	
I7SS-6(IT)	IT 1993	Mercury	0.12	
I7S-2	IT 1990	Mercury	0.09	
I7SS-4(IT)	IT 1993	Mercury	0.08	
I7S-4	IT 1990	Mercury	0.07	
I7SS-8(IT)	IT 1993	Mercury	0.06	
I7S-1	IT 1990	Mercury	0.06	

Location	Source[1]	Parameter	Result	Qual.[2]
I7SS-3	B&RE 1996	Mercury	0.05	
I7SS-10(IT)	IT 1993	Mercury	0.05	
I7SS-2(IT)	IT 1993	Mercury	0.05	
I7SS-9(IT)	IT 1993	Mercury	0.04	
I7SS-3(IT)	IT 1993	Mercury	0.04	
I7SS-1(IT)	IT 1993	Mercury	0.04	
I7SS-7(IT)	IT 1993	Mercury	0.03	
I7SS-5	B&RE 1996	Mercury	0.03	
I7SS-4	B&RE 1996	Mercury	0.02	
I7SS-3	B&RE 1996	Nickel	3.8	
I7SS-9	B&RE 1996	Nickel	2.7	
I7SS-8	B&RE 1996	Nickel	2.5	
I7SS-5	B&RE 1996	Nickel	2.2	
I7SS-1	B&RE 1996	Nickel	1.8	
I7SS-6	B&RE 1996	Nickel	1.7	
I7SS-10	B&RE 1996	Nickel	1.5	
I7SS-2	B&RE 1996	Nickel	1.4	
I7SS-4	B&RE 1996	Nickel	1.1	
I7SS-7	B&RE 1996	Nickel	1.1	
I7S-1	IT 1990	Silver	7	
I7S-2	IT 1990	Silver	6.1	
I7S-3	IT 1990	Silver	2.8	B_1
I7SS-7(IT)	IT 1993	Tin	9.5	B_1
I7SS-4	B&RE 1996	Vanadium	6.5	
I7SS-1	B&RE 1996	Vanadium	6	
I7SS-9	B&RE 1996	Vanadium	5	
I7SS-8	B&RE 1996	Vanadium	4.9	
I7SS-6	B&RE 1996	Vanadium	4.7	
I7SS-3	B&RE 1996	Vanadium	4	
I7SS-2	B&RE 1996	Vanadium	4	
I7SS-7	B&RE 1996	Vanadium	3.4	
I7SS-5	B&RE 1996	Vanadium	3.3	
I7SS-10	B&RE 1996	Vanadium	3.3	
I7S-4	IT 1990	Vanadium	3.1	B_1

TABLE 7-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 7
NAS KEY WEST
PAGE 4 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I7S-2	IT 1990	Vanadium	2.9	B_1
I7SS-10(IT)	IT 1993	Vanadium	2.7	B_1
I7S-3	IT 1990	Vanadium	2.4	B_1
I7S-1	IT 1990	Vanadium	2	B_1
I7SS-8(IT)	IT 1993	Vanadium	2	B_1
I7SS-9(IT)	IT 1993	Vanadium	1.9	B_1
I7SS-10(IT)	IT 1993	Zinc	58.6	
I7S-2	IT 1990	Zinc	46.6	
I7S-4	IT 1990	Zinc	43.1	
I7SS-5(IT)	IT 1993	Zinc	36.3	
I7SS-9(IT)	IT 1993	Zinc	24.3	
I7SS-5	B&RE 1996	Zinc	21.6	
I7S-1	IT 1990	Zinc	18.5	
I7SS-8(IT)	IT 1993	Zinc	18	
I7S-3	IT 1990	Zinc	13	
I7SS-4(IT)	IT 1993	Zinc	12.3	
I7SS-3(IT)	IT 1993	Zinc	9.2	
I7SS-7(IT)	IT 1993	Zinc	8.3	
I7SS-6(IT)	IT 1993	Zinc	7.2	
I7SS-2(IT)	IT 1993	Zinc	7	
I7SS-1(IT)	IT 1993	Zinc	5	
PESTICIDES/PCBs (µg/kg)				
I7SS-5	B&RE 1996	4,4'-DDD	4.5	
I7SS-7	B&RE 1996	4,4'-DDD	2.6	
I7SS-1	B&RE 1996	4,4'-DDD	2.4	
I7SS-4	B&RE 1996	4,4'-DDD	1.6	J
I7SS-5	B&RE 1996	4,4'-DDE	23.2	
I7SS-1	B&RE 1996	4,4'-DDE	13.3	J
I7SS-3	B&RE 1996	4,4'-DDE	2.8	
I7SS-7	B&RE 1996	4,4'-DDE	2.3	J
I7SS-4	B&RE 1996	4,4'-DDE	1.6	J
I7SS-5	B&RE 1996	4,4'-DDT	32.1	
I7SS-2	B&RE 1996	4,4'-DDT	19.8	
I7SS-1	B&RE 1996	4,4'-DDT	18.2	

Location	Source[1]	Parameter	Result	Qual.[2]
I7SS-4	B&RE 1996	4,4'-DDT	7.9	
I7SS-1	B&RE 1996	alpha-BHC	2.2	
I7SS-5	B&RE 1996	Aroclor-1254	47	J
I7SS-2	B&RE 1996	Aroclor-1260	146	
I7S-2	IT 1990	beta-BHC	170	DZ
I7SS-4	B&RE 1996	delta-BHC	1.5	
I7SS-1	B&RE 1996	Dieldrin	20.8	
I7SS-1	B&RE 1996	Endosulfan I	10.7	J
I7SS-5	B&RE 1996	Endosulfan I	2.9	
I7SS-3	B&RE 1996	Endosulfan I	2.4	
I7SS-1	B&RE 1996	Endosulfan sulfate	10.6	J
I7SS-2	B&RE 1996	Endrin	13.6	
I7SS-1	B&RE 1996	Endrin aldehyde	0.64	J
I7SS-9	B&RE 1996	gamma-BHC (lindane)	2	J
I7SS-1	B&RE 1996	gamma-BHC (lindane)	1.5	
I7SS-8	B&RE 1996	gamma-BHC (lindane)	1.5	J
I7SS-4	B&RE 1996	gamma-BHC (lindane)	1.2	J
I7SS-1	B&RE 1996	Heptachlor	11	
I7SS-3	B&RE 1996	Heptachlor	0.56	J
I7SS-1	B&RE 1996	Heptachlor epoxide	1.5	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
I7S-2	IT 1990	Acenaphthene	300	J
I7S-2	IT 1990	Anthracene	140	J
I7S-2	IT 1990	Benzo(a)anthracene	640	J
I7S-2	IT 1990	Benzo(a)pyrene	540	J
I7S-2	IT 1990	Benzo(b)fluoranthene	630	J
I7S-2	IT 1990	Benzo(g,h,i)perylene	310	J
I7S-2	IT 1990	Benzo(k)fluoranthene	610	J
I7S-4	IT 1990	Bis(2-ethylhexyl)phthalate	570	J
I7SS-10(IT)	IT 1993	Bis(2-ethylhexyl)phthalate	400	J
I7S-2	IT 1990	Bis(2-ethylhexyl)phthalate	350	J
I7S-1	IT 1990	Bis(2-ethylhexyl)phthalate	310	J
I7S-3	IT 1990	Bis(2-ethylhexyl)phthalate	260	J
I7S-2	IT 1990	Chrysene	950	

TABLE 7-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 7
NAS KEY WEST
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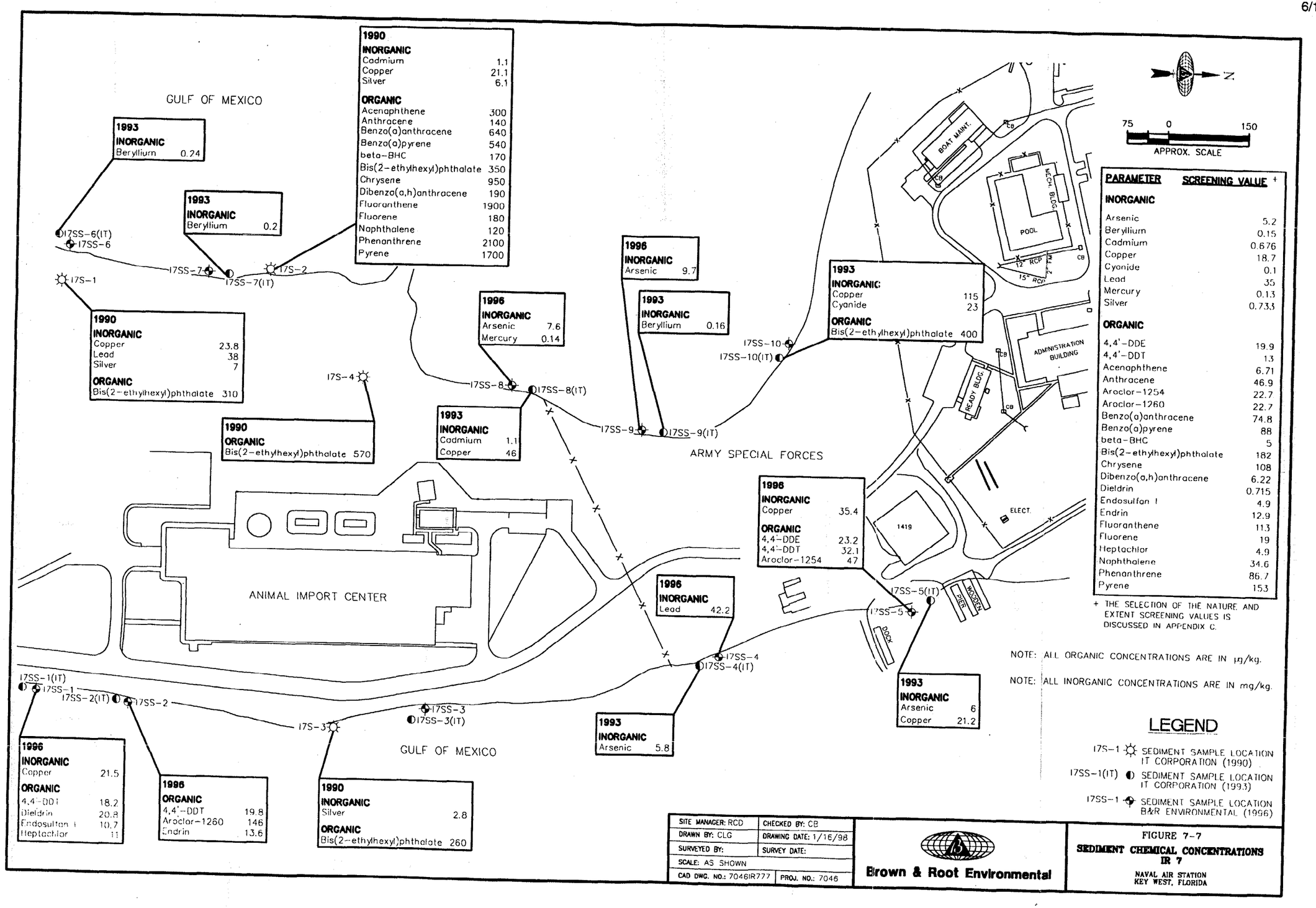
Location	Source[1]	Parameter	Result	Qual.[2]
I7S-2	IT 1990	Dibenzo(a,h)anthracene	190	J
I7S-2	IT 1990	Dibenzofuran	170	J
I7S-2	IT 1990	Fluoranthene	1900	
I7S-2	IT 1990	Fluorene	180	J
I7S-2	IT 1990	Indeno(1,2,3-cd)pyrene	280	J
I7S-2	IT 1990	Naphthalene	120	J
I7S-2	IT 1990	Phenanthrene	2100	
I7SS-8(IT)	IT 1993	Phenanthrene	34	
I7SS-9(IT)	IT 1993	Phenanthrene	32	
I7S-2	IT 1990	Pyrene	1700	
I7SS-9(IT)	IT 1993	Pyrene	140	
I7SS-8(IT)	IT 1993	Pyrene	42	
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
I7SS-7(IT)	IT 1993	Acetone	51	
I7SS-10(IT)	IT 1993	Acetone	23	
I7SS-7(IT)	IT 1993	Methylene chloride	36	B_2
I7SS-10(IT)	IT 1993	Methylene chloride	17	B_2
I7S-2	IT 1990	Methylene chloride	5	J
I7S-4	IT 1990	Methylene chloride	4	J
I7S-1	IT 1990	Methylene chloride	4	J
I7S-3	IT 1990	Methylene chloride	3	J

*All sediment samples at IR 7 were surface sediment.
Shading indicates a concentration in excess of the screening values (See Table C.3-2).

1 Data Sources:
IT Corporation 1990 - RI conducted in 1990 by IT Corporation (1991)
IT Corporation 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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
D - Compound analyzed at a secondary dilution value
Z - Elevated contract required quantitation limit due to matrix interferences obscuring the compound of interest.
B_2 - Analyte was found in the blank as well as the sample


GULF OF MEXICO
1993
INORGANIC
Beryllium 0.24
1993
INORGANIC
Beryllium 0.2
1990
INORGANIC
Cadmium 1.1
Copper 21.1
Silver 6.1
ORGANIC
Acenaphthene 300
Anthracene 140
Benzo(a)anthracene 640
Benzo(a)pyrene 540
beta-BHC 170
Bis(2-ethylhexyl)phthalate 350
Chrysene 950
Dibenzo(a,h)anthracene 190
Fluoranthene 1900
Fluorene 180
Naphthalene 120
Phenanthrene 2100
Pyrene 1700
I7SS-6(IT)
I7SS-6
I7SS-7
I7SS-7(IT)
I7S-2
I7S-1
1990
INORGANIC
Copper 23.8
Lead 38
Silver 7
ORGANIC
Bis(2-ethylhexyl)phthalate 310
I7S-4
1990
ORGANIC
Bis(2-ethylhexyl)phthalate 570
1996
INORGANIC
Arsenic 7.6
Mercury 0.14
I7SS-8
I7SS-8(IT)
1993
INORGANIC
Cadmium 1.1
Copper 46
1996
INORGANIC
Arsenic 9.7
1993
INORGANIC
Beryllium 0.16
I7SS-9
I7SS-9(IT)
I7SS-10
I7SS-10(IT)
1993
INORGANIC
Copper 115
Cyanide 23
ORGANIC
Bis(2-ethylhexyl)phthalate 400
ARMY SPECIAL FORCES
BOAT MAINT.
MECH. BLDG.
POOL
12" RCP
15" RCP
ADMINISTRATION BUILDING
READY BLDG.
ELECT.
1419
1996
INORGANIC
Copper 35.4
ORGANIC
4,4'-DDE 23.2
4,4'-DDT 32.1
Aroclor-1254 47
1996
INORGANIC
Lead 42.2
ANIMAL IMPORT CENTER
I7SS-5(IT)
I7SS-5
PIER
WOODEN
DOCK
I7SS-4
I7SS-4(IT)
1993
INORGANIC
Arsenic 6
Copper 21.2
I7SS-1(IT)
I7SS-1
I7SS-2(IT)
I7SS-2
I7S-3
I7SS-3
I7SS-3(IT)
GULF OF MEXICO
1993
INORGANIC
Arsenic 5.8
1996
INORGANIC
Copper 21.5
ORGANIC
4,4'-DDT 18.2
Dieldrin 20.8
Endosulfan I 10.7
Heptachlor 11
1996
ORGANIC
4,4'-DDT 19.8
Aroclor-1260 146
Endrin 13.6
1990
INORGANIC
Silver 2.8
ORGANIC
Bis(2-ethylhexyl)phthalate 260
N
75 0 150
APPROX. SCALE
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
ORGANIC
4,4'-DDE 19.9
4,4'-DDT 13
Acenaphthene 6.71
Anthracene 46.9
Aroclor-1254 22.7
Aroclor-1260 22.7
Benzo(a)anthracene 74.8
Benzo(a)pyrene 88
beta-BHC 5
Bis(2-ethylhexyl)phthalate 182
Chrysene 108
Dibenzo(a,h)anthracene 6.22
Dieldrin 0.715
Endosulfan I 4.9
Endrin 12.9
Fluoranthene 113
Fluorene 19
Heptachlor 4.9
Naphthalene 34.6
Phenanthrene 86.7
Pyrene 153
+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.
NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.
NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.
LEGEND
I7S-1 SEDIMENT SAMPLE LOCATION IT CORPORATION (1990)
I7SS-1(IT) SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)
I7SS-1 SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)
SITE MANAGER: RCD
CHECKED BY: CB
DRAWN BY: CLG
DRAWING DATE: 1/16/98
SURVEYED BY:
SURVEY DATE:
SCALE: AS SHOWN
CAD DWG. NO.: 7046IR777
PROJ. NO.: 7046
Brown & Root Environmental
FIGURE 7-7
SEDIMENT CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA

7.4.3.1 Volatile Organic Compounds

No VOCs exceeded the screening criteria in any of the sediment samples at IR 7. Acetone was detected at low levels in sediment at sampling locations I7SS-7(IT) and I7SS-10(IT) in 1993. The maximum level of acetone (51 µg/kg) was detected at sampling location I7SS-7(IT) but was less than the screening value of 64 µg/kg. Six sediment samples contained detectable amounts of methylene chloride. The maximum was less than 40 µg/kg, well below the screening value (427 µg/kg). No other VOCs were detected in sediment at IR 7.

7.4.3.2 Semivolatile Organic Compounds

Twelve SVOCs [acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene] exceeded their screening values in sediment at IR 7.

Acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, flourene, and naphthalene were only detected by IT Corporation in 1990 at sampling location I7S-2. Phenanthrene and pyrene, which had their maximum concentrations at I7S-2, were also detected in 1993 at two other sampling locations, but at levels below the screening values. Bis(2-ethylhexyl)phthalate exceeded the selected screening value (182 µg/kg) at all five sampling locations where it was detected. Maximum concentrations were detected at I7S-4 (570 µg/kg), I7SS-10(IT) (400 µg/kg), and I7S-2 (350 µg/kg) in 1990 and 1993. Other SVOCs, including benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)flouranthene, dibenzofuran, and ideno(1,2,3-cd)pyrene were detected at IR 7 but were below their respective screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene were identified as COPCs (Section 7.6.2.2) in the human health risk assessment based on a qualitative evaluation for benzo(g,h,i)perylene and since they are all from the same family as other COPCs although they do not have their own RBCs. Their concentrations in sediment in IR 7 were less than the Residential Soil RBCs [benzo(b)fluoranthene and benzo(k)fluoranthene] and EPA Region III BTAG Sediment Screening Levels [benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene] selected for nature and extent screening. Benzo(b)fluoranthene and benzo(k)fluoranthene were selected as ecological COPCs (see Section 7.7.4.1.2) since their hazard quotients were greater than one. However, all

benzo(b)fluoranthene and benzo(k)fluoranthene concentrations in sediment at IR 7 were less than Residential Soil RBCs selected for nature and extent screening.

7.4.3.3 Pesticides

Seven pesticide compounds were detected in sediment at concentrations greater than their screening values, predominantly in 1996. With the exception of beta-BHC (I7S-2; 170 µg/kg) which exceeded its screening value in 1990, all pesticide detections in sediment at IR 7 occurred in 1996. 4,4'-DDT and its degradation products were the most commonly detected pesticides. Detected in five samples, 4,4'-DDE was the most frequently detected pesticide. 4,4'-DDT was the pesticide most frequently detected in excess of its screening value (3 of 4 samples). The maximum concentrations of 4,4'-DDE and 4,4'-DDT were detected at I7SS-5 (23.2 µg/kg and 32.1 µg/kg, respectively). 4,4'-DDD was also detected at its maximum concentration at that location but was below the screening value. Dieldrin, endosulfan I, endrin and heptachlor also exceeded their screening values. Dieldrin and endrin were each detected only once in sediment -- dieldrin (20.8 µg/kg) at I7SS-1 and endrin (13.6 µg/kg) at I7SS-2. Endosulfan I and heptachlor were detected in more than one sample but exceeded screening values at a single location, I7SS-1. 4,4'-DDD, alpha-BHC, delta-BHC, endosulfan sulfate, endrin aldehyde, gamma-BHC (lindane), and heptachlor epoxide were detected in sediment, although none exceeded sediment screening values. Gamma-BHC (lindane) was the most frequently occurring of these compounds, detected in four samples.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Delta-BHC was identified as a COPC (see Section 7.6.2.2) in the human health risk assessment based on a qualitative evaluation since it does not have an RBC. The concentration of delta-BHC in sediment at IR 7 was less than the Hull and Sutter (1994) screening value selected for nature and extent screening. 4,4'-DDD, endosulfan sulfate, and gamma-BHC (lindane) were selected as ecological COPCs (see Section 7.7.4.1.2) since their hazard quotients were greater than one. However, all 4,4'DDD, endosulfan sulfate, and gamma-BHC (lindane) concentrations in sediment at IR 7 were less than twice the average background concentration selected for nature and extent screening.

7.4.3.4 Polychlorinated Biphenyls

Two PCBs were detected in sediment at IR 7. Both detections were in excess of the 22.7 µg/kg EPA Region III BTAG Level used for screening purposes. Aroclor-1254 was detected in a single sample (I7SS-5; 47 µg/kg) during the 1996 investigation. Aroclor-1260 was also detected in a single sample (I7SS-2; 146 µg/kg) during the 1996 investigation.

7.4.3.5 Inorganics

Inorganics detected in excess of sediment screening values included arsenic, beryllium, cadmium, copper, cyanide, lead, mercury, and silver. Of these, copper most frequently exceeded its screening value of 18.7 mg/kg (7 of 24 detections). The maximum concentration was detected at I7SS-10(IT) (115 mg/kg). At 46 mg/kg, the next highest detection [I7SS-8(IT)] was less than half of the maximum. Both of these were detected in 1993. Other detections of copper were less than twice the screening value. Arsenic exceeded its screening value of 5.2 mg/kg at four sampling locations. The maximum concentration occurred at I7SS-9 (9.7 mg/kg). Beryllium and silver were each detected only three times, but all detections exceeded their respective screening value. Beryllium detections were only slightly over the 0.15 mg/kg Residential Soil RBC used for screening purposes. Silver exceeded the 0.733 mg/kg FDEP Criteria used for screening at I7S-1 (7 mg/kg), I7S-2 (6.1 mg/kg), and I7S-3 (2.8 mg/kg), all from the 1990 IT Corporation investigation. Cadmium was detected only twice. Both detections were at different locations in different years but at the same concentration (1.1 mg/kg), exceeding the FDEP Criteria (0.676 mg/kg) used for screening. Of the 23 detections of lead, two exceeded the screening value (35 mg/kg) by a small amount. Mercury was detected 16 times. Only one detection (I7SS-8; 0.14 mg/kg) exceeded the screening value (0.13 mg/kg). Cyanide was detected only once. This 1993 detection at I7SS-10(IT) (23 mg/kg) exceeded the screening value of 0.1 mg/kg. Several inorganics, including aluminum, barium, chromium, cobalt, iron, manganese, nickel, tin, vanadium, and zinc were detected at the site, but were consistently below sediment screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Tin was selected as an ecological COPC (see Section 7.7.4.1.2) based on a comparison with twice the average background concentration, because no suitable ecological threshold was available. The selected nature and extent screening value was not ecological screening levels and were higher than twice the average background concentrations.

7.4.4 Surface Water

Data from the 1990 IT Corporation RI and the 1993 IT Corporation RFI/RI were considered in the analysis of surface-water contamination at IR 7. No other investigations tested for surface-water contamination at IR 7. Chemicals that were detected in surface-water samples are listed in Table 7-4. This table includes analytical results from historical sampling events only, since no surface-water samples were collected

TABLE 7-4

CHEMICALS DETECTED IN SURFACE WATER AT IR 7
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
I7S-2	IT 1990	Aluminum	447	
I7SS-4(IT)	IT 1993	Antimony	229	
I7SS-3(IT)	IT 1993	Antimony	222	
I7SS-1(IT)	IT 1993	Antimony	209	
I7SS-5(IT)	IT 1993	Antimony	200	
I7SS-2(IT)	IT 1993	Antimony	198	
I7SS-7(IT)	IT 1993	Antimony	188	
I7SS-8(IT)	IT 1993	Antimony	164	
I7SS-6(IT)	IT 1993	Antimony	149	
I7SS-9(IT)	IT 1993	Antimony	148	
I7S-2	IT 1990	Barium	42.9	B_1
I7SS-4(IT)	IT 1993	Barium	6	B_1
I7SS-3(IT)	IT 1993	Barium	5.7	B_1
I7SS-2(IT)	IT 1993	Barium	5.3	B_1
I7SS-5(IT)	IT 1993	Barium	5.2	B_1
I7SS-1(IT)	IT 1993	Barium	4.9	B_1
I7SS-7(IT)	IT 1993	Barium	4.7	B_1
I7SS-8(IT)	IT 1993	Barium	4.1	B_1
I7SS-6(IT)	IT 1993	Barium	4.1	B_1
I7SS-9(IT)	IT 1993	Barium	3.6	B_1
I7S-2	IT 1990	Copper	42.5	
I7SS-7(IT)	IT 1993	Cyanide	430	
I7S-2	IT 1990	Iron	556	
I7SS-7(IT)	IT 1993	Iron	8	B_1
I7S-2	IT 1990	Lead	72.2	
I7S-2	IT 1990	Mercury	0.63	
I7SS-7(IT)	IT 1993	Mercury	0.27	
I7SS-6(IT)	IT 1993	Mercury	0.25	
I7SS-9(IT)	IT 1993	Mercury	0.21	
I7SS-8(IT)	IT 1993	Mercury	0.21	
I7SS-3(IT)	IT 1993	Tin	34.7	B_1
I7S-2	IT 1990	Vanadium	18.5	B_1
I7SS-2(IT)	IT 1993	Zinc	8.2	B_1
I7SS-3(IT)	IT 1993	Zinc	7.4	B_1
I7SS-6(IT)	IT 1993	Zinc	6.7	B_1
I7SS-9(IT)	IT 1993	Zinc	6.6	B_1
I7SS-7(IT)	IT 1993	Zinc	5.9	B_1
I7SS-1(IT)	IT 1993	Zinc	5.3	B_1
I7SS-8(IT)	IT 1993	Zinc	5	B_1
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
I7SS-6(IT)	IT 1993	Naphthalene	0.25	

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

1 Data Sources:
IT 1990 - RI conducted in 1990 by IT Corporation (1991)
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)

2 Qualifier (Qual) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.

during the Supplemental RFI/RI investigation, because the surface water is open ocean water (see Appendix D, Section 7). Figure 7-8 shows the occurrence of analytes that exceeded screening values and indicated possible surface-water contamination.

IT Corporation sampled for surface water at 10 locations at IR 7. A single surface-water sample (I7S-2) taken in 1990 by IT Corporation was analyzed for VOCs, SVOCs, pesticides, PCBs, and inorganics. The other nine surface-water samples were collected in 1993. All were analyzed for VOCs, SVOCs, and inorganics. I7SS-7(IT) was analyzed for pesticides and PCBs as well.

Several metals, including antimony, aluminum, copper, cyanide, iron, lead, and tin exceeded the screening values in surface water at IR 7. Of those, only antimony detections consistently exceeded the screening values at every sampling location. No VOCs, SVOCs, pesticides, or PCBs exceeded their screening values.

Screening values were obtained from a variety of sources including FDEP SWQSs, EPA Region IV Freshwater and Marine Screening Values, EPA AWQCs for Fresh and Marine Waters, Proposed RCRA ALs, EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1 and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples.

7.4.4.1 Volatile Organic Compounds

No VOCs were detected in surface water at IR 7.

7.4.4.2 Semivolatile Organic Compounds

No SVOCs exceeded the screening criteria in any of the surface-water samples. Naphthalene was detected at low levels at sampling location I7SS-6(IT) in 1993. No other SVOCs were detected at IR 7.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Naphthalene was identified as a COPC (see Section 7.6.2.2) in the human

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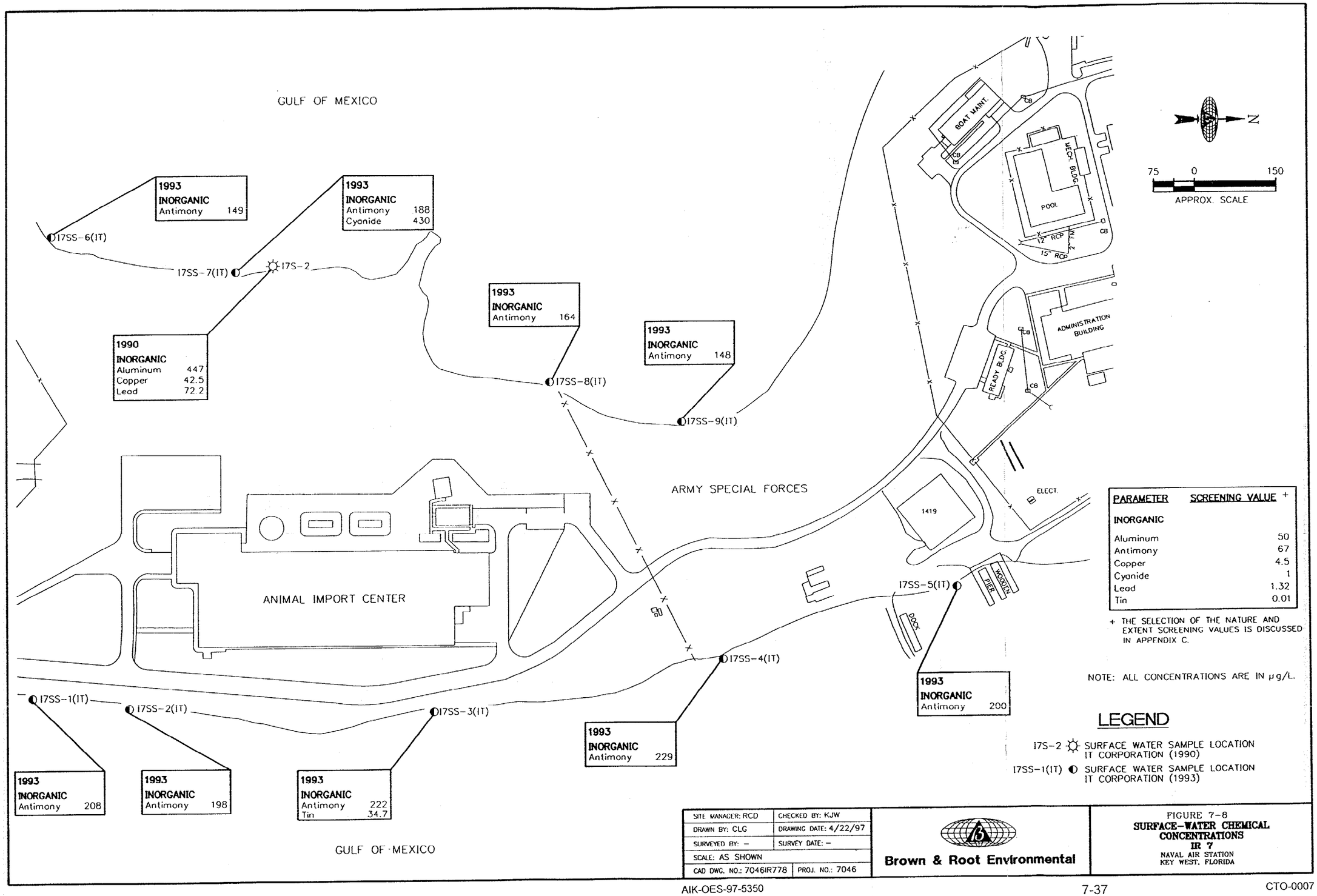
GULF OF MEXICO
1993
INORGANIC
Antimony 149
17SS-6(IT)
1993
INORGANIC
Antimony 188
Cyanide 430
17SS-7(IT)
17S-2
1990
INORGANIC
Aluminum 447
Copper 42.5
Lead 72.2
1993
INORGANIC
Antimony 164
17SS-8(IT)
1993
INORGANIC
Antimony 148
17SS-9(IT)
ARMY SPECIAL FORCES
ANIMAL IMPORT CENTER
BOAT MAINT.
MECH. BLDG.
POOL
12" RCP
15" RCP
ADMINISTRATION BUILDING
READY BLDG.
CB
ELECT.
1419
WOODEN PIER
DOCK
17SS-5(IT)
17SS-4(IT)
1993
INORGANIC
Antimony 200
17SS-1(IT)
17SS-2(IT)
17SS-3(IT)
1993
INORGANIC
Antimony 229
1993
INORGANIC
Antimony 208
1993
INORGANIC
Antimony 198
1993
INORGANIC
Antimony 222
Tin 34.7
GULF OF MEXICO
N
75 0 150
APPROX. SCALE
PARAMETER SCREENING VALUE +
INORGANIC
Aluminum 50
Antimony 67
Copper 4.5
Cyanide 1
Lead 1.32
Tin 0.01
+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.
NOTE: ALL CONCENTRATIONS ARE IN µg/L.
LEGEND
17S-2 SURFACE WATER SAMPLE LOCATION IT CORPORATION (1990)
17SS-1(IT) SURFACE WATER SAMPLE LOCATION IT CORPORATION (1993)
SITE MANAGER: RCD
CHECKED BY: KJW
DRAWN BY: CLG
DRAWING DATE: 4/22/97
SURVEYED BY: –
SURVEY DATE: –
SCALE: AS SHOWN
CAD DWG. NO.: 7046IR778
PROJ. NO.: 7046
Brown & Root Environmental
FIGURE 7-8
SURFACE-WATER CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F342

health risk assessment based on quantitative toxicity since it does not have an RBC. Naphthalene concentrations in surface water at IR 7 were less than EPA Region IV Freshwater Surface Water Screening Values selected for nature and extent screening.

7.4.4.3 Pesticides

No pesticides were detected in surface water at IR 7.

7.4.4.4 Polychlorinated Biphenyls

No PCBs were detected in surface water at IR 7.

7.4.4.5 Inorganics

Inorganics detected in excess of surface-water screening values at IR 7 included aluminum, antimony, copper, cyanide, iron, lead, and tin. Aluminum (447 µg/L), copper (42.5 µg/L), iron (556 µg/L), and lead (72.2 µg/L) were detected only in a single sample (I7S-2) from IT Corporation's 1990 investigation. This was one of only two samples that were tested for aluminum. Cyanide and tin also were each detected in a single sample-- cyanide in I7SS-7(IT) at 430 µg/L and tin in I7SS-3(IT) at 34.7 µg/L. Like aluminum, cyanide was tested only in two samples. Antimony appeared to be the most widespread surface-water contaminant, detected in excess of its 67 µg/L screening value in all nine samples tested. Others inorganics, including barium, lead, mercury, vanadium, and zinc were detected in surface water at IR 7 but were consistently below their respective screening values. With the exception of zinc, the highest concentration of all these parameters was detected at I7S-2. Barium, detected in all ten samples, was the most widespread.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Barium, mercury, vanadium, and zinc were identified as COPCs (see Section 7.6.2.2) in the human health risk assessment based on quantitative toxicity since they do not have RBCs. Barium, mercury, vanadium, and zinc concentrations in surface water at IR 7 were less than their nature and extent screening criteria selected from proposed RCRA ALs, twice the background average concentration, Tap Water RBCs, and EPA Region III Marine BTAG Surface Water Screening Levels, respectively.

7.4.5 Groundwater

Data from a number of sampling efforts including the 1986 Geraghty and Miller Initial Investigation, 1990 IT Corporation RI, 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of groundwater contamination at IR 7. Chemicals that were detected in groundwater samples are listed in Table 7-5. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. The four 1986 Geraghty and Miller and the nine 1990 IT Corporation RI groundwater samples were tested for VOCs, SVOCs, pesticides, PCBs, and inorganics with the exception that sample location KWM-09 was not tested for pesticides or PCBs in 1986. The 20 1993 IT Corporation RFI/RI groundwater samples were tested for VOCs, SVOCs, and inorganics. Of those 20, two sampling locations (I7MW-7 and I7MW-10) were also tested for pesticides and PCBs. The nine groundwater sampling locations in the 1996 Supplemental RFI/RI investigation were tested for pesticides, PCBs, and inorganics, as per the sampling and Analysis Plan (ABB, 1995). Figures 7-9 through 7-12 show the occurrence of analytes that exceeded screening values and indicated possible groundwater contamination.

Metals were detected in groundwater in all investigations. The frequency and magnitude of detection in 1996 were reduced from earlier investigations. A few VOCs and SVOCs were detected in each investigation that tested for them, but the detected compounds generally differed from year to year. Pesticides were consistently detected in 1996, but were detected very infrequently in previous investigations.

Screening values were obtained from a variety of sources including SDWA MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1 and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

7.4.5.1 Volatile Organic Compounds

Six VOCs were detected in excess of groundwater screening values at IR 7. Five of the exceedances were limited to Geraghty and Miller's 1986 investigation, and four of the parameters have not been detected since. Bromodichloromethane and dibromochloromethane were both detected in I7KWM-11 and I7KWM-10. In both cases, the maximum concentration (2 µg/L and 4.4 µg/L, respectively) was detected in

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
PAGE 1 OF 7

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
I7MW7-1	IT 1990	Aluminum	35000	
I7MW7-3	IT 1990	Aluminum	21000	
I7MW7-4	IT 1990	Aluminum	9980	
I7KWM-09	IT 1990	Aluminum	6470	
I7KWM-12	IT 1990	Aluminum	5930	
I7KWM-11	IT 1990	Aluminum	1930	
I7MW-10	IT 1993	Aluminum	1130	
I7MW7-6	IT 1990	Aluminum	630	
I7MW-7	IT 1993	Aluminum	581	
I7MW7-5	IT 1990	Aluminum	368	
I7MW7-2	IT 1990	Aluminum	271	
I7MW-2	IT 1993	Antimony	464	
I7MW-3	IT 1993	Antimony	399	
I7MW-9	IT 1993	Antimony	297	
I7MW-4	IT 1993	Antimony	292	
I7MW7-1	IT 1993	Antimony	265	
I7MW-1	IT 1993	Antimony	260	
I7MW-5	IT 1993	Antimony	243	
I7KWM-11	IT 1993	Antimony	236	
I7MW7-10	IT 1993	Antimony	225	
I7MW7-6	IT 1993	Antimony	224	
I7MW-7	IT 1993	Antimony	208	
I7MW-10	IT 1993	Antimony	208	
I7MW7-5	IT 1993	Antimony	196	
I7MW7-2	IT 1993	Antimony	189	
I7KWM-12	IT 1993	Antimony	186	
I7MW7-3	IT 1993	Antimony	183	
I7MW-8	IT 1993	Antimony	175	
I7MW7-4	IT 1993	Antimony	163	
I7KWM-09	IT 1993	Antimony	149	
I7MW-6	IT 1993	Antimony	146	
I7MW7-1	IT 1990	Antimony	141	
I7KWM-12	IT 1990	Antimony	116	

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW7-4	IT 1990	Antimony	90.4	
I7MW7-3	IT 1990	Antimony	31.8	B_1
I7MW7-10	B&RE 1996	Antimony	16.2	
I7MW7-1	B&RE 1996	Antimony	5.4	
I7MW7-5	B&RE 1996	Antimony	4	
I7MW7-3	B&RE 1996	Antimony	3.6	
I7MW7-5	IT 1993	Arsenic	73	B_1
I7MW-3	IT 1993	Arsenic	62	
I7MW-2	IT 1993	Arsenic	57.3	
I7MW7-3	B&RE 1996	Arsenic	47	
I7MW7-4	IT 1993	Arsenic	39.6	
I7MW7-1	IT 1993	Arsenic	36.9	
I7MW-6	IT 1993	Arsenic	31.2	
I7MW7-3	IT 1993	Arsenic	28.1	
I7MW7-4	IT 1990	Arsenic	27.3	W
I7MW-5	IT 1993	Arsenic	26.4	
I7MW7-3	IT 1990	Arsenic	25.6	
I7MW7-1	IT 1990	Arsenic	25.4	
I7MW7-6	IT 1993	Arsenic	25	
I7MW7-5	IT 1990	Arsenic	19.4	
I7MW-4	IT 1993	Arsenic	19.2	
I7KWM-09	IT 1993	Arsenic	11.8	
I7MW-8	IT 1993	Arsenic	9.8	B_1
I7MW-9	IT 1993	Arsenic	9.3	B_1
I7MW-10	IT 1993	Arsenic	8.1	B_1
I7KWM-11	G&M 1986	Arsenic	7	
I7KWM-09	G&M 1986	Arsenic	6	
I7KWM-12	G&M 1986	Arsenic	6	
I7MW-1	IT 1993	Arsenic	4.6	B_1
I7MW7-10	IT 1993	Arsenic	3.4	B_1
I7MW7-2	IT 1990	Arsenic	1.7	B_1W
I7MW7-1	IT 1990	Barium	531	
I7MW-4	IT 1993	Barium	478	

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
PAGE 2 OF 7

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-2	IT 1993	Barium	260	
I7KWM-12	IT 1990	Barium	247	
I7MW7-4	IT 1990	Barium	234	
I7MW7-1	IT 1993	Barium	200	B_1
I7MW-3	IT 1993	Barium	169	B_1
I7KWM-09	IT 1990	Barium	155	B_1
I7MW7-1	B&RE 1996	Barium	149	
I7MW7-4	IT 1993	Barium	136	B_1
I7MW-6	IT 1993	Barium	113	B_1
I7MW7-6	IT 1993	Barium	113	B_1
I7MW7-3	IT 1990	Barium	108	B_1
I7MW7-4	B&RE 1996	Barium	102	
I7KWM-09	IT 1993	Barium	99.4	B_1
I7MW-8	IT 1993	Barium	97.5	B_1
I7MW7-6	B&RE 1996	Barium	84.8	
I7MW7-6	IT 1990	Barium	75.8	B_1
I7KWM-12	IT 1993	Barium	69	B_1
I7MW7-10	IT 1993	Barium	57.7	B_1
I7MW7-5	IT 1993	Barium	56.1	B_1
I7MW7-10	B&RE 1996	Barium	52.6	
I7MW7-2	IT 1990	Barium	51.9	B_1
I7MW7-2	B&RE 1996	Barium	51	
I7MW7-2	IT 1993	Barium	48.9	B_1
I7KWM-12	B&RE 1996	Barium	47.7	
I7MW7-3	B&RE 1996	Barium	47.6	
I7KWM-11	IT 1990	Barium	47.4	B_1
I7MW7-5	IT 1990	Barium	42.3	B_1
I7KWM-11	IT 1993	Barium	41.6	B_1
I7MW-1	B&RE 1996	Barium	35.2	
I7MW7-3	IT 1993	Barium	32.4	B_1
I7MW-5	IT 1993	Barium	30.6	B_1

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-1	IT 1993	Barium	28.3	B_1
I7MW7-5	B&RE 1996	Barium	27.6	
I7MW-10	IT 1993	Barium	26.7	B_1
I7MW-7	IT 1993	Barium	23.7	B_1
I7MW-9	IT 1993	Barium	19.6	B_1
I7MW7-3	IT 1990	Beryllium	1.5	B_1
I7MW7-1	IT 1990	Beryllium	1.3	B_1
I7MW7-1	IT 1990	Cadmium	21.7	
I7MW7-4	IT 1990	Cadmium	14.9	
I7MW7-2	IT 1990	Cadmium	12.4	
I7MW7-3	IT 1990	Cadmium	12	
I7MW7-5	IT 1990	Cadmium	10.3	
I7MW7-6	IT 1990	Cadmium	9.2	
I7MW-2	IT 1993	Cadmium	6.1	
I7MW-3	IT 1993	Cadmium	4.3	
I7MW7-1	IT 1990	Chromium	384	
I7MW-2	IT 1993	Chromium	256	
I7MW-3	IT 1993	Chromium	250	
I7MW7-1	IT 1993	Chromium	139	
I7MW7-4	IT 1990	Chromium	115	
I7MW-8	IT 1993	Chromium	107	
I7MW7-2	IT 1993	Chromium	99.8	
I7MW-4	IT 1993	Chromium	96	
I7MW7-4	IT 1993	Chromium	70.8	
I7MW-6	IT 1993	Chromium	39.1	
I7MW7-5	IT 1993	Chromium	37.2	
I7MW7-6	IT 1993	Chromium	36.8	
I7KWM-12	IT 1990	Chromium	28.8	
I7MW7-3	IT 1990	Chromium	23.8	
I7KWM-09	IT 1990	Chromium	22.9	
I7KWM-09	IT 1993	Chromium	21	
I7MW7-2	IT 1990	Chromium	11.5	
I7KWM-11	IT 1993	Chromium	11.2	

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
PAGE 3 OF 7

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-2	IT 1993	Cobalt	62.6	
I7MW-3	IT 1993	Cobalt	25.6	B_1
I7MW7-1	IT 1990	Cobalt	21.1	B_1
I7MW-2	IT 1993	Copper	5560	
I7MW-3	IT 1993	Copper	4240	
I7MW-8	IT 1993	Copper	1350	
I7MW7-1	IT 1990	Copper	956	
I7MW7-4	IT 1990	Copper	680	
I7MW-4	IT 1993	Copper	625	
I7MW7-4	IT 1993	Copper	449	
I7MW7-1	IT 1993	Copper	413	
I7KWM-09	IT 1990	Copper	315	
I7KWM-11	IT 1993	Copper	271	
I7MW7-5	IT 1993	Copper	257	
I7KWM-12	IT 1990	Copper	215	
I7KWM-09	IT 1993	Copper	175	
I7KWM-11	IT 1990	Copper	154	
I7MW7-6	IT 1993	Copper	140	
I7MW7-2	IT 1993	Copper	116	
I7MW7-10	IT 1993	Copper	111	
I7KWM-11	G&M 1986	Copper	70	
I7KWM-10	G&M 1986	Copper	60	
I7KWM-12	IT 1993	Copper	57.9	
I7MW7-3	IT 1990	Copper	55.3	
I7MW7-2	IT 1990	Copper	54.7	
I7MW-1	IT 1993	Copper	54	
I7KWM-12	G&M 1986	Copper	50	
I7KWM-09	G&M 1986	Copper	50	
I7MW7-1	B&RE 1996	Copper	39.6	
I7MW-6	IT 1993	Copper	38.3	
I7MW-5	IT 1993	Copper	31.2	
I7MW-10	IT 1993	Copper	24.4	B_1
I7MW7-5	IT 1990	Copper	12.7	B_1

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-9	IT 1993	Copper	12.4	B_1
I7MW-7	IT 1993	Cyanide	270	
I7MW-10	IT 1993	Cyanide	20	
I7MW7-1	IT 1990	Iron	121000	
I7MW7-4	IT 1990	Iron	44800	
I7KWM-12	IT 1990	Iron	32300	E
I7KWM-11	IT 1990	Iron	21600	E
I7KWM-09	IT 1990	Iron	14600	
I7MW7-3	IT 1990	Iron	10600	
I7MW7-5	IT 1990	Iron	3620	
I7MW-10	IT 1993	Iron	1600	
I7MW7-6	IT 1990	Iron	1560	
I7KWM-12	B&RE 1996	Iron	1400	
I7MW7-2	IT 1990	Iron	1194.5	
I7MW-7	IT 1993	Iron	570	
I7MW7-5	B&RE 1996	Iron	193	
I7MW-1	B&RE 1996	Iron	164	
I7MW7-1	B&RE 1996	Iron	36.6	
I7MW7-3	B&RE 1996	Iron	18.3	
I7MW-4	IT 1993	Lead	2000	
I7MW-3	IT 1993	Lead	1915	
I7MW7-1	IT 1990	Lead	1430	
I7MW-8	IT 1993	Lead	1420	
I7MW-2	IT 1993	Lead	1170	
I7MW7-4	IT 1990	Lead	746	
I7KWM-12	IT 1990	Lead	718	
I7KWM-11	IT 1993	Lead	714	
I7KWM-11	IT 1990	Lead	462	
I7MW7-1	IT 1993	Lead	430	
I7MW7-4	IT 1993	Lead	358	
I7MW7-6	IT 1993	Lead	303	
I7KWM-12	IT 1993	Lead	286	
I7MW7-5	IT 1993	Lead	271	
I7MW7-2	IT 1993	Lead	206	

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
PAGE 4 OF 7

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW7-10	IT 1993	Lead	146	
I7KWM-09	IT 1990	Lead	125	
I7KWM-09	IT 1993	Lead	99.3	
I7MW-1	IT 1993	Lead	59.1	
I7MW7-3	IT 1990	Lead	42.1	
I7KWM-12	B&RE 1996	Lead	35.3	
I7MW7-6	IT 1990	Lead	29.4	
I7MW-5	IT 1993	Lead	26.8	
I7MW-10	IT 1993	Lead	16.7	
I7MW7-2	IT 1990	Lead	15.8	
I7MW7-5	IT 1990	Lead	10.6	
I7MW7-1	IT 1990	Manganese	656	E
I7MW7-4	IT 1990	Manganese	380	E
I7KWM-09	IT 1990	Manganese	165	
I7MW7-5	IT 1990	Manganese	109	E
I7KWM-12	IT 1990	Manganese	106	
I7MW7-3	IT 1990	Manganese	105	E
I7MW-10	IT 1993	Manganese	75.6	
I7MW7-6	IT 1990	Manganese	75.6	E
I7KWM-11	IT 1990	Manganese	56.9	
I7MW-7	IT 1993	Manganese	32.5	
I7MW7-6	B&RE 1996	Manganese	31.5	
I7MW7-4	B&RE 1996	Manganese	18.5	
I7MW7-3	B&RE 1996	Manganese	4.5	
I7KWM-11	G&M 1986	Mercury	62	
I7KWM-09	G&M 1986	Mercury	57	
I7KWM-10	G&M 1986	Mercury	57	
I7MW-3	IT 1993	Mercury	49.9	
I7KWM-12	G&M 1986	Mercury	46	
I7MW-8	IT 1993	Mercury	23.5	
I7MW7-4	IT 1990	Mercury	13.6	
I7MW7-1	IT 1990	Mercury	12.4	
I7MW-2	IT 1993	Mercury	10.3	
I7MW7-4	IT 1993	Mercury	7.2	

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-4	IT 1993	Mercury	6.2	
I7MW7-5	IT 1993	Mercury	4.8	
I7MW7-1	IT 1993	Mercury	3.2	
I7MW7-6	IT 1993	Mercury	3.1	
I7MW7-2	IT 1993	Mercury	2.7	
I7MW7-10	IT 1993	Mercury	1.3	
I7KWM-12	IT 1990	Mercury	1.3	
I7KWM-11	IT 1993	Mercury	1.1	
I7MW7-2	IT 1990	Mercury	0.87	
I7KWM-09	IT 1990	Mercury	0.73	
I7MW-1	IT 1993	Mercury	0.66	
I7KWM-12	IT 1993	Mercury	0.51	
I7MW-10	IT 1993	Mercury	0.51	
I7MW7-3	IT 1990	Mercury	0.48	
I7MW-6	IT 1993	Mercury	0.47	
I7KWM-09	IT 1993	Mercury	0.47	
I7KWM-11	IT 1990	Mercury	0.46	
I7MW7-5	IT 1990	Mercury	0.44	
I7MW7-4	B&RE 1996	Mercury	0.39	
I7MW7-6	IT 1990	Mercury	0.37	
I7MW-5	IT 1993	Mercury	0.3	
I7MW7-3	B&RE 1996	Mercury	0.12	
I7MW7-10	B&RE 1996	Mercury	0.11	
I7MW7-2	B&RE 1996	Mercury	0.11	
I7MW-2	IT 1993	Nickel	409	
I7MW-3	IT 1993	Nickel	380	
I7MW-8	IT 1993	Nickel	282	
I7KWM-11	IT 1993	Nickel	106	
I7MW7-1	IT 1990	Nickel	91.2	
I7MW7-4	IT 1990	Nickel	51.2	
I7MW7-4	IT 1993	Nickel	42.6	
I7KWM-11	IT 1990	Nickel	34.9	B_1
I7KWM-12	IT 1990	Nickel	31.1	B_1

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
PAGE 5 OF 7

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW7-1	IT 1993	Nickel	31.1	B_1
I7MW7-10	B&RE 1996	Nickel	29.3	
I7MW-4	IT 1993	Nickel	22.2	B_1
I7MW7-2	B&RE 1996	Nickel	8.1	
I7MW7-1	B&RE 1996	Nickel	6.7	
I7MW7-2	IT 1990	Silver	11.8	
I7MW7-5	IT 1990	Silver	8	B_1
I7MW7-6	IT 1990	Silver	7.9	B_1
I7MW-8	IT 1993	Thallium	17.6	
I7MW-9	IT 1993	Thallium	17.2	
I7MW-7	IT 1993	Thallium	10.8	
I7MW-5	IT 1993	Thallium	9.3	B_1
I7MW-2	IT 1993	Tin	1530	
I7MW7-1	IT 1993	Tin	268	
I7KWM-11	IT 1993	Tin	242	
I7MW-3	IT 1993	Tin	155	B_1
I7MW7-4	IT 1993	Tin	141	B_1
I7MW7-2	IT 1993	Tin	127	B_1
I7MW7-5	IT 1993	Tin	118	B_1
I7MW-4	IT 1993	Tin	110	B_1
I7MW-2	IT 1993	Vanadium	229	
I7MW7-1	IT 1990	Vanadium	74.2	
I7MW-3	IT 1993	Vanadium	62.1	
I7MW7-4	IT 1990	Vanadium	43.1	B_1
I7MW-6	IT 1993	Vanadium	38.8	B_1
I7MW7-1	IT 1993	Vanadium	32.3	B_1
I7MW7-3	IT 1990	Vanadium	21.1	B_1
I7MW7-4	IT 1993	Vanadium	19.5	B_1
I7KWM-12	IT 1990	Vanadium	19.4	B_1
I7KWM-09	IT 1990	Vanadium	17.9	B_1
I7MW-4	IT 1993	Vanadium	17.6	B_1

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW7-5	IT 1993	Vanadium	16.8	B_1
I7MW7-6	IT 1993	Vanadium	13.6	B_1
I7KWM-11	IT 1993	Vanadium	11.8	B_1
I7MW-2	IT 1993	Zinc	8790	
I7MW-3	IT 1993	Zinc	4515	
I7MW-8	IT 1993	Zinc	4290	
I7KWM-12	IT 1990	Zinc	3950	
I7MW7-1	IT 1990	Zinc	2880	
I7MW7-4	IT 1990	Zinc	1630	
I7KWM-12	IT 1993	Zinc	1340	
I7MW7-1	IT 1993	Zinc	1000	
I7MW-4	IT 1993	Zinc	772	
I7MW7-4	IT 1993	Zinc	763	
I7KWM-11	IT 1993	Zinc	589	
I7MW7-2	IT 1990	Zinc	433	
I7MW7-5	IT 1993	Zinc	424	
I7MW7-3	IT 1990	Zinc	388	
I7KWM-09	IT 1990	Zinc	380	
I7MW7-10	IT 1993	Zinc	380	
I7MW7-2	IT 1993	Zinc	356	
I7KWM-11	IT 1990	Zinc	344	
I7MW7-5	IT 1990	Zinc	290	
I7MW7-6	IT 1990	Zinc	267	
I7MW7-6	IT 1993	Zinc	263	
I7KWM-09	IT 1993	Zinc	205	
I7MW7-10	B&RE 1996	Zinc	120	
I7MW-9	IT 1993	Zinc	115	
I7MW-1	IT 1993	Zinc	108	
I7KWM-12	B&RE 1996	Zinc	107	
I7MW-6	IT 1993	Zinc	79.5	
I7MW-10	IT 1993	Zinc	75.7	
I7MW-5	IT 1993	Zinc	70.7	
I7MW7-1	B&RE 1996	Zinc	54.6	

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
PAGE 6 OF 7

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-7	IT 1993	Zinc	24.1	
I7MW7-3	IT 1993	Zinc	23.9	
PESTICIDES/PCBs (µg/L)				
I7MW-7	IT 1993	4,4'-DDD	0.73	
I7MW7-5	B&RE 1996	4,4'-DDD	0.038	J
I7MW7-2	B&RE 1996	4,4'-DDD	0.029	J
I7MW-7	IT 1993	4,4'-DDE	0.28	
I7MW7-2	B&RE 1996	4,4'-DDE	0.028	J
I7MW-7	IT 1993	4,4'-DDT	0.42	
I7MW7-2	B&RE 1996	4,4'-DDT	0.026	J
I7KWM-12	B&RE 1996	Aldrin	0.016	J
I7MW7-3	B&RE 1996	Aldrin	0.012	J
I7MW7-3	B&RE 1996	alpha-BHC	0.1	J
I7MW-1	B&RE 1996	alpha-BHC	0.018	J
I7KWM-12	B&RE 1996	alpha-BHC	0.015	J
I7MW7-6	B&RE 1996	Chlordane	0.18	J
I7MW7-10	B&RE 1996	delta-BHC	0.019	J
I7MW7-5	B&RE 1996	delta-BHC	0.018	J
I7MW7-3	B&RE 1996	delta-BHC	0.017	J
I7MW7-4	B&RE 1996	delta-BHC	0.016	J
I7KWM-12	B&RE 1996	delta-BHC	0.016	J
I7MW7-1	B&RE 1996	delta-BHC	0.015	J
I7MW7-5	B&RE 1996	Dieldrin	0.033	J
I7MW7-10	B&RE 1996	Dieldrin	0.03	J
I7MW7-3	B&RE 1996	Dieldrin	0.029	J
I7MW7-2	B&RE 1996	Dieldrin	0.028	J
I7MW-1	B&RE 1996	Dieldrin	0.026	J
I7KWM-12	B&RE 1996	Dieldrin	0.025	J
I7MW7-6	B&RE 1996	Dieldrin	0.022	J
I7MW7-6	B&RE 1996	Endosulfan I	0.032	J
I7MW7-5	B&RE 1996	Endosulfan I	0.031	J
I7MW7-4	B&RE 1996	Endosulfan I	0.02	J
I7KWM-12	B&RE 1996	Endosulfan I	0.019	J
I7MW7-10	B&RE 1996	Endosulfan I	0.017	J

Location	Source[1]	Parameter	Result	Qual.[2]
I7MW-1	B&RE 1996	Endosulfan I	0.014	J
I7MW7-2	B&RE 1996	Endosulfan I	0.012	J
I7MW7-3	B&RE 1996	Endosulfan sulfate	0.051	J
I7MW7-6	B&RE 1996	Endrin	0.027	J
I7MW7-3	B&RE 1996	Endrin	0.025	J
I7KWM-12	B&RE 1996	Endrin	0.022	J
I7MW7-3	B&RE 1996	gamma-BHC (lindane)	1.1	J
I7MW7-4	B&RE 1996	gamma-BHC (lindane)	1	J
I7MW7-6	B&RE 1996	gamma-BHC (lindane)	0.41	J
I7MW7-5	B&RE 1996	gamma-BHC (lindane)	0.28	J
I7KWM-12	B&RE 1996	gamma-BHC (lindane)	0.2	J
I7MW7-10	B&RE 1996	gamma-BHC (lindane)	0.14	J
I7MW7-1	B&RE 1996	gamma-BHC (lindane)	0.022	J
I7MW-1	B&RE 1996	gamma-BHC (lindane)	0.016	J
I7KWM-12	B&RE 1996	Heptachlor	0.012	J
I7MW7-3	B&RE 1996	Heptachlor	0.011	J
I7MW7-5	B&RE 1996	Heptachlor	0.011	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
I7MW-3	IT 1993	Benzo(g,h,i)perylene	0.41	
I7MW-5	IT 1993	Benzo(k)fluoranthene	0.11	
I7KWM-09	IT 1990	Bis(2-ethylhexyl)phthalate	4	B_2J
I7MW-3	IT 1993	Dibenzo(a,h)anthracene	0.1	
I7KWM-09	G&M 1986	Diethyl phthalate	1.1	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
I7KWM-12	IT 1990	2-butanone	1	J
I7KWM-12	IT 1990	Acetone	15	
I7KWM-11	IT 1990	Acetone	6	J
I7MW7-1	IT 1990	Acetone	4	J
I7MW7-5	IT 1990	Acetone	4	J
I7MW-3	IT 1993	Bis(2-chloroisopropyl)ether	15	*
I7KWM-11	G&M 1986	Bromodichloromethane	2	
I7KWM-10	G&M 1986	Bromodichloromethane	1.1	
I7KWM-11	G&M 1986	Bromoform	4	
I7MW7-3	IT 1990	Carbon disulfide	3	J

TABLE 7-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 7
NAS KEY WEST
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Location	Source[1]	Parameter	Result	Qual.[2]
I7KWM-09	IT 1990	Carbon disulfide	2	J
I7KWM-12	IT 1990	Carbon disulfide	1	J
I7KWM-11	G&M 1986	Chloroform	0.8	J
I7KWM-11	G&M 1986	Dibromochloromethane	4.4	
I7KWM-10	G&M 1986	Dibromochloromethane	2.3	
I7KWM-10	G&M 1986	Methylene chloride	6.8	BG*
I7KWM-12	G&M 1986	Methylene chloride	4.9	BG*
I7KWM-09	G&M 1986	Methylene chloride	4.7	BG*
I7MW-10	IT 1993	Methylene chloride	4	B_2J
I7KWM-11	G&M 1986	Methylene chloride	3.1	BG*
I7MW-7	IT 1993	Methylene chloride	2	B_2J
I7MW7-2	IT 1990	Methylene chloride	1.8	B_2J
I7MW7-4	IT 1990	Methylene chloride	1	B_2J
I7MW7-3	IT 1990	Methylene chloride	1	B_2J
I7KWM-09	IT 1990	Methylene chloride	1	B_2J
I7MW7-6	IT 1990	Methylene chloride	1	B_2J
I7MW7-5	IT 1990	Methylene chloride	1	B_2J
I7MW7-1	IT 1990	Methylene chloride	1	B_2J
I7KWM-12	G&M 1986	Toluene	1.2	

Shading indicates a concentration in excess of the screening values (See Table C.3-4).

1 Data Sources:
G&M 1986 - Verification Study conducted in 1986 by Geraghty and Miller (1987)
IT 1990 - RI conducted in 1990 by IT Corporation (1991)
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
W - Post-digestion spike for GFAA was out of control limits (85-115 percent), while sample absorbance was less than 50 percent of spike absorbance.
E - The reported value is estimated because of the presence of interference.
J - The associated value is an estimated quantity.
* - Analyte quantitated from the confirmation analysis.
B_2 - Analyte was found in the blank as well as the sample.
BG* - Qualifier definition not available.

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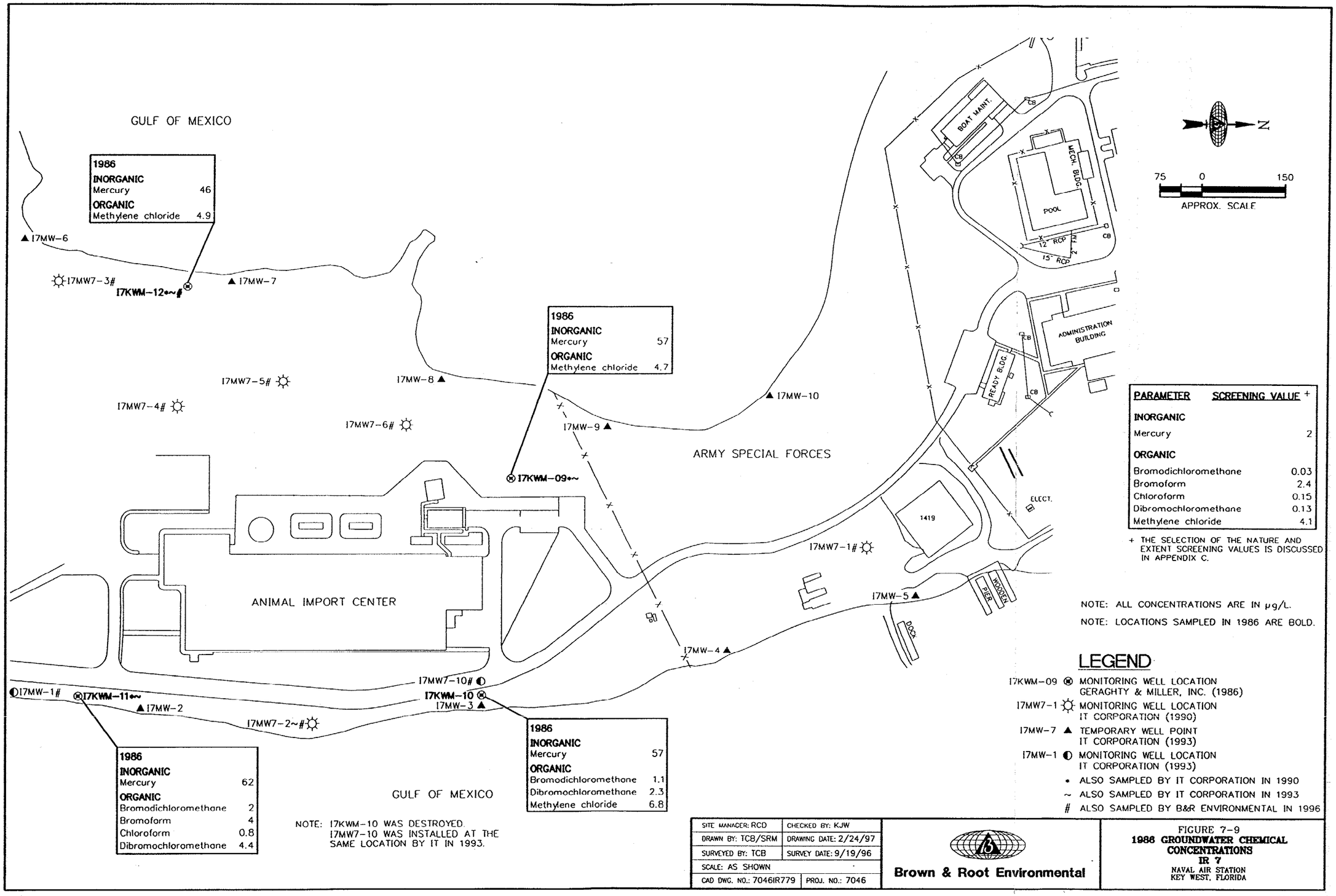


PARAMETER	SCREENING VALUE +
INORGANIC	
Mercury	2
ORGANIC	
Bromodichloromethane	0.03
Bromoform	2.4
Chloroform	0.15
Dibromochloromethane	0.13
Methylene chloride	4.1

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1986 ARE BOLD.

NOTE: 17KWM-10 WAS DESTROYED. 17MW7-10 WAS INSTALLED AT THE SAME LOCATION BY IT IN 1993.

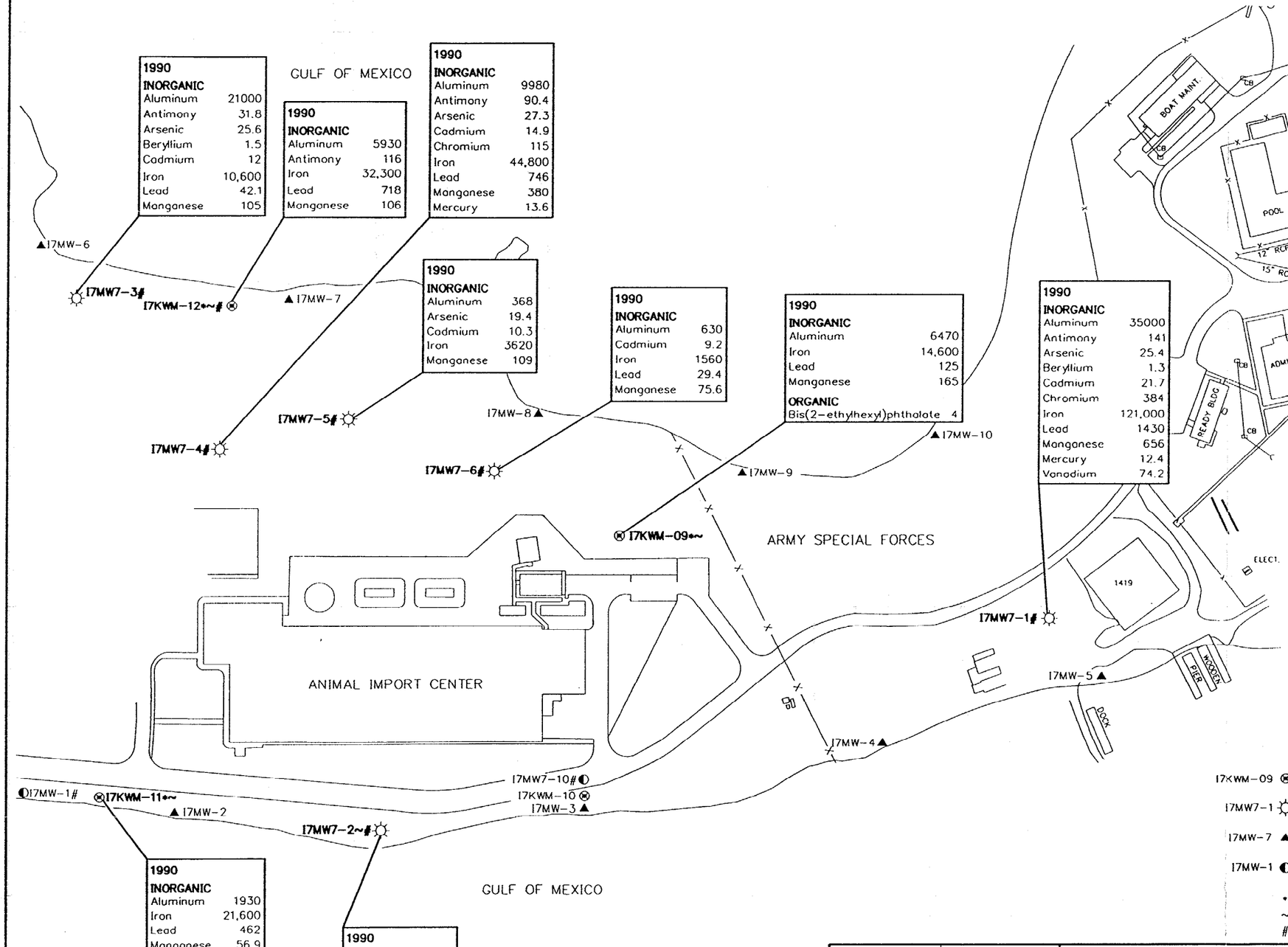
LEGEND

- 17KWM-09 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER, INC. (1986)
- 17MW7-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)
- 17MW-7 ▲ TEMPORARY WELL POINT IT CORPORATION (1993)
- 17MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)
- • ALSO SAMPLED BY IT CORPORATION IN 1990
- ~ ALSO SAMPLED BY IT CORPORATION IN 1993
- # ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: TCB/SRM	DRAWING DATE: 2/24/97
SURVEYED BY: TCB	SURVEY DATE: 9/19/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR779	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-9
1986 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA



1990 INORGANIC

Aluminum	21000
Antimony	31.8
Arsenic	25.6
Beryllium	1.5
Cadmium	12
Iron	10,600
Lead	42.1
Manganese	105

1990 INORGANIC

Aluminum	5930
Antimony	116
Iron	32,300
Lead	718
Manganese	106

1990 INORGANIC

Aluminum	9980
Antimony	90.4
Arsenic	27.3
Cadmium	14.9
Chromium	115
Iron	44,800
Lead	746
Manganese	380
Mercury	13.6

1990 INORGANIC

Aluminum	368
Arsenic	19.4
Cadmium	10.3
Iron	3620
Manganese	109

1990 INORGANIC

Aluminum	630
Cadmium	9.2
Iron	1560
Lead	29.4
Manganese	75.6

1990 INORGANIC

Aluminum	6470
Iron	14,600
Lead	125
Manganese	165

ORGANIC

Bis(2-ethylhexyl)phthalate	4

1990 INORGANIC

Aluminum	35000
Antimony	141
Arsenic	25.4
Beryllium	1.3
Cadmium	21.7
Chromium	384
Iron	121,000
Lead	1430
Manganese	656
Mercury	12.4
Vanadium	74.2

PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	200
Antimony	6
Arsenic	9.3
Beryllium	0.008
Cadmium	5
Chromium	100
Iron	300
Lead	15
Manganese	50
Mercury	2
Vanadium	49
ORGANIC	
Bis(2-ethylhexyl)phthalate	3

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1990 ARE BOLD.

LEGEND

- 17KWM-09 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER, INC. (1986)
- 17MW7-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)
- 17MW-7 ▲ TEMPORARY WELL POINT IT CORPORATION (1993)
- 17MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)
- • ALSO SAMPLED BY IT CORPORATION IN 1990
- ~ ALSO SAMPLED BY IT CORPORATION IN 1993
- # ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

1990 INORGANIC

Aluminum	1930
Iron	21,600
Lead	462
Manganese	56.9

1990 INORGANIC

Aluminum	271
Cadmium	12.4
Iron	1194.5
Lead	15.8

NOTE: 17KWM-10 WAS DESTROYED. 17MW7-10 WAS INSTALLED AT THE SAME LOCATION BY IT IN 1993.

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: TCB/SRM	DRAWING DATE: 2/24/97
SURVEYED BY: TCB	SURVEY DATE: 9/19/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR7710	PROJ. NO.: 7046

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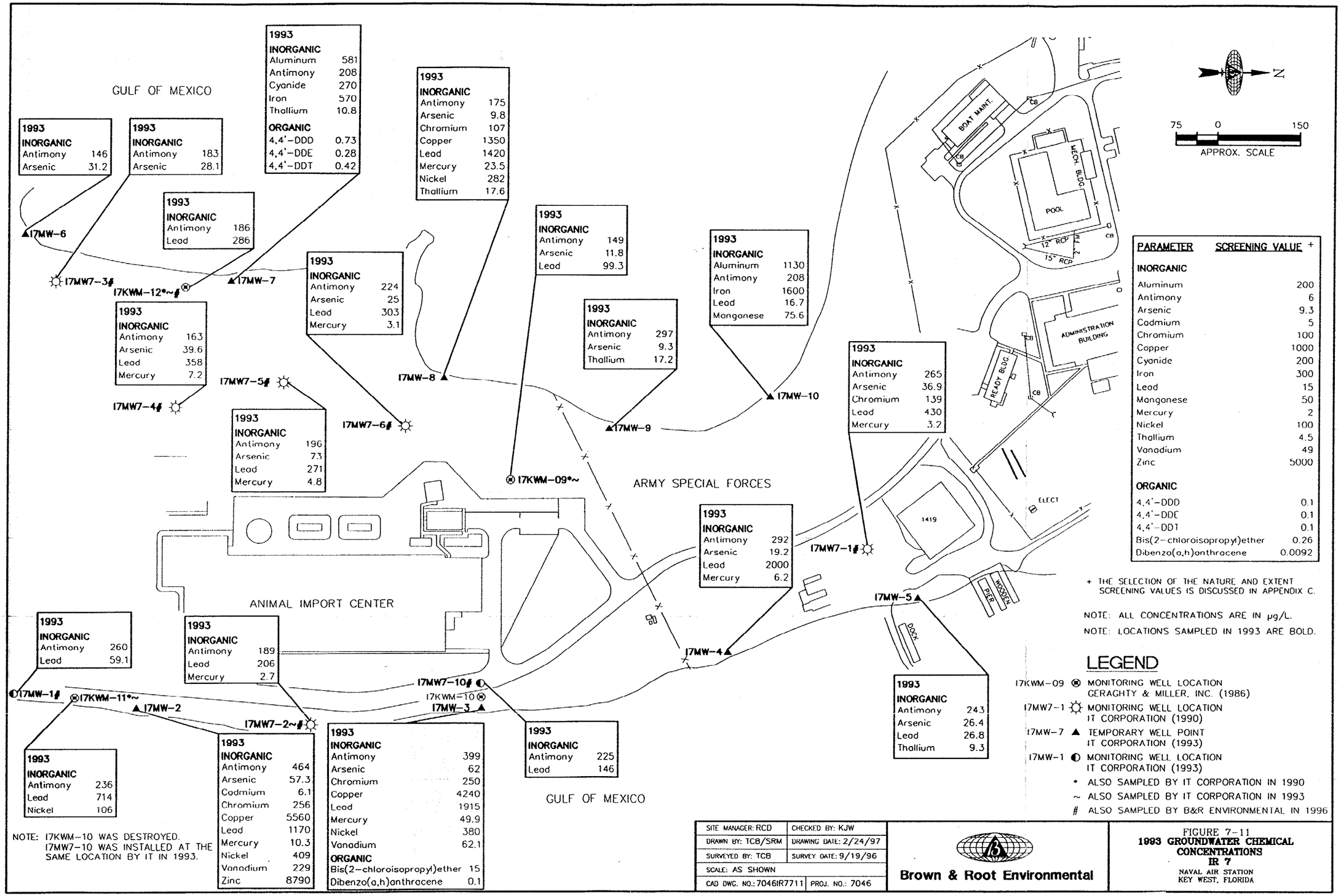
FIGURE 7-10
1990 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	200
Antimony	6
Arsenic	9.3
Cadmium	5
Chromium	100
Copper	1000
Cyanide	200
Iron	300
Lead	15
Manganese	50
Mercury	2
Nickel	100
Thallium	4.5
Vanadium	49
Zinc	5000
ORGANIC	
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
Bis(2-chloroisopropyl)ether	0.26
Dibenzo(a,h)anthracene	0.0092

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.

LEGEND

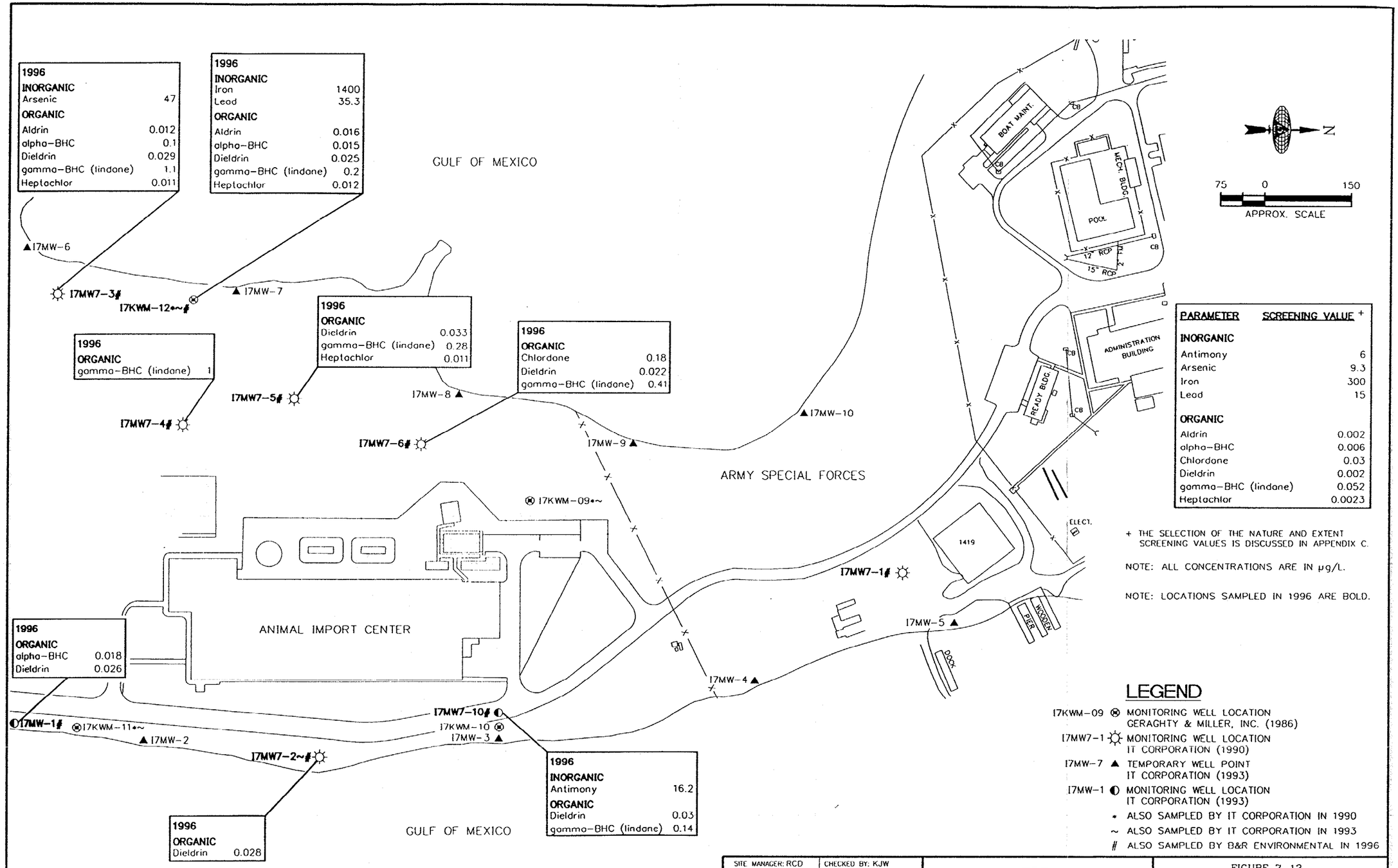
- 17KWM-09 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER, INC. (1986)
- 17MW7-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)
- 17MW-7 ▲ TEMPORARY WELL POINT IT CORPORATION (1993)
- 17MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)
- * ALSO SAMPLED BY IT CORPORATION IN 1990
- ~ ALSO SAMPLED BY IT CORPORATION IN 1993
- # ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

NOTE: 17KWM-10 WAS DESTROYED. 17MW7-10 WAS INSTALLED AT THE SAME LOCATION BY IT IN 1993.

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: TCB/SRM	DRAWING DATE: 2/24/97
SURVEYED BY: TCB	SURVEY DATE: 9/19/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR7711	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-11
1993 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6
Arsenic	9.3
Iron	300
Lead	15
ORGANIC	
Aldrin	0.002
alpha-BHC	0.006
Chlordane	0.03
Dieldrin	0.002
gamma-BHC (lindane)	0.052
Heptachlor	0.0023

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1996 ARE BOLD.

LEGEND

I7KWM-09 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER, INC. (1986)

I7MW7-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)

I7MW-7 ▲ TEMPORARY WELL POINT IT CORPORATION (1993)

I7MW-1 ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

* ALSO SAMPLED BY IT CORPORATION IN 1990

~ ALSO SAMPLED BY IT CORPORATION IN 1993

\# ALSO SAMPLED BY B&R ENVIRONMENTAL IN 1996

NOTE: I7KWM-10 WAS DESTROYED. I7MW7-10 WAS INSTALLED AT THE SAME LOCATION BY IT IN 1993.

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: TCB/SRM	DRAWING DATE: 2/24/97
SURVEYED BY: TCB	SURVEY DATE: 9/19/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046IR7712	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 7-12
1996 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 7
NAVAL AIR STATION
KEY WEST, FLORIDA

I7KWM-11. This was also the only sample location at which bromoform (4 µg/L) and chloroform (0.8 µg/L) were detected. Methylene chloride, the most frequently detected VOC, was detected in all four 1986 samples and in two 1993 samples; however, it was only detected in excess of its 4.1 µg/L screening value in 1986 at I7KWM-10 (6.8 µg/L). Bis(2-chloroisopropyl)ether was the only compound that exceeded its screening value and was not detected in 1986. It was detected in a single sample (I7MW-3; 15 µg/L) in 1993. VOCs were not detected in groundwater in 1996.

Other VOCs, including 2-butanone, acetone, carbon disulfide, and toluene were detected in groundwater at IR 7 but were below their respective screening values. 2-butanone, acetone, and carbon disulfide were detected only in 1990, while the single detection of toluene occurred in a 1986 sample.

7.4.5.2 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate and dibenzo(a,h)anthracene were the only two SVOCs detected in excess of groundwater screening values at IR 7. The single detection of bis(2-ethylhexyl)phthalate (4 µg/L) occurred in the 1990 sample from I7KWM-09. Dibenzo(a,h) anthracene (0.1 µg/L) was also detected only once but occurred in a 1993 sample (I7MW-3). Two other compounds, benzo(g,h,i)perylene and benzo(k)fluoranthene, were each also detected once in 1993, but were well below screening values, as was diethyl phthalate, detected only in 1986. No other SVOCs were detected in any other monitoring well at IR 7. The Sampling and Analysis Plan (1995) determined that previous analyses were sufficient to adequately characterize SVOCs in groundwater, therefore no SVOC analyses were conducted during the 1996 Supplemental RFI/RI.

7.4.5.3 Pesticides

Nine pesticides were detected in excess of groundwater screening values at IR 7. The majority of the detections occurred in samples from the 1996 Supplemental RFI/RI. 4,4'-DDT and its degradation products were the only pesticides detected in groundwater prior to 1996. All three compounds were detected in 1996 but at lower concentrations than previously detected onsite. Gamma-BHC (lindane), present in 8 samples, was the most frequently detected pesticide, while dieldrin was most frequently detected in excess of its screening value. It exceeded its screening value in all 7 samples in which it was detected. Each pesticide that exceeded its respective screening value is discussed in detail below.

4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected at concentrations (0.73 µg/L, 0.28 µg/L, and 0.42 µg/L respectively) above the selected screening value (0.1 µg/L). All three of these exceedances occurred at sampling location I7MW-7 (1.3 µg/L) in 1993. These compounds were also detected at I7MW7-2, in 1996 but concentrations were less than the screening values.

Aldrin was detected in 1996 at I7KWM-12 (0.016 µg/L) and I7MW7-3 (0.012 µg/L). Both detections exceeded the selected screening value(0.002 µg/L). Aldrin was not detected in any other monitoring well by any other investigation.

Alpha-BHC exceeded its screening value (0.006 µg/L) at I7MW7-3 (0.1 µg/L), I7MW-1 (0.018 µg/L), and I7KWM-12 (0.015 µg/L), all in 1996. Alpha-BHC was not detected in any other monitoring well by any other investigation.

Chlordane exceeded its screening value (0.03 µg/L) only at I7MW7-6 (0.18 µg/L) in 1996. Chlordane was not detected in any other monitoring well by any other investigation.

Dieldrin was detected at relatively consistent concentrations above the RCRA AL (0.002 µg/L) used as a screening value. It exceeded the screening value in all seven samples in which it was detected, with maximum concentration occurring at I7MW7-5 (0.033 µg/L). All detections were in 1996 samples.

Gamma-BHC (lindane) exceeded its screening value (0.052 µg/L) at I7MW7-3 (1.1 µg/L), I7MW7-4 (1 µg/L, I7MW7-6 (0.41 µg/L), I7MW7-5 (0.28 µg/L), I7KWM-12 (0.2 µg/L), and I7MW7-10 (0.14 µg/L), all in 1996. Gamma-BHC (lindane) was detected at 2 other monitoring wells in 1996, but concentrations were below the screening value.

Heptachlor exceeded its screening value (0.0023 µg/L) at I7KWM-12 (0.012 µg/L), I7MW7-3 (0.011 µg/L), and I7MW7-5 (0.011 µg/L) in 1996. Heptachlor was not detected in any other monitoring well by any other investigation.

Other pesticides, including delta-BHC, endosulfan I, endosulfan sulfate, and endrin were detected in groundwater at IR 7 but below their respective screening values.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Delta-BHC, endosulfan I, endosulfan sulfate, and endrin were selected as ecological COPCs (see Section 7.7.4.1.2) based on hazard quotients greater than one. However, all concentrations for these pesticides were less than the nature and extent screening values based on Florida Groundwater Guidance Concentrations (delta-BHC and endosulfan sulfate), proposed RCRA AIs (endosulfan I), and Safe Drinking Water Act Maximum Contaminant Levels (endrin).

7.4.5.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at IR 7.

7.4.5.5 Inorganics

Sixteen inorganic compounds were detected in excess of groundwater screening values at IR 7. Three metals (arsenic, copper, and mercury) were detected by Geraghty and Miller in 1986, and only mercury exceeded its screening value in that year. Mercury was the only one of these compounds that decreased in concentration between 1986 and 1990. Increased concentrations of arsenic and copper were detected in 1990, while a variety of other inorganics were detected for the first time. In general, inorganic concentrations either increased or remained fairly constant between 1990 and 1993; however, both the extent and magnitude of inorganic contamination decreased markedly between 1993 and 1996. In 1996, only three metals exceeded screening values. For ease of interpretation, each of the parameters that exceeded its respective screening value is discussed individually below.

Aluminum was detected 11 times in 11 different monitoring wells at IR 7 between 1990 and 1993. Of those 11 detections, all exceeded the secondary MCL (200 µg/L) used as a screening value. The maximum concentration detected at I7MW7-1 (35,000 µg/L) in 1990 was 175 times the screening value. Other high concentrations were detected at I7MW7-3 (21,000 µg/L), I7MW7-4 (9,980 µg/L), I7KWM-09 (6,470 µg/L), and I7KWM-12 (5,930 µg/L), all in 1990. Aluminum was not detected at any monitoring well in 1996.

Antimony was detected 28 times at 20 of the monitoring wells at IR 7 between 1986 and 1996. Of those 28 detections, 25 exceeded the MCL (6 µg/L) used as a screening value. Maximum concentrations were detected in 1993 at I7MW-2 (464 µg/L), I7MW-3 (399 µg/L), I7MW-9 (297 µg/L), I7MW-4 (292 µg/L), I7MW7-1 (265 µg/L), and I7MW-1 (260 µg/L). Concentrations were less than 250 µg/L at all other sampling locations. Antimony was detected in four 1996 samples; however, only one 1996 detection exceeded the screening value.

Arsenic was detected 25 times at 18 of the monitoring wells at IR 7 between 1986 and 1996. Of those 25 detections, 18 exceeded the (9.3 µg/L) screening value. Maximum concentrations were detected in 1993 at I7MW7-5 (73 µg/L), I7MW-3 (62 µg/L), and I7MW-2 (57 µg/L). Concentrations were less than 50 µg/L at all other sampling locations. Arsenic was detected only once, at 47 µg/L, during the 1996 Supplemental RFI/RI.

Beryllium exceeded its screening value (0.008 µg/L) in 1990 at I7MW7-3 (1.5 µg/L) and I7MW7-1 (1.3 µg/L). Beryllium was not detected at any other monitoring well by any other investigation.

Cadmium was detected eight times in 1990 and 1993. Of those eight detections, seven exceeded the selected screening value (5 µg/L). Maximum concentrations were detected at I7MW7-1 (21.7 µg/L), I7MW7-4 (14.9 µg/L), I7MW7-2 (12.4 µg/L), and I7MW7-3 (12 µg/L). Concentrations were less than 11 µg/L at all other sampling locations. Cadmium was not detected in 1996.

Chromium was detected 18 times at monitoring wells at IR 7 between 1990 and 1993. Of those 18 detections, six exceeded the selected screening value (100 µg/L). Maximum concentrations were detected in 1990 and 1993 at I7MW7-1 (384 µg/L), I7MW-2 (256 µg/L), and I7MW-3 (250 µg/L). Concentrations were less than 140 µg/L at all other sampling locations. Chromium was not detected in 1996.

Copper was detected 31 times at monitoring wells at IR 7 between 1986 and 1996. Of those 31 detections, three exceeded the selected screening value (1,000 µg/L). These maximum concentrations were detected in 1993 at I7MW-2 (5,560 µg/L), I7MW-3 (4,240 µg/L), and I7MW-8 (1,350 µg/L). Copper was detected in other monitoring wells by other investigations, but concentrations were less than the screening value. It was detected only in a single 1996 sample.

Cyanide was detected twice in monitoring wells at IR 7 in 1993. The selected screening value (200 µg/L) was exceeded only at I7MW-7 (270 µg/L). The concentration of cyanide detected at I7MW-10 (20 µg/L) was below the screening value.

Iron was detected in excess of 300 µg/L screening value at 9 monitoring wells in IT Corporation's 1990 sampling. Maximum concentration was over 400 times greater than the screening value (121,000 µg/L, I7MW7-1). Iron was also detected in excess of screening criteria in two wells in 1993. However, these detections were only approximately 2 to 5 times greater than the screening criteria. Iron was detected at 5 monitoring wells in 1996, but only one detection was in excess of the screening value.

Lead was detected 26 times at monitoring wells at IR 7 between 1990 and 1996. Of those 26 detections, 25 exceeded the selected screening value (15 µg/L). Maximum concentrations were detected in 1990 and 1993 at I7MW-4 (2,000 µg/L), I7MW-3 (1,915 µg/L), I7MW7-1 (1,430 µg/L), I7MW-8 (1,420 µg/L), and I7MW-2 (1,170 µg/L). Concentrations were less than 750 µg/L at all other sampling locations. Lead was detected only once in 1996, and the concentration was reduced from previous levels at the same location.

Manganese was detected 13 times in monitoring wells at IR 7 between 1990 and 1996. Of those 13 detections, nine exceeded the selected screening value (50 µg/L). Maximum concentrations were detected in 1990 at I7MW7-1 (656 µg/L) and I7MW7-4 (380 µg/L). Concentrations were less than 170 µg/L at all other sampling locations. All three 1996 detections of manganese were below the screening value.

Mercury was detected 34 times at monitoring wells at IR 7 between 1986 and 1996. Of those 34 detections, 15 exceeded the MCL (2 µg/L) used as a screening value. Maximum concentrations were detected in 1986 at I7KWM-11 (62 µg/L), I7KWM-09 (57 µg/L), and I7KWM-10 (57 µg/L). Concentrations were less than 50 µg/L at other sampling locations. Mercury concentrations in groundwater in 1996 were at levels less than 0.40 µg/L.

Nickel was detected 14 times in monitoring wells at IR 7 in 1993 and 1996. Of those 14 detections, four exceeded the screening value (100 µg/L). These detections occurred in 1993 at I7MW-2 (409 µg/L), I7MW-3 (380 µg/L), I7MW-8 (282 µg/L), and I7KWM-11 (106 µg/L). All three 1996 detections of nickel were below the screening value.

Thallium was detected four times in monitoring wells at IR 7 in 1993. All four detections exceeded the screening value of 4.52 µg/L. These detections occurred at I7MW-8 (17.6 µg/L), I7MW-9 (17.2 µg/L), I7MW-7 (10.8 µg/L), and I7MW-5 (9.3 µg/L). Thallium was not detected in any other monitoring well in 1993, and was not detected during any other investigation.

Vanadium was detected 14 times at monitoring wells at IR 7 between 1990 and 1993. Of those 14 detections, three exceeded the selected screening value (49 µg/L). Maximum concentrations were detected at I7MW-2 (229 µg/L), I7MW7-1 (74.2 µg/L), and I7MW-3 (62.1 µg/L). Concentrations were less than 45 µg/L at other sampling locations. Vanadium was not detected in 1996.

Zinc was detected 32 times at monitoring wells at IR 7 between 1990 and 1996. Only a single detection (I7MW-2; 8,790 µg/L) exceeded the selected screening value (5,000 µg/L). The three 1996 detections were all well below the screening value.

Other inorganics, including barium, cobalt, silver, and tin were detected in groundwater at IR 7 but below their respective screening values.

7.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at IR 7. Section 7.5.1 presents those chemicals detected in excess of the screening values discussed in the nature and extent sections,

along with apparent temporal and spatial trends. Section 7.5.2 addresses potential routes of migration, and Section 7.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. These properties are presented in Section 3.1.5.1 of Appendix C.

7.5.1 Contaminant Summary and Trends

IR 7 is in the northern portion of Fleming Key and covers approximately 30 acres (see Figure 7-1). The Gulf of Mexico lies along the eastern and western edges of IR 7 and the eastern shoreline has erosion protection consisting of grass cover and concrete rubble riprap. The shoreline with the Man of War Harbor borders the west side of IR 1. From 1952 to 1962, the site was used as the landfill for NAS Key West and the city of Key West. Approximately 4,000 to 5,000 tons of unknown wastes reportedly were disposed of annually. Trenches, typically 25 feet wide, 10 feet deep, and 500 to 1,000 feet long, were used to bury the waste. The construction of the USDA Animal Import Center in 1977 at IR 7 involved the excavation and transfer of wastes under the building footprint to an area immediately west of the construction site, where they were buried under a soil and rock cover.

In September 1995, BEI performed an IRA at IR 7 that involved (1) the grading of the west side of the site to provide drainage and prevent ponding of water over the waste material and (2) the addition of clean topsoil to fill low areas and promote runoff. Currently, the entire landfill is covered with soil and is vegetated by either grass, weeds, or trees.

A total of three surface soil samples were collected from the northeast, southeast, and northwest corners of IR 7 near the shorelines (see Figure 7-2). Subsurface soil samples (at depths of 4 feet) were collected from the two surface soil sampling locations near the southwest and northeast corners of IR 7. Several sediment and surface-water samples were collected from evenly spaced intervals along the west and east shorelines bordering IR 7 (see Figures 7-3 and 7-4). And finally, groundwater samples were also collected from evenly spaced intervals near the east and west shorelines and from the interior of IR 7. Metals and pesticides were the most widespread contaminants detected at IR 7. However, SVOCs were present in excess of screening values in sediment and groundwater, VOCs were present in excess of screening values in groundwater, and PCBs, to a limited extent, were also detected in excess of screening values in subsoil and sediment.

Section 7.4.5.5 describes the 15 metals and cyanide detected in excess of screening levels in groundwater at IR 7. Figures 7-9, 7-10, 7-11, and 7-12 show the wide distribution of metals contamination in groundwater at the site (e.g., aluminum, antimony, arsenic, lead, and mercury). Fewer metals were detected during the 1996 groundwater sampling activities than in the preceding years. Some of the same

metals present in groundwater were also found in surface soils in excess of screening levels at the northeast corner of the site (see Figure 7-6). These metals included antimony, copper, iron, lead, mercury, nickel, and zinc. Both subsurface soils collected from the northeast and southwest corners of the site also exhibited concentrations of antimony, arsenic, mercury, and zinc in excess of screening levels (see Section 7.4.1.5 for a complete discussion of the 11 metals found in excess of screening levels in subsoil).

Sediment along the Gulf of Mexico shoreline on the east side of IR 7 had localized concentrations in excess of the screening levels for arsenic, copper, lead, and silver, while the associated surface water had widespread levels of antimony in excess of screening levels with a single sample showing tin in excess of screening levels. Sediment on the west side of IR 7 had more widespread contamination by beryllium and copper in excess of screening levels, along with isolated contamination in excess of screening levels by arsenic, cadmium, cyanide, mercury, lead and silver. The surface water associated with the western shoreline also had widespread antimony contamination in excess of screening levels with just single detections of aluminum, copper, cyanide, and lead in excess of screening levels (see Sections 7.4.3.5 and 7.4.4.5 for further discussion on inorganic results from sediment and surface-water analyses).

Except for one sediment sampling location on the west shoreline of IR 7 where the pesticide beta-BHC was found in excess of screening levels, the six other pesticides at IR 7 in excess of sediment screening levels (e.g., dieldrin, endosulfan 1, endrin, heptachlor) were detected in isolated samples along the east shoreline (see Figure 7-7). Groundwater at IR 7 had nine pesticides in excess of screening levels (as discussed in Section 7.4.5.3, dieldrin and gamma-BHC occurred most frequently). Slight exceedances of the screening levels for 4,4'-DDD and 4,4'-DDE were found in the subsoil from the northeast corner of the site while 4-4'-DDD and 4,4'-DDT were present in the surface soil at the southwest corner of IR 7 in excess of screening levels (see Figure 7-6). No pesticides were detected in surface water at IR 7.

SVOCs (12 compounds) in excess of screening levels were found at one sediment sampling location midway along the western shoreline. The SVOC bis(2-ethylhexyl)phthalate was also found in a few other sediment samples at IR 7, only slightly in excess of the screening value (see Figure 7-7). No SVOCs exceeded the screening levels in surface soil, subsurface soil, and surface-water samples collected at IR 7. One detection each of bis(2-ethylhexyl)phthalate and dibenzo(a,h)anthracene from two separate sampling locations was in excess of groundwater screening levels (see Section 7.4.5.2). Given the unknown nature of wastes buried at SWMU, it is uncertain whether SVOC contamination can be linked to previous site activities. However, the infrequent detection of PAHs in sediments suggests that their presence may be due to boat traffic in the area rather than IR 7 related inputs.

VOCs found in excess of screening levels in groundwater included bis(2-chloroisopropyl)ether, bromodichloromethane, bromoform, chloroform, dibromochloromethane, and methylene chloride. As shown in Figures 7-9 and 7-11, these isolated exceedances were detected during the groundwater sampling conducted in 1986 [except that bis(2-chloroisopropyl)ether was again detected as the only VOC in excess of groundwater screening values in 1993]. VOCs were not detected in excess of screening levels in any other environmental media at IR 7.

Finally, low levels of PCBs in excess of screening values were found in the subsoil at the northeast corner of IR 7 and in sediment approximately midway up the east shoreline. Sections 7.4.1.4 and 7.4.3.4 provide the specific aroclors and a more complete description on the detection of PCBs in subsoil and sediment at IR 7.

7.5.2 Potential Routes of Migration

The contaminant source at IR 7 consists of the former landfill. The contaminant release pathways from this area include volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in soil could volatilize from surficial material or become airborne via wind erosion. Contaminated fugitive dust can be generated during ground-disturbing activities, such as construction or excavation. The contaminants could then be dispersed in the surrounding environment and transported to downwind locations where they could repartition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. However, vegetation over the landfill minimizes the airborne contaminant transport pathway.

Precipitation runoff can carry contaminants to nearby surface waters and sediments in the Gulf of Mexico. Infiltrating precipitation can cause the contamination of subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. After reaching the water table, contaminants can be carried with the flow of groundwater to downgradient locations. Groundwater under the landfill is shallow and is connected hydrologically to surface water at the shoreline. Contaminants transported in groundwater to surface water can be deposited subsequently in sediment or surface water, and can potentially accumulate in the tissues of aquatic organisms. In addition, offsite sediments carried along the shoreline into IR 7 by sediment transport through wave action may be another possible source of contaminants detected in the sediments.

An IRA was conducted in 1995 to prevent ponding of rainwater and minimize infiltration. Clean topsoil was placed in low areas to promote runoff and a vegetative cover was established to reduce erosion. This action has presumably reduced the infiltration pathway.

7.5.3 Contaminant Transport Potential and Persistence

Inorganics and pesticides were the predominant contaminants at IR 7 with concentrations in excess of screening levels in the surface and subsurface soil, sediment, groundwater, and to a limited degree, surface water (except that pesticides were not in surface water). A localized area of SVOC contamination in excess of screening levels in sediment on the west shoreline was also detected. VOCs were also found in excess of screening levels at IR 7 in 1986, but were not detected again above screening levels in 1996. Finally, low levels of PCBs in excess of screening values were found in isolated areas in the subsoil and sediment at IR 7.

In general, metals are adsorbed onto soil and organic matter, greatly reducing both mobility and potential for transport in the aqueous phase. Geotechnical data collected during the preliminary RI presented a relatively high total organic content of 6,600 mg/kg indicating the media's ability to minimize metals migration by adsorption. In addition, the high pH (8.35) of soil at IR 7 would also reduce the mobility of most metals (e.g., iron, copper, and zinc). The transport of lead in the environment is strongly influenced by the speciation of the ion. Since sorption appears to exert a dominant effect on the distribution of lead in the environment, lead is strongly complexed to organic materials in soil (Clement Associates, 1985). Although sorption tends to reduce the mobility of inorganics in the subsurface, strong associations with soil particles may increase the persistence of inorganic contamination. Contaminants that persist in the solid media may also continue to be present in groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations would remain low.

Pesticides were also detected in excess of screening levels in isolated samples in sediment, in groundwater, and to a lesser degree, surface and subsurface soil at IR 7. The pesticides are not expected to migrate significantly due to (1) the relatively low solubility of pesticides in water, (2) low vapor pressures, (3) low Henry's Law constants, and especially, (4) soil and sediment/water partition coefficients that strongly favor soil and sediment sorption. However, sediment transport by wave action could disperse the pesticide contamination along the shoreline. As shown in Appendix C, pesticides are some of the most immobile and persistent of environmental organic contaminants. For example, the half-lifes for the biodegradation in groundwater of 4,4'-DDT and 4,4'-DDE can be as long as 31 years (i.e., for groundwater under anaerobic conditions) while the half-life for dieldrin could be 6 years (Howard et. al, 1991).

For the same reasons as pesticides, PCBs are also some of the most immobile and persistent of environmental organic contaminants. However, in the environment, the composition of PCBs may differ

from the commercial mixtures (e.g., Aroclor-1242, -1254, and -1260). This difference occurs because after release into the environment, the composition of PCB mixtures change over time, through partitioning, chemical transformation, and preferential bioaccumulation (EPA, 1996b). The efficiency of these mechanisms often depend on the chlorine content of the PCB mixture or congener. Of the PCB mixtures detected in excess of screening levels, Aroclor-1260 is the most highly chlorinated with an average chlorine content of 60 percent. Aroclor-1254 has 54 percent chlorine while Aroclor-1242 would have the lowest average chlorine content of 42 percent.

Partitioning in the environment of PCB congeners would be by adsorption of PCBs to organic materials, sediments, and soils. This behavior tends to increase with chlorine content of the PCBs and organic content of the other material. Volatilization and solubility of the lower chlorinated congeners (e.g., the PCB congeners present in Aroclor-1242) would occur while limited volatilization and solubility of the higher chlorinated congeners would take place (e.g., the PCB congeners present in Aroclor-1260). During biodegradation of PCBs, anerobic bacteria in sediments selectively remove chlorines from meta and para positions of the PCB congener appearing to reduce the toxicity and bioaccumulation potential of residues. Aerobic bacteria break open the carbon rings through oxidation and also remove chlorines; however, aerobic biodegradation occurs mostly with PCBs containing lower percentages of chlorine (e.g., PCB congeners found in Aroclor-1242 and other congeners that typically contain 1 to 4 chlorines). Photolysis can also slowly break down congeners with high chlorine content.

Because PCB detections were isolated and low in concentration, these chemicals do not have a significant potential for contaminant migration at IR 7.

Twelve SVOCs were also detected at concentrations in excess of screening levels at one sediment sampling location midway along the western shoreline in sediment at concentration levels in excess of screening values [e.g., acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, phenathrene, and pyrene]. Similar to the same reasons as pesticides (i.e., relatively low solubility in water, low vapor pressures, low Henry's Law constants, and high sediment/water partition coefficients), these SVOCs are also relatively immobile in sediment unless transported under wave action. Biodegradation of these contaminants is more rapid than for pesticides, with half-lifes (i.e., in groundwater under anaerobic conditions) ranging from a year or less up to a maximum of 6 years for chrysene and 10 years for pyrene (Howard et. al., 1991).

The localized concentrations of VOCs detected in groundwater in excess of screening levels in 1986 included bis(2-chloroisopropyl)ether, bromodichloromethane, bromoform, chloroform, dibromochloromethane, and methylene chloride [note: bis(2-chloroisopropyl)ether was also detected in 1993 as the only VOC in excess of groundwater screening values]. These VOCs are considered to be much more

mobile than pesticides, PCBs, and SVOCs in the environment due to their (1) higher solubility in water, (2) higher vapor pressures, (3) Henry's Law constants, and (4) relatively lower soil and sediment/water partition coefficients (see Appendix C). However, the persistence of these chemicals is low due to the relatively high biodegradation rates (e.g., generally as short as a few days to a year).

7.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section presents the baseline human health risk assessment for IR 7. It describes a qualitative and quantitative assessment of actual or potential risks for IR 7. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and RGOs. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 3.1.7.8.

7.6.1 Preliminary Risk Evaluation

A PRE was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 7-6 and 7-7 summarize the preliminary risk evaluation for IR 7 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. The risk ratio calculated for the residential land use scenario is less than 1E-04 for carcinogenic effects. However, the risk ratio calculated for the residential land use scenario is greater than 1.0 for noncarcinogenic effects. Therefore, a baseline human health risk assessment is necessary for IR 7. The primary contributors to noncarcinogenic risk are antimony and iron in soil; arsenic in sediment; and antimony and cyanide in surface water.

7.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals

found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

7.6.2.1 Soils

Four VOCs (acetone, 1,2-DCE, toluene, and methylene chloride), two SVOCs [4-methyl-2-pentanone and bis(2-ethylhexyl)phthalate)], four pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and beta-BHC), and metals were detected in one or more of the surface soil samples collected at IR 7. Three VOCs (acetone, methylene chloride, and 1,2-DCE), bis(2-ethylhexyl)phthalate, four pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan II), two pesticides (Aroclor-1242 and Aroclor-1254), and several metals were detected in subsurface soil samples collected at IR 7. The occurrence and distribution of chemicals in surface and subsurface soils are presented in Tables 7-8 through 7-11. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in IR 7 soils are also presented in these tables. The following chemicals were selected as COPCs at IR 7 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
Antimony	None Selected	Arsenic	None Selected

Antimony is selected as the only COPC in surface soil. It was detected in one sample at a concentration of 4.8 mg/kg. This concentration exceeded RBCs developed for the residential land use scenario. Organic chemicals in surface soils were detected at concentrations less than residential RBC values. Therefore, no organic COPCs were selected from surface soils.

Arsenic is selected as the only COPC in subsurface soil. It was detected in two samples at a range of 3.3 mg/kg to 8.4 mg/kg. The maximum concentration of arsenic exceeded RBCs developed for the industrial land use scenario. Organic chemicals detected in subsurface soils each detected at levels less than industrial RBC values. Therefore, no organic COPCs were selected from subsurface soils.

7.6.2.2 Sediment and Surface Water

Several VOCs, phthalates, PAHs, PCBs, pesticides, and metals were detected in one or more of the sediment samples collected at IR 7. Naphthalene and metals were detected in surface-water samples collected at IR 7. The occurrence and distribution of chemicals in sediment and surface water are presented in Tables 7-12 through 7-15. Summary statistics, COPC selection results, and representative

TABLE 7-6

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
IR 7
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	1.6	9.7	ND	0.43	0.43	0.045	3.8	4E-06	2E-05	NA	4E-07
Beryllium	ND	0.24	ND	0.15	0.15	0.016	1.3	NA	2E-06	NA	NA
PESTICIDES/PCBs											
4,4'-DDD	160	4.5	ND	2,700	2,700	0.28	24,000	6E-08	2E-09	NA	7E-09
4,4'-DDE	40	23.2	ND	1,900	1,900	0.2	17,000	2E-07	1E-08	NA	2E-08
4,4'-DDT	1,900	32.1	ND	1,900	1,900	0.2	17,000	1E-06	2E-08	NA	1E-07
Aroclor-1242	ND	ND	ND	319	319	0.0335	2,860	NA	NA	NA	NA
Aroclor-1254	ND	47	ND	319	319	0.0335	2,860	NA	2E-07	NA	NA
Aroclor-1260	ND	146	ND	319	319	0.0335	2,860	NA	5E-07	NA	NA
alpha-BHC	ND	2.2	ND	100	100	0.011	910	NA	2E-08	NA	NA
Dieldrin	ND	20.8	ND	40	40	0.0042	360	NA	5E-07	NA	NA
gamma-BHC (lindane)	ND	2	ND	490	490	0.052	4,400	NA	4E-09	NA	NA
Heptachlor	ND	11	ND	140	140	0.0023	1,300	NA	8E-08	NA	NA
Heptachlor epoxide	ND	1.5	ND	70	70	0.0012	630	NA	2E-08	NA	NA
beta-BHC	59	170	ND	350	350	0.037	3,200	2E-07	5E-07	NA	2E-08
SEMIVOLATILE ORGANIC COMPOUNDS											
Benzo(a)anthracene	ND	640	ND	880	880	0.092	7,800	NA	7E-07	NA	NA
Benzo(a)pyrene	ND	540	ND	88	88	0.0092	780	NA	6E-06	NA	NA
Benzo(b)fluoranthene	ND	630	ND	880	880	0.092	7,800	NA	7E-07	NA	NA
Benzo(k)fluoranthene	ND	610	ND	8,800	8,800	0.92	78,000	NA	7E-08	NA	NA
Bis(2-ethylhexyl)phthalate	290	570	ND	46,000	46,000	4.8	410,000	6E-09	1E-08	NA	7E-10
Chrysene	ND	950	ND	88,000	88,000	9.2	780,000	NA	1E-08	NA	NA
Dibenzo(a,h)anthracene	ND	190	ND	88	88	0.0092	780	NA	2E-06	NA	NA
Indeno(1,2,3-cd)pyrene	ND	280	ND	880	880	0.092	7,800	NA	3E-07	NA	NA
VOLATILE ORGANIC COMPOUNDS											
4-Methyl-2-pentanone	0.3	ND	ND							NA	
Methylene chloride	69	36	ND	85,000	85,000	4.1	760,000	8E-10	4E-10	NA	9.1E-11
							Risk Sums by Medium	**6E-05**	**2E-04**	**5E-07**	**7E-06**
							Risk Sums by Use Scenario	**2E-04**			**7E-06**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 7-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
IR 7
NAS KEY WEST
PAGE 1 OF 2

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	599	1,010	477	78,000	78,000	37,000	1,000,000	8E-02	1E-01	1E-01	6E-03
Antimony	4.8	ND	229	31	31	15	820	2E+00	NA	2E+02	6E-02
Arsenic	1.6	9.7	ND	23	23	11	610	7E-01	4E+00	NA	3E-02
Barium	5.6	16.8	42.9	5,500	5,500	2,600	140,000	1E-02	1E-02	2E-01	4E-04
Beryllium	ND	0.24	ND	390	390	180	1,000	NA	5E-03	NA	NA
Cadmium	ND	1.1	ND	39	39	18	1,000	NA	3E-01	NA	NA
Chromium VI	8.6	8.7	ND	390	390	180	10,000	2E-01	2E-01	NA	9E-03
Cobalt	ND	0.35	ND	4,700	4,700	2,200	120,000	NA	7E-04	NA	NA
Copper	24	115	42.5	3,100	3,100	1,500	82,000	8E-02	4E-01	3E-01	3E-03
Cyanide	ND	23	430	1,600	1,600	730	41,000	NA	1E-01	6E+00	NA
Iron	2,560	2,080	556	23,000	23,000	11,000	610,000	1E+00	9E-01	5E-01	4E-02
Manganese	23.8	29.2	ND	390	390	180	10,000	6E-01	8E-01	NA	2E-02
Mercury	0.31	0.14	0.63	23	23	11	610	1E-01	6E-02	6E-01	5E-03
Nickel	3.6	3.8	ND	1,600	1,600	730	41,000	2E-02	2E-02	NA	9E-04
Silver	ND	7	ND	390	390	180	10,000	NA	2E-01	NA	NA
Tin	ND	9.5	34.7	47,000	47,000	22,000	1,000,000	NA	2E-03	2E-02	NA
Vanadium	2.9	6. 5	18.5	550	550	2,600	14,000	5E-02	1E-01	7E-02	2E-03
Zinc	90.3	58.6	8.2	23,000	23,000	11,000	610,000	4E-02	3E-02	8E-03	2E-03
PESTICIDES/PCBs											
4,4'-DDT	1,900	32.1	ND	39,000	39,000	18	1,000,000	5E-01	8E-03	NA	2E-02
Aroclor-1254	ND	47	ND	1,600	1,600	0.73	41,000	NA	3E-01	NA	NA
Dieldrin	ND	20.8	ND	3,900	3,900	1.8	100,000	NA	5E-02	NA	NA
Endosulfan I	ND	10.7	ND	470,000	470,000	220	12,000,000	NA	2E-04	NA	NA
Endosulfan Sulfate	ND	10.6	ND	470,000	470,000	220	12,000,000	NA	2E-04	NA	NA
Endrin	ND	13.6	ND	23,000	23,000	11	610,000	NA	6E-03	NA	NA
Endrin aldehyde	ND	0.64	ND	23,000	23,000	11	610,000	NA	3E-04	NA	NA
gamma-BHC (lindane)	ND	2	ND	NA	23,000	NA	NA	NA	9E-04	NA	NA
Heptachlor	ND	11	ND	39,000	39,000	18	1,000,000	NA	3E-03	NA	NA
Heptachlor epoxide	ND	1.5	ND	NA	1,000	NA	NA	NA	2E-02	NA	NA
SEMIVOLATILE ORGANIC COMPOUNDS											
4-Methyl-2-pentanone	0.3	ND	ND	6,300,000	NA	NA	160,000,000	5E-07	NA	NA	2E-08
Acenaphthene	ND	300	ND	4,700,000	4,700,000	2,200	120,000,000	NA	6E-04	NA	NA

TABLE 7-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
IR 7
NAS KEY WEST
PAGE 2 OF 2

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
Anthracene	ND	140	ND	23,000,000	23,000,000	11,000	610,000,000	NA	6E-05	NA	NA
Bis(2-ethylhexyl)phthalate	290	570	ND	1,600,000	1,600,000	730	41,000,000	2E-03	4E-03	NA	7E-05
Dibenzofuran	ND	170	ND	310,000	310,000	150	8,200,000	NA	6E-03	NA	NA
Fluoranthene	ND	1,900	ND	3,100,000	3,100,000	1,500	82,000,000	NA	6E-03	NA	NA
Fluorene	ND	180	ND	3,100,000	3,100,000	1,500	82,000,000	NA	6E-04	NA	NA
Naphthalene	ND	120	0.25	3,100,000	3,100,000	1,500	82,000,000	NA	4E-04	2E-03	NA
Pyrene	ND	1,700	ND	2,300,000	2,300,000	1,100	61,000,000	NA	7E-03	NA	NA
VOLATILE ORGANIC COMPOUNDS											
1,2-dichloroethene	3	ND	ND	700,000	NA	NA	18,000,000	4E-05	NA	NA	2E-06
Acetone	15	51	ND	7,800,000	7,800,000	3,700	200,000,000	2E-05	7E-05	NA	8E-07
Methylene chloride	69	36	ND	4,700,000	4,700,000	260	120,000,000	2E-04	8E-05	NA	6E-06
Toluene	1	ND	ND	16,000,000	16,000,000	750	410,000,000	6E-07	NA	NA	2E-08
Vinyl acetate	0.4	ND	ND	78,000,000	NA	NA	1,000,000,000	5E-08	NA	NA	4E-09
Hazard Sums by Medium								**7E+00**	**1E+01**	**3E+00**	**3E-01**
Hazard Sums by Use Scenario								**2E+01**			**3E-01**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 7-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT IR 7 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	14/14	120 - 4,250	1,887	2/2	547 - 599	573	573	7,800	599	N	A
Antimony	2/15	0.26 - 0.48	0.39	1/1	4.8 - 4.8	4.8	4.80	3.1	4.8	Y	C
Arsenic	6/15	0.63 - 2.7	1.29	2/2	1.4 - 1.6	1.5	1.50	0.43	1.6	N	G
Barium	15/15	4.4 - 17.7	10.51	2/2	5.6 - 5.6	5.6	5.60	550	5.6	N	A
Chromium**	15/15	1.9 - 15.5	6.02	2/2	4.5 - 8.6	6.55	6.55	39	8.6	N	A
Copper	14/15	1.3 - 15.6	5.43	2/2	9.3 - 24	16.65	16.65	310	24	N	A
Iron	14/14	98.1 - 2,260	1,167	1/1	2,560 - 2,560	2,560	2,560	2,300	2,560	N	G
Lead	14/15	0.65 - 48.3	15.66	2/2	18.7 - 73.5	46.10	46.10	400	73.5	N	A
Manganese	14/14	2.6 - 33.7	17.65	2/2	16.1 - 23.8	19.95	19.95	180	23.8	N	A
Mercury	5/15	0.03 - 0.08	0.03	1/1	0.31 - 0.31	0.31	0.31	2.3	0.31	N	A
Nickel	11/15	0.63 - 4.1	1.67	2/2	3.1 - 3.6	3.35	3.35	160	3.6	N	A
Vanadium	15/15	0.8 - 8.8	3.97	2/2	1.9 - 2.9	2.40	2.40	55	2.9	N	A
Zinc	12/15	0.63 - 89.1	15.22	2/2	21.7 - 90.3	56	56	2,300	90.3	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

**As chromium VI

TABLE 7-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT IR 7 (µg/kg) NAS KEY WEST

Chemical	Background			Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection						
PESTICIDES/PCBs											
4,4'-DDD	3/14	2 - 233	22.46	1/1	160 - 160	160	160	2,700	160	N	A
4,4'-DDE	7/14	1.8 - 741	63.23	1/2	40 - 40	40	44	1,900	40	N	A
4,4'-DDT	7/14	1.8 - 557	46.78	2/2	35 - 1,900	967.50	967.50	1,900	1,900	N	A
beta-BHC	0/11	Not detected	–	1/1	59 - 59	59	59	350	59	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	1/11	330 - 330	470.55	1/2	290 - 290	290	745	46,000	290	N	A
VOLATILE ORGANIC COMPOUNDS											
1,2-dichloroethene	0/2	Not detected	–	2/2	3 - 3	3	3	70,000	3	N	A
4-methyl-2-pentanone	0/12	Not detected	–	1/1	0.3 - 0.3	0.3	0.3	630,000	0.3	N	A
Acetone	1/12	1 - 1	3.67	1/1	15 - 15	15	15	780,000	15	N	A
Methylene chloride	6/12	0.11 - 14	2.80	2/2	17 - 69	43	43	85,000	69	N	A
Toluene	1/15	1 - 1	1.62	1/1	1 - 1	1	1	1,600,000	1	N	A
Vinyl acetate	0/12	Not detected	–	1/1	0.4 - 0.4	0.4	0.4	7,800,000	0.4	N	A

Notes:

Because most organics are not naturally occurring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

TABLE 7-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SUBSURFACE SOILS AT IR 7 (mg/kg)

NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	14/14	120. - 4,250	1,887	2/2	384.5 - 422	403.25	403.25	100,000	422	N	A
Antimony	2/15	0.26 - 0.48	0.39	2/2	3.1 - 50.3	26.70	26.70	82	50.3	N	A
Arsenic	6/15	0.63 - 2.7	1.29	2/2	3.3 - 8.4	5.85	5.85	4	8.4	Y	C
Barium	15/15	4.4 - 17.7	10.51	2/2	6.1 - 18.8	12.43	12.43	14,000	18.8	N	A
Cadmium	4/15	0.11 - 0.45	0.15	1/2	3.5 - 3.5	3.5	1.9	100	3.5	N	A
Chromium**	15/15	1.9 - 15.5	6.02	2/2	4.3 - 26.4	15.35	15.35	1,000	26.4	N	A
Cobalt	7/15	0.22 - 0.51	0.29	1/2	14.3 - 14.3	14.3	7.75	12,000	14.3	N	A
Copper	14/15	1.3 - 15.6	5.43	2/2	8.3 - 53.9	31.08	31.08	8,200	53.9	N	A
Iron	14/14	98.1 - 2,260	1,167	1/1	5,500 - 5,500	5,500	5,500	61,000	5,500	N	A
Lead	14/15	0.65 - 48.3	15.66	2/2	15.3 - 337	176.13	176.13	400	337	N	A
Manganese	14/14	2.6 - 33.7	17.65	2/2	26.6 - 158	92.28	92.28	4,700	158	N	A
Mercury	5/15	0.03 - 0.08	0.03	2/2	0.095 - 0.3	0.20	0.20	61	0.3	N	A
Nickel	11/15	0.63 - 4.1	1.67	2/2	2.9 - 9.2	6.05	6.05	4,100	9.2	N	A
Vanadium	15/15	0.8 - 8.8	3.97	2/2	3.8 - 5.8	4.78	4.78	1,400	5.8	N	A
Zinc	12/15	0.63 - 89.1	15.22	2/2	47.7 - 5,940	2,994	2,994	61,000	5,940	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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 industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As chromium VI

TABLE 7-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SUBSURFACE SOILS AT IR 7 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBs											
4,4'-DDD	3/14	2 - 233	22.46	1/2	140 - 140	140	75.25	24,000	140	N	A
4,4'-DDE	7/14	1.8 - 741	63.23	1/2	300 - 300	300	155.25	17,000	300	N	A
4,4'-DDT	7/14	1.8 - 557	46.78	1/2	28 - 28	28	19.25	17,000	28	N	A
Aroclor-1242	0/11	Not detected	–	1/2	970 - 970	970	512.5	2,800	970	N	A
Aroclor-1254	0/11	Not detected	–	1/2	450 - 450	450	277.5	2,800	450	N	A
Endosulfan II	0/11	Not detected	–	1/1	37.8 - 37.8	37.8	37.8	1,200,000	37.8	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Bis(2-ethylhexyl)phthalate	1/11	330 - 330	470.55	2/2	620 - 1,125	872.5	872.5	410,000	1,130	N	A
VOLATILE ORGANIC COMPOUNDS											
1,2-dichloroethene	0/2	Not detected	–	1/1	2.8 - 2.8	2.8	2.8	1,800,000	2.8	N	A
Acetone	1/12	1 - 1	3.67	2/2	44 - 75	59.5	59.5	20,000,000	75	N	A
Methylene chloride	6/12	0.11 - 14	2.80	2/2	20 - 38	29	29	760,000	38	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of RBCs.

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 industrial exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

TABLE 7-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SEDIMENT AT IR 7 (mg/kg)

NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	12-Jan	97.7 - 3,350	1,332	16/16	225 - 1,010	448.47	448.47	7,800	566	N	A
Arsenic	8/12	1.5 - 7	2.63	20/24	1 - 9.7	3.55	3.21	0.43	5.23	Y	C
Barium	13/13	5 - 15.2	9.27	24/24	3.3 - 16.8	7.24	7.24	550	8.72	N	A
Beryllium	1/13	0.12 - 0.12	0.06	3/24	0.16 - 0.24	0.2	0.08	0.15	0.128	Y	C
Cadmium	3/13	0.06 - 0.9	0.22	2/24	1.1 - 1.1	1.1	0.34	3.90	0.972	N	A
Chromium**	8/13	2.1 - 11.7	5.01	16/24	3.3 - 8.7	4.8	4.07	39	4.75	N	A
Cobalt	2/13	0.12 - 0.56	0.47	1/24	0.35 - 0.35	0.35	1.15	470	0.35	N	A
Copper	13/13	0.76 - 34.6	8.88	24/24	2.4 - 115	18.03	18.03	310	28.3	N	A
Cyanide	0/13	Not detected	–	1/14	23 - 23	23	2.46	160,000	16.6	N	A
Iron	12/12	109 - 3,640	1,199	16/16	17 - 2,080	756.28	756.28	2,300	2,080	N	A
Lead	12/13	5.5 - 56.5	17.97	23/24	4.6 - 42.1	15.22	14.66	400	21.1	N	A
Manganese	12/12	4 - 38.6	15.39	16/16	3.2 - 29.2	10.23	10.23	180	13.9	N	A
Mercury	4/13	0.04 - 0.07	0.05	16/24	0.02 - 0.14	0.06	0.05	2.3	0.0748	N	A
Nickel	10/13	0.7 - 5.5	2.15	10/24	1.1 - 3.8	1.98	1.89	160	2.15	N	A
Silver	1/13	0.5 - 0.5	0.27	3/24	2.8 - 7	5.3	0.97	39	1.39	N	A
Tin	1/2	0.99 - 0.99	2.85	1/9	10 - 9.5	9.5	3.77	4,700	5.2	N	A
Vanadium	13/13	1.6 - 11.7	5.08	17/24	1.9 - 6.5	3.65	2.89	55	3.94	N	A
Zinc	8/13	3.5 - 140	25.74	15/24	5 - 58.6	21.93	13.78	2,300	58.6	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Sediment RBCs are adapted using residential soil RBC.

An RBC for lead based on cancer risk or hazard index is not available. The 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As chromium VI

TABLE 7-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SEDIMENT AT IR 7 (µg/kg)

NAS KEY WEST

PAGE 1 OF 2

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentratio	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBs											
4,4'-DDD	1/12	3.9 - 3.9	13.03	4/16	1.6 - 4.5	2.78	6.22	2,700	4.5	N	A
4,4'-DDE	5/12	2.2 - 149	19.85	5/16	1.6 - 23.2	8.64	8.16	1,900	19.7	N	A
4,4'-DDT	1/12	3.7 - 3.7	13.02	4/16	7.9 - 32.1	19.49	10.12	1,900	32.1	N	A
alpha-BHC	3/11	1.1 - 1.5	7.11	1/16	2.2 - 2.2	2.2	3.04	100	2.2	N	A
Aroclor-1254	0/9	Not detected	–	1/16	47 - 47	47	53.53	320	47	N	A
Aroclor-1260	1/15	40.8 - 40.8	70.57	1/16	146 - 146	146	58.82	320	146	N	A
beta-BHC	0/9	Not detected	–	1/16	170 - 170	170	13.22	350	36.8	N	A
delta-BHC	2/12	2.8 - 15.7	7.35	1/16	1.5 - 1.5	1.5	3.00		1.45	Y	F
Dieldrin	0/9	Not detected	–	1/16	20.8 - 20.8	20.8	7.03	40	20.8	N	A
Endosulfan I	3/12	1.2 - 2.7	6.70	3/16	2.4 - 10.7	5.33	3.85	47,000	9.74	N	A
Endosulfan sulfate	0/9	Not detected	–	1/16	10.6 - 10.6	10.6	6.39	47,000	10.6	N	A
Endrin	1/12	1.4 - 1.4	12.89	1/16	13.6 - 13.6	13.6	6.30	2,300	13.6	N	A
Endrin aldehyde	0/8	Not detected	–	1/10	0.64 - 0.64	0.64	1.62	2,300	0.64	N	A
gamma-BHC (Lindane)	4/12	1.2 - 2.1	6.72	4/16	1.2 - 2	1.55	3.16	490	2	N	A
Heptachlor	2/12	1.1 - 1.3	6.51	2/16	0.56 - 11	5.78	3.60	140	10.6	N	A
Heptachlor epoxide	0/9	Not detected	–	1/16	1.5 - 1.5	1.5	3.00	70	1.5	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Acenaphthene	0/13	Not detected	–	1/14	300 - 300	300	274.00	470,000	300	N	A
Anthracene	0/13	Not detected	–	1/14	140 - 140	140	260.75	2,300,000	140	N	A
Benzo(a)anthracene	0/13	Not detected	–	1/14	640 - 640	640	296.46	880	640	Y	E
Benzo(a)pyrene	0/13	Not detected	–	1/14	540 - 540	540	289.54	88	540	Y	B
Benzo(b)fluoranthene	1/13	489 - 489	966.92	1/14	630 - 630	630	296.79	880	630	Y	E
Benzo(g,h,i)perylene	0/13	Not detected	–	1/14	310 - 310	310	277.11		310	Y	EF
Benzo(k)fluoranthene	0/13	Not detected	–	1/14	610 - 610	610	294.93	8,800	610	Y	E
Bis(2-ethylhexyl)phthalate	1/6	4500 - 4500	1,992.17	5/6	260 - 570	378	610.83	46,000	570	N	A
Chrysene	1/13	417 - 417	961.38	1/14	950 - 950	950	318.61	88,000	950	Y	E
Dibenzo(a,h)anthracene	0/13	Not detected	–	1/14	190 - 190	190	268.39	88	190	Y	B
Dibenzofuran	0/6	Not detected	–	1/6	170 - 170	170	604.17	31,000	170	N	A

TABLE 7-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
ORGANICS IN SEDIMENT AT IR 7 (µg/kg)
NAS KEY WEST
PAGE 2 OF 2

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentratio	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
SEMIVOLATILE ORGANIC COMPOUNDS (CONTINUED)											
Fluoranthene	1/13	690 - 690	982.38	1/14	1,900 - 1,900	1,900	386.46	310,000	1,900	N	A
Fluorene	0/13	Not detected	–	1/14	180 - 180	180	263.61	310,000	180	N	A
Indeno(1,2,3-cd)pyrene	0/13	Not detected	–	1/14	280 - 280	280	270.89	880	280	Y	E
Naphthalene	0/13	Not detected	–	1/14	120 - 120	120	261	310,000	120	N	A
Phenanthrene	0/13	Not detected	–	3/14	32 - 2,100	722	417	–	2,100	Y	F
Pyrene	1/13	509 - 509	968.46	3/14	42 - 1,700	627.33	385	230,000	1,700	N	A
VOLATILE ORGANIC COMPOUNDS											
Acetone	3/6	4 - 120	30.90	2/6	23 - 51	37	16.75	780,000	51	N	A
Methylene chloride	2/6	5 - 20	7.50	6/14	3 - 36	11.5	13	85,000	22	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
Sediment RBCs are adapted using residential soil RBC.
Applicable RBCs originate from EPA Region 3 RBCs for residential exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)
B - COPC (Max>RBC, organics)
E - COPC (same family)
F - COPC (eval. qual.)
**As chromium VI

TABLE 7-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE WATER AT IR 7 (µg/L)

NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	2/12	25 - 148	24.97	1/2	447 - 447	447	233.50	–	447	Y	H
Antimony	4/12	3.5 - 205	33.71	9/10	148 - 229	189.56	172.10	14	229	Y	C
Barium	11/13	4.7 - 16.3	6.93	10/10	3.6 - 42.9	8.65	8.65	–	14.1	Y	H
Copper	1/13	2 - 2	2.26	1/10	42.5 - 42.5	47.5	8.75	1,300	13.7	N	A
Cyanide	0/8	Not detected	–	1/2	430 - 430	430	217.50	700	430	N	A
Iron	5/12	8.5 - 170	24.7	2/2	8 - 556	282	282.00	–	556	Y	H
Lead	0/12	Not detected	–	1/10	72.2 - 72.2	72.2	16.22	50	24.5	Y	C
Mercury	6/13	0.29 - 4.2	0.52	5/10	0.21 - 0.63	0.31	0.21	–	0.342	Y	H
Tin	0/4	Not detected	–	1/8	34.7 - 34.7	34.7	17.46	–	21.9	Y	H
Vanadium	2/13	2 - 2.8	1.99	1/10	18.5 - 18.5	18.5	6.35	–	8.3	Y	H
Zinc	5/13	1.4 - 39.6	7.19	7/10	5 - 8.2	6.44	5.26	–	7.59	Y	H

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg)

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

H - COPC (lacks an RBC, but has a quantitative toxicity)

TABLE 7-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE WATER AT IR 7 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
SEMIVOLATILE ORGANIC COMPOUNDS											
Naphthalene	0/13	Not detected	–	1/10	0.25 - 0.25	0.25	1.57	–	0.25	Y	H

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-ased screening levels (RBCs).

RBCs represent concentrations associated with a IE-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

H - COPC (lacks an RBC, but has a quantitative toxicity)

concentrations for chemicals detected in IR 7 sediment and surface water are also presented in these tables. The following chemicals were selected as COPCs for IR 7 sediment and surface water:

SEDIMENT		SURFACE WATER	
Inorganics	Organics	Inorganics	Organics
Arsenic	Benzo(a)anthracene	Antimony	Naphthalene**
Beryllium	Benzo(a)pyrene	Lead*	
	Benzo(b)fluoranthene	Aluminum**	
	Benzo(k)fluoranthene	Barium**	
	Chrysene	Iron**	
	Dibenzo(a,h)anthracene	Mercury**	
	Indeno(1,2,3-cd)pyrene	Tin**	
	delta-BHC*	Vanadium**	
	Benzo(g,h,i)perylene*	Zinc**	
	Phenanthrene*		

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No WQSs (for consumption of water and organisms) are listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Arsenic was selected as a COPC for sediment at IR 7 and was detected in 20 out of 24 samples at a range of 0.66 mg/kg to 9.7 mg/kg. Beryllium was also selected as a COPC in sediment. It was detected in three out of 24 samples at a range of 3.3 mg/kg to 16.8 mg/kg. Maximum and representative concentrations of these metals exceeded RBCs for residential soil exposure. Carcinogenic polyaromatic hydrocarbons (PAHs), including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were selected as COPCs in sediment at IR 7. They were each detected in one out of 14 sediment samples. The maximum and representative concentrations of these PAHs were detected at concentrations exceeding residential soil RBCs. Soil RBCs are used because RBCs protective of human health for sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health. Delta-BHC, benzo(g,h,i)perylene, and phenanthrene will be evaluated qualitatively in the uncertainty section because they lack qualitative toxicity values.

WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure that provides the basis for developing an applicable WQS. Thus, the use of WQSs as RBCs to select surface-water COPCs is conservative regarding protection of human health.

Antimony was selected as a COPC for surface water. It was detected in 9 out of 10 samples at a range of 148 μg/L to 229 μg/L. All concentrations of antimony exceeded the WQS. Lead does not have a listed quantitative toxicity value; therefore, it will be evaluated qualitatively in the uncertainty section. Aluminum, barium, iron, mercury, tin, vanadium, zinc, and naphthalene were also selected as COPCs for surface water at IR 7. These chemicals did not have listed WQSs, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

7.6.2.3 Shellfish Tissue

Several pesticides and metals were detected in one or more of the lobster and stone crab tissue samples collected at IR 7. The occurrence and distribution of chemicals in lobster tissue is presented in Tables 7-16 through 7-17. The occurrence and distribution of chemicals in crab tissue is presented in Tables 7-18 through 7-19. Summary statistics and COPC selection results for chemicals detected in IR 7 lobster and crab tissue samples are also presented in these tables. The following chemicals were selected as COPCs for IR 7 lobster and crab tissue:

LOBSTER TISSUE		CRAB TISSUE	
Inorganics	Organics	Inorganics	Organics
Mercury	Heptachlor Epoxide	None selected	Aldrin
	delta-BHC*		Heptachlor
			delta-BHC*

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section.

Mercury was selected as a COPC for lobster tissue at IR 7. It was detected in five out of ten samples at a range of 0.03 mg/kg to 0.14 mg/kg. Heptachlor epoxide was also selected as a COPC for lobster tissue at

TABLE 7-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN LOBSTER TISSUE AT IR 7 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
Aluminum	0/19	Not detected	–	2/10	2.6 - 9.9	6.25	2.25	140	N	A
Arsenic	19/19	4.7 - 20.7	13.43	10/10	12.2 - 23	17.09	17.09	0.0021	N	G
Barium	4/19	1.1 - 1.6	0.52	2/10	1.2 - 1.3	1.25	0.53	9.5	N	A
Cadmium	12/19	0.65 - 1.5	0.66	2/10	0.58 - 0.81	0.7	0.37	0.068	N	G
Copper	19/19	14.2 - 37.1	26.18	10/10	18.9 - 38.6	26.07	26.07	5.4	N	G
Manganese	5/19	1.3 - 1.7	0.65	3/10	0.18 - 0.53	0.34	0.37	3.1	N	A
Mercury	5/19	0.02 - 0.08	0.02	5/10	0.03 - 0.14	0.08	0.06	0.041	Y	C
Silver	5/19	0.26 - 0.45	0.19	1/10	0.42 - 0.42	0.42	0.18	0.68	N	A
Zinc	19/19	12.5 - 25.8	20.51	10/10	18,010 - 28.9	21.35	21.35	41	N	A

Notes:
Metals are selected as COPCs if average values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
C - COPC (Avg>RBC & Avg>2XBkgdAvg, inorganics)
G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 7-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN LOBSTER TISSUE AT IR 7 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection					
PESTICIDES/PCBs										
4,4'-DDD	4/19	0.72 - 0.86	1.48	4/10	0.13 - 1.2	0.57	1.21	13	N	A
4,4'-DDE	1/19	0.31 - 0.31	1.58	2/10	0.58 - 0.67	0.63	1.44	9.3	N	A
4,4'-DDT	0/19	Not detected	–	3/10	0.12 - 2	0.78	1.38	9.3	N	A
Aldrin	5/19	0.08 - 0.21	0.66	1/10	0.06 - 0.06	0.06	0.77	0.19	N	G
beta-BHC	3/19	0.11 - 0.2	0.74	4/10	0.13 - 0.72	0.36	0.66	1.8	N	A
delta-BHC	0/19	Not detected	–	4/10	0.05 - 0.6	0.2	0.59	–	Y	F
gamma-BHC (lindane)	3/19	0.03 - 0.14	0.73	2/10	0.12 - 0.13	0.13	0.7	2.4	N	A
Chlorobenzilate	0/19	Not detected	–	1/10	15 - 15	15	9.16	12	N	A
Dieldrin	1/19	0.56 - 0.56	1.59	4/10	0.32 - 0.76	0.47	1.13	0.2	N	G
Endosulfan I	0/19	Not detected	–	1/10	0.23 - 0.23	0.23	0.79	810	N	A
Endosulfan II	8/19	0.12 - 0.67	1.08	6/10	0.11 - 0.25	0.18	0.78	810	N	A
Endosulfan sulfate	0/19	Not detected	–	3/10	0.8 - 3.9	2.67	1.96	810	N	A
Endrin	9/19	0.06 - 0.56	0.98	3/10	0.1 - 0.5	0.27	1.23	41	N	A
Endrin aldehyde	5/19	0.65 - 3.1	1.54	4/10	0.1 - 2.2	1.17	1.45	41	N	A
Heptachlor	10/19	0.07 - 0.33	0.50	4/10	0.07 - 0.37	0.21	0.6	0.7	N	A
Heptachlor epoxide	0/19	Not detected	–	1/10	0.44 - 0.44	0.44	0.81	0.35	Y	B

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)

B - COPC (Avg>RBC, organics)

F - COPC (eval. qual.)

G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 7-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN CRAB TISSUE AT IR 7 (mg/kg) NAS KEY WEST

Chemical	Background						Site						Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection			Average		Frequency of Detection	Range of Positive Detection			Average of Detected Values	Average of all Values			
Arsenic	10/10	6.7	-	31	20.07		2/2	11.7	-	22.7	17.2	17.2	0.0021	N	G
Barium	4/10	1.1	-	3.5	0.85		1/2	1.6	-	1.6	1.6	0.99	9.5	N	A
Cadmium	4/10	0.8	-	1.7	0.58		1/2	0.69	-	0.69	0.69	0.5	0.068	N	G
Copper	10/10	5.5	-	60.5	26.65		2/2	17	-	39.4	28.2	28.2	5.4	N	G
Manganese	9/10	0.36	-	2.3	1.12		1/2	1.8	-	1.8	1.8	1.09	3.1	N	A
Mercury	7/10	0.04	-	0.17	0.08		2/2	0.06	-	0.14	0.1	0.1	0.041	N	G
Silver	6/10	0.27	-	0.92	0.41		1/2	0.26	-	0.26	0.26	0.21	0.68	N	A
Zinc	10/10	9	-	58	43.85		2/2	17.7	-	66.8	42.25	42.25	41.	N	G

Notes:
Metals are selected as COPCs if average values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 7-19

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN CRAB TISSUE AT IR 7 (µg/kg) NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values			
PESTICIDES/PCBs										
4,4'-DDD	8/10	0.41 - 1.8	0.39	2/2	0.16 - 0.81	0.39	0.39	13.	N	A
4,4'-DDT	2/10	0.48 - 0.71	1.44	2/2	0.16 - 1.1	1.03	1.03	9.3	N	A
Aldrin	7/10	0.13 - 3.4	0.75	1/2	0.65 - 0.65	0.65	0.76	0.19	Y	B
delta-BHC	0/10	Not detected	–	1/2	0.07 - 0.07	0.07	0.51	–	Y	F
Chlorobenzilate	7/10	4.4 - 140	31.03	1/2	5.8 - 5.8	5.8	7.16	12.	N	A
Dieldrin	6/10	0.38 - 2.3	1.24	2/2	0.19 - 0.59	0.39	0.39	0.2	N	B
Endosulfan II	3/10	0.14 - 2.6	1.48	1/2	0.14 - 0.14	0.14	0.9	810.	N	A
Endrin	7/10	0.31 - 2.7	1.1	1/2	1 - 1	1	1.3	41.	N	A
Endrin aldehyde	9/10	0.34 - 2.8	1.62	1/2	3.4 - 3.4	3.4	2.5	41.	N	A
Heptachlor	3/10	0.05 - 0.52	0.68	1/2	0.72 - 0.72	0.72	0.78	0.7	Y	B
Heptachlor epoxide	2/10	0.37 - 8.2	1.5	1/2	0.83 - 0.83	0.83	0.84	0.35	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
B - COPC (Avg>RBC, organics)
F - COPC (eval. qual.)

IR 7. It was detected in one out of ten samples at a concentration of 0.44 µg/kg. Maximum and average concentrations for mercury and heptachlor epoxide exceeded fish RBCs. Chemicals that lack toxicity criteria (i.e. delta-BHC) will be evaluated qualitatively in the uncertainty section.

Aldrin was selected as a COPC for crab tissue at IR 7. It was detected in one out of two samples at a concentration of 0.65 µg/kg. Heptachlor was also selected as a COPC for crab tissue at IR 7. It was detected in one out of two samples at a concentration of 0.72 µg/kg. Maximum and average concentrations for aldrin and heptachlor expoxide exceeded fish RBCs. Chemicals that lack toxicity criteria (i.e., delta-BHC) will be evaluated qualitatively in the uncertainty section.

7.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at IR 7 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

7.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at IR 7 are presented in Section 3.1.7.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

7.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under a RME and a CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if an HI (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in three parts:

- Carcinogenic risks
- Noncarcinogenic risks
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

7.6.5.1 Carcinogenic Risks

Table 7-20 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risks for the current trespasser adult (2E-06), current trespasser adolescent (2E-06), and hypothetical future resident 3E-05 are within the EPA "target risk range" of 1E-04 to 1E-06 and exceed the FDEP target risk of 1E-06. The dermal exposure route contributes the most to the cumulative carcinogenic risk for the current trespassers and the future resident. This exposure route is also associated with high uncertainty based on the $ABSEFF_{oral}$ presented in Appendix C, Section 3.2.3.4. The principal COPC contributing to this cancer risk is arsenic in sediment. The estimated carcinogenic risks for the excavation worker is less than the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 7.6.8.

Table 7-21 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risk for the hypothetical future resident of 2E-06 is at the lower end of the EPA "target risk range" of 1E-04 to 1E-06 and slightly exceeds FDEP's 1E-06 target risk. The dermal contact with surface soil contributes the most to the cumulative carcinogenic risk for the future resident. The estimated carcinogenic risks for all other receptors are below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 7.6.8.

Table 7-20 lists the estimated cumulative RME carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk due to shellfish ingestion for the hypothetical future adult resident (8E-06) is within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds the FDEP target risk of 1E-06. Aldrin (in crab tissue), heptachlor (in crab tissue), and heptachlor epoxide (in lobster tissue) are generally equal contributors to the cumulative carcinogenic risk. Table 7-21 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk due to shellfish ingestion for the hypothetical future adult resident is below both the EPA "target risk range" of 1E-04 to 1E-06 and the FDEP target risk of 1E-06. Chemical-specific risks for COPCs are presented in Section 7.6.8.

TABLE 7-20

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
IR 7*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	1E-07	NA
Dermal Contact	NA	NA	NA	NA	2E-07	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	3E-15	NA
Subtotal	NA	NA	NA	NA	3E-07	NA
Sediment						
Incidental Ingestion	7E-06	4E-07	5E-07	NA	NA	NA
Dermal Contact	1E-05	2E-06	2E-06	NA	NA	NA
Subtotal	2E-05	2E-06	2E-06	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish* **						
Ingestion	8E-06	NA	NA	NA	NA	NA
Subtotal	8E-06	NA	NA	NA	NA	NA
TOTAL	3E-05	2E-06	2E-06	NA	3E-07	NA
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	2E-01	1E-03	3E-03	7E-04	NA	6E-03
Dermal Contact	7E-03	3E-04	5E-04	2E-04	NA	1E-03
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	2E-01	1E-03	4E-03	8E-04	NA	7E-03
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	2E-02	NA
Dermal Contact	NA	NA	NA	NA	3E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	5E-02	NA
Sediment						
Incidental Ingestion	6E-02	2E-03	4E-03	NA	NA	NA
Dermal Contact	1E-01	2E-02	2E-02	NA	NA	NA
Subtotal	2E-01	2E-02	3E-02	NA	NA	NA
Surface Water						
Incidental Ingestion	1E+00	7E-02	2E-01	NA	NA	NA
Dermal Contact	9E-01	4E-02	6E-02	NA	NA	NA
Subtotal	2E+00	1E-01	2E-01	NA	NA	NA
Shellfish* **						
Ingestion	2E-01	NA	NA	NA	NA	NA
Subtotal	2E-01	NA	NA	NA	NA	NA
TOTAL	3E+00	1E-01	2E-01	8E-04	5E-02	7E-03

* = Chemical-Specific Risks are presented in Section 7.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

*** = Adult Resident Only.

NA = Not Applicable, Pathway is not applicable for the respective media.

TABLE 7-21

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
IR 7*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	6E-09	NA
Dermal Contact	NA	NA	NA	NA	1E-08	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	8E-16	NA
Subtotal	NA	NA	NA	NA	2E-08	NA
Sediment						
Incidental Ingestion	1E-06	4E-08	2E-08	NA	NA	NA
Dermal Contact	4E-07	7E-08	3E-08	NA	NA	NA
Subtotal	1E-06	1E-07	5E-08	NA	NA	NA
Surface Water						
Incidental Ingestion	**	**	**	NA	NA	NA
Dermal Contact	**	**	**	NA	NA	NA
Subtotal	**	**	**	NA	NA	NA
Shellfish* **						
Ingestion	1E-06	NA	NA	NA	NA	NA
Subtotal	1E-06	NA	NA	NA	NA	NA
TOTAL	2E-06	1E-07	5E-08	NA	2E-08	NA
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	2E-01	3E-04	6E-04	3E-04	NA	6E-03
Dermal Contact	1E-03	3E-05	1E-05	3E-05	NA	3E-04
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	2E-01	3E-04	6E-04	3E-04	NA	6E-03
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	2E-03	NA
Dermal Contact	NA	NA	NA	NA	3E-03	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	5E-03	NA
Sediment						
Incidental Ingestion	3E-02	4E-04	9E-04	NA	NA	NA
Dermal Contact	1E-02	2E-03	2E-03	NA	NA	NA
Subtotal	4E-02	2E-03	3E-03	NA	NA	NA
Surface Water						
Incidental Ingestion	7E-01	4E-02	8E-02	NA	NA	NA
Dermal Contact	6E-01	2E-02	3E-02	NA	NA	NA
Subtotal	1E+00	6E-02	1E-01	NA	NA	NA
Shellfish* **						
Ingestion	3E-02	NA	NA	NA	NA	NA
Subtotal	3E-02	NA	NA	NA	NA	NA
TOTAL	2E+00	6E-02	1E-01	3E-04	5E-03	6E-03

* = Chemical-Specific Risks are presented in Section 7.6.8.

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.

*** = Adult Resident Only.

NA = Not Applicable; pathway is not applicable for the respective media.

7.6.5.2 Noncarcinogenic Risks

Table 7-20 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The incidental ingestion exposure route contributes the most to the cumulative noncarcinogenic risk for the future resident. This exposure route is also associated with high uncertainty based on the $ABSEFF_{oral}$ presented in Appendix C, Section 3.2.3.4. The principal COPC contributing to the noncarcinogenic risk is antimony in surface water. The target organ for antimony is the heart. The HI for antimony (via exposure to surface soil and surface water) is greater than 1.0. The HIs for all other receptors at IR 7 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 7.6.8.

Table 7-21 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and excavation workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The HI based on the same target organ for the future residential receptor (exposure to antimony via ingestion and dermal contact with surface water) would be above 1.0. The HIs for all other receptors at IR 7 are less than or equal to 1.0. Chemical-specific risks for COPCs are presented in Section 7.6.8.

Table 7-20 lists the estimated cumulative RME noncarcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The cumulative HI due to shellfish ingestion for the hypothetical future resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Table 7-21 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario The cumulative HI due to shellfish ingestion for the hypothetical future adult resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Chemical-specific risks for COPCs are presented in Section 7.6.8.

7.6.5.3 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C,

groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the IR 7 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 7-22 and 7-23 for inorganics and organics, respectively. The results of this preliminary comparison for IR 7 are presented in this section.

The maximum values of antimony, arsenic, cadmium, copper, cyanide, lead, mercury, nickel, thallium, methylene chloride, and gamma-BHC exceeded both their respective MCL and RBC values. Most of the metals that exceeded both MCLs and tap water RBCs were detected in 50 percent of more of the samples analyzed with the exception of cadmium, cyanide, nickel, and thallium. A majority of the detections of these metals were above tap water RBCs. Generally the higher range of detections of these metals were above MCLs. Gamma-BHC was detected in eight samples with the majority of the detections exceeding MCLs and tap water RBCs. Methylene chloride was detected in 13 out of 33 samples with the maximum value exceeding MCLs and tap water RBCs. Chromium VI concentrations exceeded tap water RBCs; however, this is not uncommon for unfiltered groundwater. Several pesticides, VOCs, and a PAH exceeded tap water RBC values.

7.6.6 Uncertainties for IR 7

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of IR 7 risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This condition can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and hazard index (via surface soils and sediment) for the future residential receptors. The uncertainty associated with the dermal exposure route may overestimate the risk at IR 7.

TABLE 7-22

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

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site 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?
Aluminum	0/10	Not detected	–	11/20	271 - 35,000	7,572	4174.30	–	NA	3,700	Y
Antimony	0/12	Not detected	–	28/42	3.6 - 464	183	133.37	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	25/42	1.7 - 73	24.44	17	50	Y	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	38/38	19.6 - 531	110.27	110	2,000	N	260	Y
Beryllium	0/13	Not detected	–	2/42	1.3 - 1.5	1.4	0.89	4	N	0.016	Y
Cadmium	0/13	Not detected	–	8/42	4.25 - 21.7	11.35	3.95	5	Y	1.8	Y
Chromium*	3/13	0.71 - 13	2.51	18/42	11.2 - 384	97.21	44.65	100	Y	3,700	N
Cobalt	0/13	Not detected	–	3/38	21.1 - 62.6	36.43	9.96	–	NA	220	N
Copper	1/13	3.15 - 3.15	2.45	31/42	12.4 - 5,560	537	397.58	1,300**	Y	150	Y
Cyanide	2/8	2.4 - 5.525	1.47	2/24	20 - 270	145	39.44	200	Y	73	Y
Iron	2/10	76.9 - 97.4	41.72	16/20	18.3 - 121,000	15,954	12,763	–	NA	1,100	Y
Lead	1/12	2.5 - 2.5	1.39	26/42	10.6 - 2,000	501.35	311.94	15***	Y	15	Y
Manganese	7/10	2.2 - 10.3	3.78	13/20	4.5 - 656	139.7	91.16	–	NA	84	Y
Mercury	4/13	0.13 - 0.24	0.10	34/42	0.11 - 62	10.87	8.81	2	Y	1.1	Y
Nickel	0/13	Not detected	–	14/42	6.7 - 409	109	42.32	100	Y	73	Y
Silver	1/13	3.3 - 3.3	1.37	3/42	7.9 - 11.8	9.23	5.57	–	NA	18	N
Thallium	1/13	4.925 - 4.925	2.24	4/42	9.3 - 17.6	13.73	9.83	2	Y	2.9	Y
Tin	0/3	Not detected	–	8/19	110 - 1,530	337	150.32	–	NA	2,200	N
Vanadium	4/13	3.4 - 3.9	2.62	14/38	11.8 - 229	44.09	18.52	–	NA	26	Y
Zinc	3/13	3.425 - 15.3	2.82	32/42	23.9 - 8,790	1,095	834.61	–	NA	1,100	Y

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
**Copper Action Level
***Lead Action Level

TABLE 7-23

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

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Maximum Contaminan Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
PESTICIDES/PCBs											
4,4'-DDD	0/10	Not detected	–	3/23	0.029 - 0.73	0.27	0.07	–	NA	0.28	Y
4,4'-DDE	0/10	Not detected	–	2/23	0.028 - 0.28	0.15	0.05	–	NA	0.2	Y
4,4'-DDT	0/10	Not detected	–	2/23	0.026 - 0.42	0.22	0.06	–	NA	0.2	Y
Aldrin	0/10	Not detected	–	2/23	0.012 - 0.016	0.01	0.04	–	NA	0.004	Y
alpha-BHC	0/10	Not detected	–	3/23	0.015 - 0.1	0.04	0.05	–	NA	0.011	Y
Chlordane	0/7	Not detected	–	1/12	0.18 - 0.18	0.18	0.16	2	N	0.052	Y
delta-BHC	0/10	Not detected	–	6/23	0.015 - 0.019	0.02	0.05	–	NA	–	NA
Dieldrin	0/10	Not detected	–	7/23	0.022 - 0.033	0.03	0.04	–	NA	0.0042	Y
Endosulfan I	0/10	Not detected	–	7/23	0.012 - 0.032	0.02	0.04735	–	NA	22	N
Endosulfan sulfate	0/10	Not detected	–	1/23	0.051 - 0.051	0.051	0.04	–	NA	22	N
Endrin	0/10	Not detected	–	3/23	0.022 - 0.027	0.02	0.04	2	N	1.1	N
gamma-BHC (lindane)	0/10	Not detected	–	8/23	0.016 - 1.1	0.39	0.18	0.2	Y	0.05	Y
Heptachlor	0/10	Not detected	–	3/23	0.011 - 0.012	0.01	0.04	0.4	N	0.0023	Y
SEMIVOLATILE ORGANIC COMPOUNDS											
Benzo(g,h,i)perylene	0/7	Not detected	–	1/33	0.41 - 0.41	0.41	1.87	–	NA	–	NA
Benzo(k)fluoranthene	0/7	Not detected	–	1/33	0.11 - 0.11	0.11	1.86	–	NA	0.92	N
Bis(2-chloroisopropyl)ether	0/4	Not detected	–	1/33	15 - 15	15	7.41	–	NA	–	NA
Bis(2-ethylhexyl)phthalate	0/7	Not detected	–	1/15	4 - 4	4	3.9	6	N	4.8	N
Dibenzo(a,h)anthracene	0/7	Not detected	–	1/33	0.1 - 0.1	0.1	1.87	–	NA	0.0092	Y
Diethylphthalate	0/7	Not detected	–	1/15	1.1 - 1.1	1.1	4.01	–	NA	2,900	N
VOLATILE ORGANIC COMPOUNDS											
2-butanone	2/4	7 - 32	11.625	1/11	1 - 1	1	4.64	–	NA	190	N
Acetone	1/4	5 - 5	5	4/11	4 - 15	7.25	5.82	–	NA	370	N
Bromodichloromethane	0/4	Not detected	–	2/33	1.1 - 2	1.55	1.23	80	N	0.17	Y
Bromoform	0/4	Not detected	–	1/33	4 - 4	4	1.55	80	N	2.4	N
Carbon disulfide	0/4	Not detected	–	3/10	1 - 3	2	2.35	–	NA	100	N
Chloroform	0/4	Not detected	–	1/33	0.8 - 0.8	0.8	1.03939	80	N	0.15	Y
Dibromochloromethane	0/4	Not detected	–	2/33	2.3 - 4.4	3.39	1.31	80	N	0.13	Y
Methylene chloride	2/4	1 - 1	1.75	13/33	1 - 6.8	2.56	5.25	5	Y	4.1	Y
Toluene	0/4	Not detected	–	1/33	1.2 - 1.2	1.2	1.46	1,000	N	75	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.

- Arsenic is a major contributor to the cumulative carcinogenic risks in sediment, but arsenic was detected at levels in IR 7 that slightly exceed background levels. The inclusion of arsenic as site-related surface soil COPC could overestimate the quantitative risk at IR 7 for the future residential receptor. Furthermore, the carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Since arsenic is a major contributor to the risk, risks may be overstated.

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at IR 7 (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

- Lead was determined to be a COPC in surface water at IR 7. Lead exposure to surface water is not estimated under the IEUBK Lead Model for the baseline human health risk assessment at IR 7. This probably underestimates the risks to potential receptors exposed to lead in surface water, especially to residential children (surface water). Exposure to lead in surface water and by residential children is lower than exposure to lead in surface soil at IR 7. It is generally desirable to avoid contact with lead for all potential receptors, especially for young children.

- One chemical in lobster tissue (delta-BHC) did not have a listed toxicity value for use in the quantitative risk assessment; therefore, no risks were estimated for exposure to delta-BHC. Delta-BHC was detected at similar levels to other pesticides detected in lobster tissue. Most of these pesticides were not selected as COPCs. This could possibly underestimate the carcinogenic and noncarcinogenic risk at IR 7, but without additional toxicity information, the uncertainty remains unknown.

7.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for IR 7.

7.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment, a subset of chemicals, called COCs, was selected for the evaluation of RGOs. At IR 7, COCs were included in the RGO evaluation only if the COC's contribution to risk exceeds a cancer risk level of 1E-06 or a hazard quotient of 0.1. The COCs selected at IR 7 are as follows:

Surface Soils

- Antimony

Antimony was selected as a COC in soil because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor).

Surface Water

- Antimony

Antimony was selected as a COC in surface water because its contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor).

7.6.7.2 Remedial Goal Options

RGOs based on generic FDEP and RCRA TBCs for COCs in surface soils are listed in Table 7-24 for residential exposure scenarios. Table 7-25 lists RGOs for COCs in surface water based on WQS (for consumption of water and organisms). The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 7-26 (surface soil - future resident) and Table 7-27 (surface water - future resident). These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

TABLE 7-24

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE SOIL AT IR 7 NAS KEY WEST

COC	RCRA Subpart S Action Levels (mg/kg)	FDEP Residential Soil Cleanup Goals (mg/kg)
INORGANICS		
Antimony	32	26

TABLE 7-25
TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE WATER AT IR 7 NAS KEY WEST

COC	Human Health Criteria Water+Organism Consumption (µg/L)
Antimony	14

TABLE 7-26

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE SOIL AT IR 7 NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Antimony	-	-	-	3.1	31	93

TABLE 7-27

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE WATER AT IR 7 NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Antimony	-	-	-	10.1	100	303

7.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 7-28 and 7-29. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium
- Representative concentrations for each COPC in each applicable medium
- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use
- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents and excavation workers) receptors. COPCs in IR 7 media were not present at sufficient concentrations to cause adverse noncarcinogenic health effects to any current potential receptors or future excavation workers. Although some cancer risks exceeded FDEP's 1E-06 target risks, the cancer risks estimated for the current potential or future receptors were below or within the 1E-04 to 1E-06 target risk range that is often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation.

COPCs at IR 7 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Antimony is the main contributor to the noncarcinogenic risk.

TABLE 7-28

RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	1.5E-01	7.4E-03	NA	1.6E-01
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5E-01	7.4E-03	NA	1.6E-01
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	3.5E-06	1.3E-05	NA	1.7E-05	6.4E-02	9.8E-02	NA	1.6E-01
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	2.5E-07	2.9E-08	NA	2.8E-07	9.4E-05	4.5E-06	NA	9.8E-05
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	2.1E-07	NA	NA	2.1E-07	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	1.8E-06	NA	NA	1.8E-06	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	2.1E-07	NA	NA	2.1E-07	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	2.0E-08	NA	NA	2.0E-08	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	3.1E-09	NA	NA	3.1E-09	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	6.2E-07	NA	NA	6.2E-07	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	9.1E-08	NA	NA	9.1E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	6.7E-06	1.3E-05	NA	2.0E-05	NA	NA	NA	1.6E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	1.1E-03	7.1E-04	NA	1.8E-03
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	1.4E+00	9.1E-01	NA	2.3E+00
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	4.8E-04	3.2E-04	NA	8.0E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	4.4E-03	3.0E-03	NA	7.4E-03
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	2.7E-03	1.8E-03	NA	4.5E-03
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	8.7E-05	5.8E-05	NA	1.4E-04
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	2.8E-03	1.9E-03	NA	4.7E-03
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	6.0E-05	4.0E-05	NA	1.0E-04
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	1.5E-05	1.1E-04	NA	1.2E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4E+00	9.2E-01	NA	2.3E+00

TABLE 7-28

RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	4.3E-06	NA	NA	4.3E-06	2.0E-02	NA	NA	2.0E-02
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	1.16E-06	NA	NA	1.2E-06	1.20E-03	NA	NA	1.2E-03
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	1.5E-01	NA	NA	1.5E-01
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	2.4E-06	NA	NA	2.4E-06	4.8E-02	NA	NA	4.8E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	7.9E-06	NA	NA	7.9E-06	2.2E-01	NA	NA	2.2E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.5E-05	1.3E-05	NA	2.8E-05	1.7E+00	9.3E-01	NA	2.8E+00

TABLE 7-28

RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	1.1E-03	3.2E-04	NA	1.5E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1E-03	3.2E-04		1.5E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	2.0E-07	1.8E-06	NA	2.0E-06	1.6E-03	1.5E-02	NA	1.7E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	1.4E-08	4.0E-09	NA	1.8E-08	2.4E-06	6.9E-07	NA	3.1E-06
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	1.2E-08	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	1.0E-07	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	1.2E-08	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	1.1E-09	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	1.8E-10	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	3.5E-08	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	5.2E-09	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.8E-07	1.8E-06	NA	2.1E-06	1.6E-03	1.5E-02	NA	1.7E-02
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	5.5E-05	3.1E-05	NA	8.6E-05
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	7.0E-02	4.0E-02	NA	1.1E-01
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	2.5E-05	1.4E-05	NA	3.9E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	2.3E-04	1.3E-04	NA	3.6E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	1.4E-04	8.0E-05	NA	2.2E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	4.5E-06	2.6E-06	NA	7.0E-06
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	1.4E-04	8.3E-05	NA	2.3E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	3.1E-06	1.8E-06	NA	4.9E-06
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	7.6E-07	1.5E-05	NA	1.6E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.1E-02	4.1E-02	NA	1.1E-01

TABLE 7-28

RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.8E-07	1.8E-06	NA	2.1E-06	7.3E-02	5.6E-02	NA	1.3E-01

TABLE 7-28

RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Treaspasser - Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	2.5E-03	5.1E-04	NA	3.0E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5E-03	5.1E-04	NA	3.0E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	2.5E-07	1.7E-06	NA	1.9E-06	3.6E-03	2.4E-02	NA	2.7E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	1.8E-08	3.7E-09	NA	2.1E-08	5.3E-06	1.1E-06	NA	6.3E-06
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	1.5E-08	NA	NA	1.5E-08	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	1.3E-07	NA	NA	1.3E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	1.5E-08	NA	NA	1.5E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	1.4E-09	NA	NA	1.4E-09	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	2.2E-10	NA	NA	2.2E-10	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	4.5E-08	NA	NA	4.5E-08	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	6.6E-09	NA	NA	6.6E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	4.8E-07	1.7E-06	NA	2.2E-06	3.6E-03	2.4E-02	NA	2.7E-02
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	1.2E-04	4.9E-05	NA	1.7E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	1.5E-01	6.3E-02	NA	2.2E-01
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	5.4E-05	2.2E-05	NA	7.6E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	5.0E-04	2.0E-04	NA	7.0E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	3.0E-04	1.3E-04	NA	4.3E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	9.8E-06	4.0E-06	NA	1.4E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	3.2E-04	1.3E-04	NA	4.5E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	6.8E-06	2.8E-06	NA	9.6E-06
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	1.7E-06	2.6E-05	NA	2.8E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5E-01	6.4E-02	NA	2.2E-01

TABLE 7-28

RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Treaspasser - Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.8E-07	1.7E-06	NA	2.2E-06	1.6E-01	8.8E-02	NA	2.5E-01

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RME -- CHEMICAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	6.7E-04	1.6E-04	NA	8.3E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.7E-04	1.6E-04	NA	8.3E-04
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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RME -- CHEMICAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.7E-04	1.6E-04	NA	8.3E-04

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RME -- CHEMICAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	1.0E-07	1.9E-07	3.1E-15	3.0E-07	1.6E-02	3.0E-02	NA	4.6E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.0E-07	1.9E-07	3.1E-15	3.0E-07	1.6E-02	3.0E-02	NA	4.6E-02
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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RME -- CHEMICAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.0E-07	1.9E-07	3.1E-15	3.0E-07	1.6E-02	3.0E-02	NA	4.6E-02

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RME -- CHEMICAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	5.9E-03	1.4E-03	NA	7.2E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9E-03	1.4E-03	NA	7.2E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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RME -- CHEMICAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9E-03	1.4E-03	NA	7.2E-03

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	1.5E-01	1.5E-03	NA	1.5E-01
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5E-01	1.5E-03	NA	1.5E-01
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	5.6E-07	4.1E-07	NA	9.7E-07	3.2E-02	9.7E-03	NA	4.2E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	3.9E-08	8.9E-10	NA	4.0E-08	4.7E-05	4.4E-07	NA	4.7E-05
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	3.4E-08	NA	NA	3.4E-08	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	2.8E-07	NA	NA	2.8E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	3.3E-08	NA	NA	3.3E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	3.2E-09	NA	NA	3.2E-09	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	5.0E-10	NA	NA	5.0E-10	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	1.0E-07	NA	NA	1.0E-07	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	1.5E-08	NA	NA	1.5E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.1E-06	4.1E-07	NA	1.5E-06	3.2E-02	9.7E-03	NA	4.2E-02
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	5.3E-04	4.7E-04	NA	1.0E-03
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	6.8E-01	6.0E-01	NA	1.3E+00
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	2.4E-04	2.1E-04	NA	4.5E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	2.2E-03	2.0E-03	NA	4.2E-03
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	1.4E-03	1.2E-03	NA	2.6E-03
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	4.3E-05	3.8E-05	NA	8.2E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	1.4E-03	1.2E-03	NA	2.7E-03
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	3.0E-05	2.7E-05	NA	5.7E-05
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	7.4E-06	1.8E-05	NA	2.5E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.9E-01	6.1E-01	NA	1.3E+00

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	1.5E-07	NA	NA	1.5E-07	2.4E-03	NA	NA	2.4E-03
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	4.19E-08	NA	NA	4.2E-08	1.45E-04	NA	NA	1.5E-04
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	1.9E-02	NA	NA	1.9E-02
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	8.8E-08	NA	NA	8.8E-08	5.8E-03	NA	NA	5.8E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.8E-07	NA	NA	2.8E-07	2.7E-02	NA	NA	2.7E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.4E-06	NA	NA	1.8E-06	9.0E-01	6.2E-01	NA	1.5E+00

TABLE 7-29

CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	2.8E-04	3.2E-05	NA	3.1E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8E-04	3.2E-05		3.1E-04
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	1.8E-08	6.8E-08	NA	8.6E-08	4.1E-04	1.5E-03	NA	1.9E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	1.3E-09	1.5E-10	NA	1.4E-09	6.0E-07	6.9E-08	NA	6.7E-07
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	1.1E-09	NA	NA	1.1E-09	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	9.3E-09	NA	NA	9.3E-09	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	1.1E-09	NA	NA	1.1E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	1.0E-10	NA	NA	1.0E-10	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	1.6E-11	NA	NA	1.6E-11	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	3.3E-09	NA	NA	3.3E-09	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	4.8E-10	NA	NA	4.8E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.5E-08	6.8E-08	NA	1.0E-07	4.1E-04	1.5E-03	NA	1.9E-03
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	2.7E-05	1.6E-05	NA	4.3E-05
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	3.5E-02	2.0E-02	NA	5.5E-02
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	1.2E-05	7.1E-06	NA	1.9E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	1.1E-04	6.5E-05	NA	1.8E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	7.0E-05	4.0E-05	NA	1.1E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	2.2E-06	1.3E-06	NA	3.5E-06
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	7.2E-05	4.2E-05	NA	1.1E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	1.5E-06	8.9E-07	NA	2.4E-06
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	3.8E-07	7.6E-06	NA	7.9E-06
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5E-02	2.0E-02	NA	5.6E-02

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.5E-08	6.8E-08	NA	1.0E-07	3.6E-02	2.2E-02	NA	5.8E-02

TABLE 7-29

CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA		6.2E-04	9.5E-06	NA	6.3E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.2E-04	9.5E-06	NA	6.3E-04
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	1.2E-08	3.1E-08	NA	4.3E-08	9.0E-04	2.4E-03	NA	3.3E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	8.1E-10	6.9E-11	NA	8.8E-10	1.3E-06	1.1E-07	NA	1.4E-06
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	6.9E-10	NA	NA	6.9E-10	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	5.8E-09	NA	NA	5.8E-09	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	6.8E-10	NA	NA	6.8E-10	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	6.5E-11	NA	NA	6.5E-11	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	1.0E-11	NA	NA	1.0E-11	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	2.0E-09	NA	NA	2.0E-09	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	3.0E-10	NA	NA	3.0E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.2E-08	3.1E-08	NA	5.3E-08	9.0E-04	2.4E-03	NA	3.3E-03
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	6.0E-05	2.5E-05	NA	8.5E-05
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	7.6E-02	3.2E-02	NA	1.1E-01
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	2.7E-05	1.1E-05	NA	3.8E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	2.5E-04	1.1E-04	NA	3.5E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	1.5E-04	6.5E-05	NA	2.2E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	4.9E-06	2.1E-06	NA	6.9E-06
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	1.6E-04	6.7E-05	NA	2.3E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	3.4E-06	1.4E-06	NA	4.8E-06
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	8.3E-07	1.3E-05	NA	1.4E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.7E-02	3.3E-02	NA	1.1E-01

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.2E-08	3.1E-08	NA	5.3E-08	7.9E-02	3.5E-02	NA	1.1E-01

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA		2.8E-04	3.2E-05	NA	3.1E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8E-04	3.2E-05	NA	3.1E-04
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.8E-04	3.2E-05	NA	3.1E-04

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CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	6.2E-09	9.7E-09	7.8E-16	1.6E-08	1.9E-03	3.0E-03	NA	5.0E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	6.2E-09	9.7E-09	7.8E-16	1.6E-08	1.9E-03	3.0E-03	NA	5.0E-03
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-29

CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
PAGE 10 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	6.2E-09	9.7E-09	7.8E-16	1.6E-08	1.9E-03	3.0E-03	NA	5.0E-03

TABLE 7-29

CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
PAGE 11 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SURFACE SOIL															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	4.8	NA	NA	NA	NA	5.9E-03	2.7E-04	NA	6.1E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9E-03	2.7E-04	NA	6.1E-03
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	8.4	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	5.23	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.128	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	640	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	540	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	630	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	610	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	950	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	–	–	–	7.30E+00	1.46E+01	3.10E+00	190	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	–	–	–	7.30E-01	1.46E+00	3.10E-01	280	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	447	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	229	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	14.1	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	556	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.342	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	21.9	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	8.3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	7.59	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Naphthalene	4.00E-02	2.00E-02	–	–	–	–	0.25	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-29

CTE--CHEMCIAL SPECIFIC RISKS AT IR 7
NAS KEY WEST
PAGE 12 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalatio	Total	Ingestion	Dermal	Inhalation	Total
SHELLFISH-- CRAB[5]															
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00076	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	5.00E-04	–	–	4.50E+00	–	–	0.00078	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Inorganics															
Mercury	3.00E-04	–	–	–	–	–	0.06	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00081	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.9E-03	2.7E-04	NA	6.1E-03

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

7.7 ECOLOGICAL RISK ASSESSMENT

This section presents the results of the ecological risk assessment performed at IR 7 including a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

7.7.1 Problem Formulation

This section presents the problem formulation including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

7.7.1.1 Habitat Types and Ecological Receptors

Section 7.1 (See Figure 7-13) describes the physical setting at IR 7. The site consists of the USDA Animal Import Center and surrounding grounds, a wooded area to the west of this facility, and shorelines along the east and west sides of Fleming Key. Terrestrial habitat over much of the site consists of turf grass and weedy areas. Wooded portions of the site are dominated by Australia pine and Brazilian pepper. A narrow strip of black mangrove is located along the west shoreline. The east shoreline is rocky, with turf grass extending down to the high tide line. Terrestrial receptors at IR 7 include various invertebrates, reptiles, birds, and mammals such as raccoons, opossums, and possibly cotton rats (*Sigmodon hispidus*), as well as exotic rodents such as the black rat (*Rattus rattus*) and house mouse (*Mus musculus*). There is no fresh water at the site.

Aquatic habitat along both the east and west shorelines of IR 7 is dominated by vast expanses of turtle grass, with manatee grass (*Syringodium filiforme*) and shoal grass (*Halodule wrightii*) present in some areas. Numerous fish were observed near both shorelines during sampling activities of August through October 1996. Other aquatic animal life included spiny lobster, queen conch, stone crab (*Menippe mercenaria*), spiny spider crab (*Mithrax spinosissimus*), and loggerhead sponge (*Spheciospongia vesparium*). Lobster, stone crab, spiny spider crab, and turtle grass were collected from the nearshore vicinity of the site for tissue analysis.

Based on water quality measurements and the richness and diversity of aquatic life observed, the nearshore waters at the site are of excellent quality. DO levels were relatively high, ranging from 4.99 mg/L to 12.39 mg/L (Appendix C, Table C.1-3). Water clarity (as indicated by turbidity) was high (0 to 4 NTUs), suggesting that the water is low in suspended matter (silt, fine particulate organic matter, microscopic organisms) and high in light transmissivity. Salinity values ranged from 32.4 to 37.1 ppt, and

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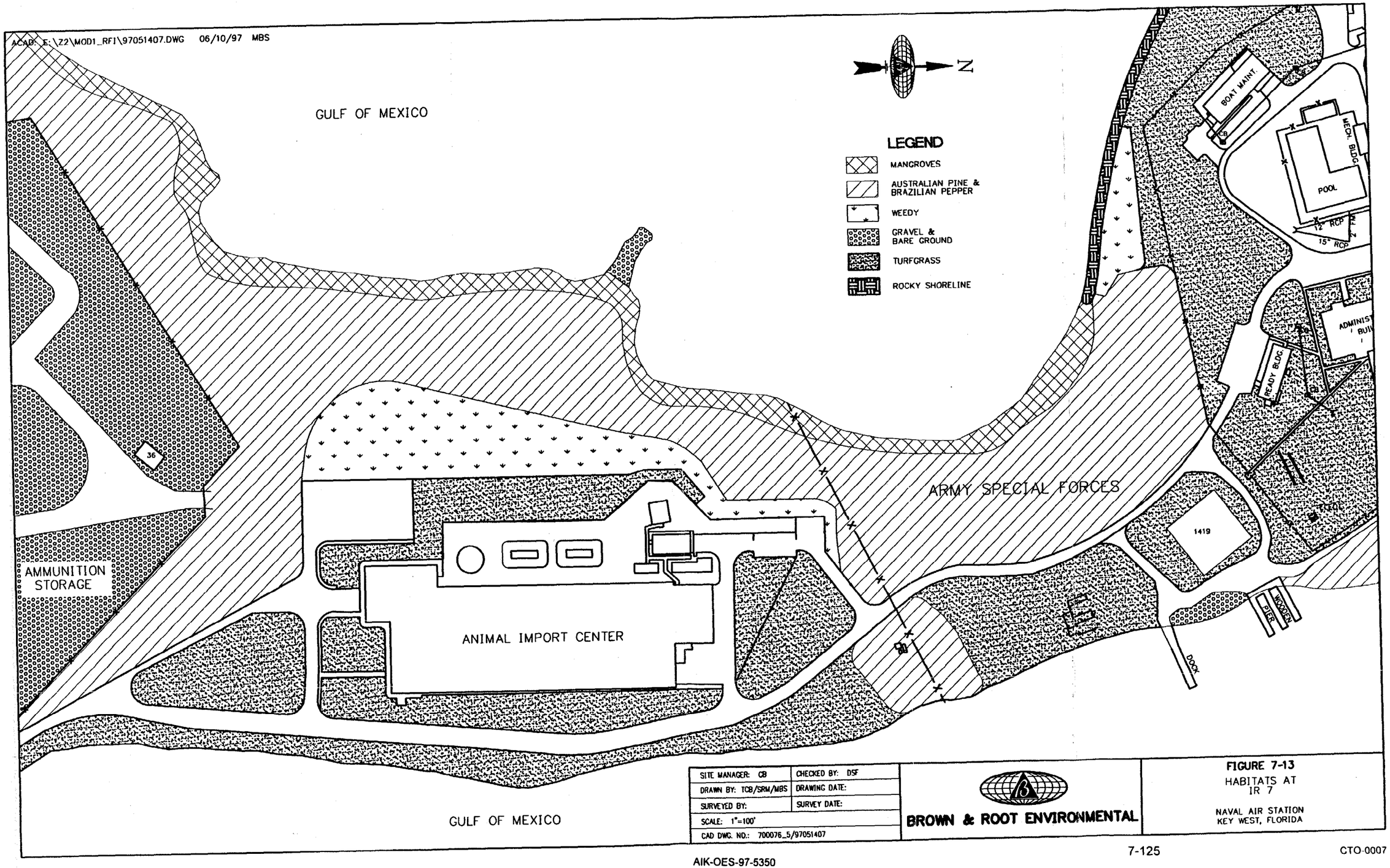
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GULF OF MEXICO
N
LEGEND
MANGROVES
AUSTRALIAN PINE & BRAZILIAN PEPPER
WEEDY
GRAVEL & BARE GROUND
TURFGRASS
ROCKY SHORELINE
BOAT MAINT.
MECH. BLDG.
POOL
12" RCP
15" RCP
ADMINIST. BUIL.
READY BLDG.
ARMY SPECIAL FORCES
1419
PIER
WOODEN
DOCK
36
AMMUNITION STORAGE
ANIMAL IMPORT CENTER
GULF OF MEXICO
SITE MANAGER: CB
CHECKED BY: DSF
DRAWN BY: TCB/SRM/MBS
DRAWING DATE:
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SURVEY DATE:
SCALE: 1"=100'
CAD DWG. NO.: 700076_5/97051407
BROWN & ROOT ENVIRONMENTAL
FIGURE 7-13
HABITATS AT IR 7
NAVAL AIR STATION KEY WEST, FLORIDA

010F367

are assumed to vary with salinities in this part of the Gulf of Mexico. Temperatures ranged from 28.3 to 31°C (82.9 and 87.8°F, respectively) and would also be moderated by seasonal patterns of water temperature in the Gulf.

Ecological receptors listed as threatened, endangered, or of special concern that could potentially be exposed to site-related contamination are limited primarily to piscivorous birds such as the little blue heron, snowy egret, tricolored heron, brown pelican, and osprey, which are all state listed as SSC. Ospreys were observed near the site during August to October sampling activities, and ospreys nests are located approximately 1,300 feet north and 2,600 feet south of the site (IT Corporation, 1994). Indigo snakes (state and federally listed as threatened) and red rat snakes (state listed as SSC) could potentially inhabit some on-site areas. The white-crowned pigeon (state listed as threatened) could occasionally forage on the site. The Lower Keys marsh rabbit is not known to exist on Fleming Key, and there are no sandy beaches favored as nesting habitat for sea turtles on the island. There are no known eagle nests on or near Fleming Key, but bald eagles could occasionally forage in nearshore waters.

7.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways is presented in Section 7.5.2.

7.7.1.3 Exposure Routes

Terrestrial animals at IR 7 can be exposed to soil contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation. Aerial deposition could have been a significant exposure route during historical landfill activities. However, aerial deposition is presently minimal. Terrestrial receptors can also come into contact with contaminants in surface water by using it for drinking, although this exposure route generally represents a negligible portion of total exposure for most receptors. In addition, the high salt content of the adjacent marine waters precludes the use of the water for drinking, and no freshwater resources exist on the site. Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue. Volatile constituents could be present in some site soils and soil-bound contaminant airborne suspension could occur at IR 7. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are

quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors.

Aquatic and semi-aquatic organisms utilizing the open water adjacent to IR 7 can be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semi-aquatic organisms can also be exposed to constituents in contaminated groundwater that discharges into surface water.

7.7.1.4 Selection of Ecological Chemicals of Potential Concern

Calcium, magnesium, potassium, and sodium were excluded as ecological COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water and groundwater. Otherwise, analytes selected for evaluation consisted of all analytes detected during current and previous sampling of surface water, sediment, and surface soil at IR 7. Groundwater analytes selected for evaluation consisted of analytes detected during current sampling of the monitoring wells nearest to the shoreline (I7MW7-3 and I7KWM-12 near the western shoreline and I7MW-1, I7MW7-2, and I7MW7-10 near the eastern shoreline). Inorganic contaminants in groundwater, surface water, sediment, and surface soil whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

7.7.1.5 Assessment and Measurement Endpoints

A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3.1.1.5 of Appendix C.

7.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 7-14 shows the conceptual model for IR 7. The figure shows complete exposure routes for wind erosion and volatile emission pathways. However, since most of the site is heavily vegetated, the wind erosion and volatile emission pathways are possible only to a small extent.

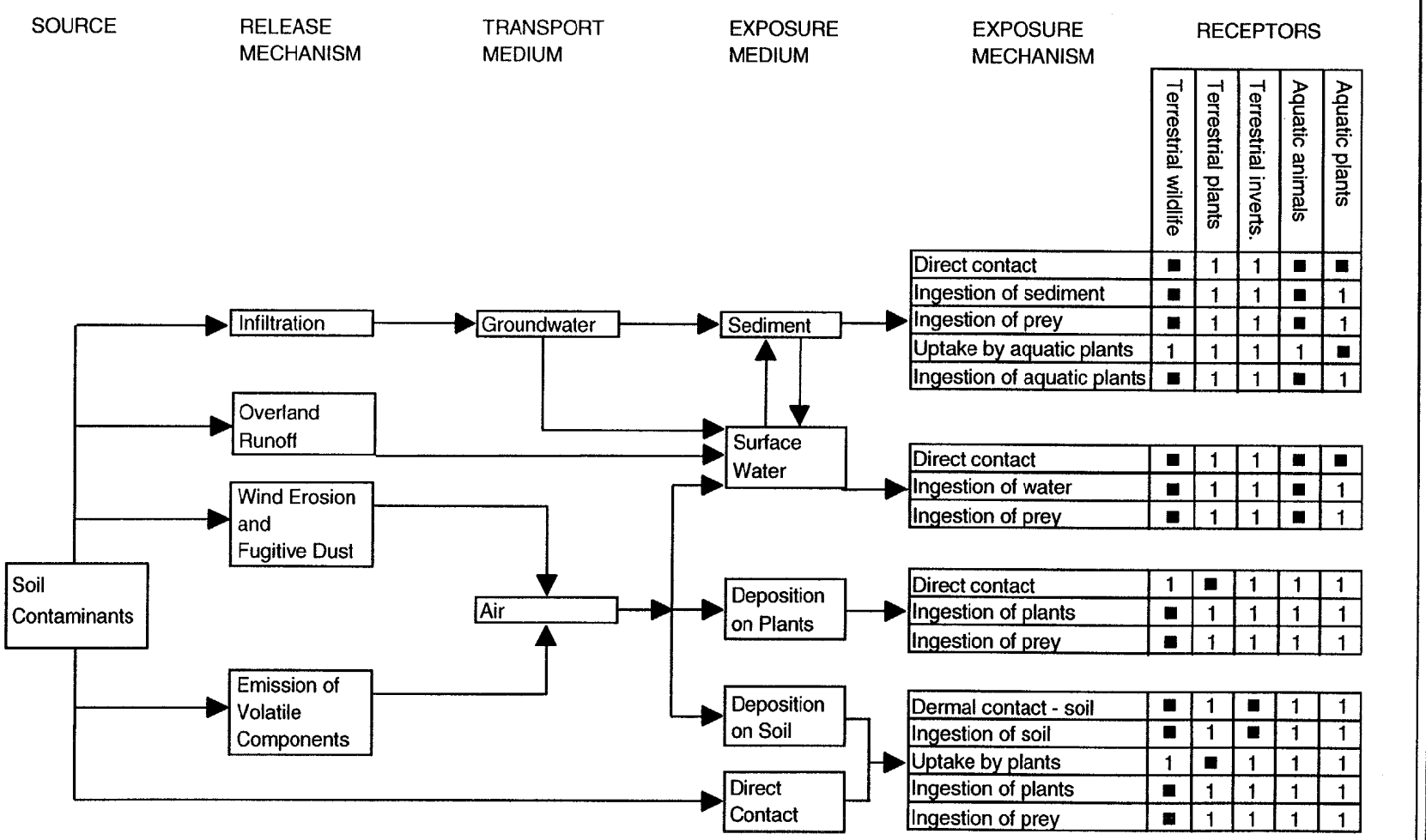

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Figure 7-14. Conceptual Site Model - IR 7, NAS Key West, Fleming Key, Florida

7.7.2 Ecological Effects Characterization

Ecologically-based thresholds (e.g., concentrations of contaminants in various media protective of ecological receptors) were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at IR 7. Brief descriptions of each COPC are included in Appendix B Part 3. Groundwater contaminant concentrations were compared to surface-water thresholds for saltwater. Terrestrial plant thresholds were obtained to assess potential risks to plants from soil contaminants. Contaminant intake doses for the cotton rat, raccoon, and kestrel were modeled, and estimated doses were compared to TRVs, which are doses above which potential risks might be present (example doses and TRVs are provided in Appendix B, Part 4). Groundwater, surface-water, sediment, terrestrial plant, and surface soil thresholds, as well as TRVs used in food-chain modeling, are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Lobster, stone crab, spiny spider crab, and turtle grass were collected from the nearshore vicinity of the site for tissue analysis. Tissue samples were analyzed for pesticides, PCBs, and metals. Concentrations of analytes detected in tissues were compared to concentrations in tissues collected at background sites. Maximum and mean contaminant concentrations in crab samples were used to estimate doses to the raccoon.

7.7.3 Exposure Assessment

This section presents the ecological exposure assessment for IR 7 and includes a discussion of exposure point contaminant concentrations and dose calculations.

7.7.3.1 Exposure Point Contaminant Concentrations

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil were used as representative exposure point concentrations for screening against threshold values. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.

7.7.3.2 Dose Calculations

The potential risks to ecological receptors resulting from exposure to IR 7-related contaminants were also evaluated by estimating the total contaminant dose that representative organisms inhabiting the site might receive for each contaminant and comparing those doses to TRVs, which are doses above which adverse

effects might occur. The cotton rat, raccoon, and kestrel were selected as representative terrestrial receptors for foodchain modeling at IR 7. Due to the absence of shallow surface water at the site, modeling of potential risks to piscivorous birds was not conducted. Section 3.3.2.1.2 of Appendix C provides a detailed description of dose calculations and exposure parameters used for the foodchain modeling.

7.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at IR 7.

7.7.4.1 Results

The results of the ecological risk characterization at IR 7 are presented in this section, which includes a discussion of the results from the Phase I and Phase II ecological screening assessments, foodchain modeling for selected receptors, and tissue analyses.

7.7.4.1.1 Phase I

The Phase I ecological risk assessment for IR 7 conducted by IT Corporation (1994) identified antimony, copper, lead, manganese, mercury, nickel, thallium, vanadium, 4,4'-DDD, 4,4'-DDT as groundwater COCs. Cadmium, manganese, mercury, silver, and beta-BHC were sediment COCs. The assessment concluded that the greatest potential risk to aquatic organisms from inorganics is through direct contact via groundwater discharges, and to a much lesser extent, sediment. Antimony was the only surface-water inorganic COC. Arsenic, cadmium, chromium, copper, lead, mercury, silver, vanadium, acenapthylene, benzo(k)fluoranthene, fluoranthene, fluorene, beta-BHC, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were considered to be capable of bioaccumulating sufficiently in fish to pose risks to piscivores. In soils, antimony, chromium, vanadium, zinc, and 4,4'-DDT were identified as COCs. Zinc and 4,4'-DDT in vegetation was considered to pose potential risks to terrestrial receptors that forage on plants. The Phase I ecological screening assessment concluded that surface and subsurface soil contamination had been adequately characterized, and recommended no further soil sampling (IT Corporation, 1994). EPA and FDEP concurred with this recommendation (IT Corporation, 1994; Responses to General and Specific Comments), and no further soil samples were collected during current sampling. The overall conclusion of the Phase I assessment was that groundwater was the most heavily impacted medium at IR 7 and that contaminants in groundwater and sediment pose moderate to high potential risks to ecological receptors at the site. Furthermore, additional ecological investigations to more fully characterize ecological risks were warranted (IT Corporation, 1994).

7.7.4.1.2 Phase II - Ecological Screening Assessment

Iron, lead, and zinc were retained as groundwater COPCs since their maximum concentrations exceeded ecological thresholds and twice their average background concentrations (Table 7-30). Nickel was retained as groundwater COPC since its maximum detected concentration exceeded its threshold and it was not detected in background samples. Organic compounds that exceeded thresholds and were retained as COPCs consisted of the pesticides aldrin, dieldrin, delta-BHC, gamma-BHC (lindane), 4,4'-DDD, 4,4'-DDT, endosulfan I, endosulfan sulfate, heptachlor, and endrin.

Copper and iron were retained as COPCs in IR 7 surface water since their maximum concentrations exceeded twice their average background concentrations and thresholds (Table 7-31). Cyanide and lead were not detected in background and their maximum concentrations in groundwater exceeded threshold values (Table 7-31). Cyanide was retained as a sediment COPC since it was not detected in background but was detected at a maximum concentration in excess of the only threshold available (Table 7-32). Arsenic, cadmium, copper, lead, and mercury were retained as sediment COPCs since their maximum concentrations exceeded two times average background and the most conservative thresholds but did not exceed less conservative thresholds used in this ERA. Silver was retained as a sediment COPC since its maximum concentration exceeded two times average background and both thresholds. Beryllium and tin were conservatively retained as sediment COPCs since their maximum concentrations exceeded two times their average background concentrations but no thresholds were available. Numerous organic compounds were retained as sediment COPCs because their maximum concentrations exceeded the only threshold available, exceeded the most conservative threshold, or exceeded both most and less conservative thresholds used in the assessment. These included several pesticides, the PCB mixture Aroclor-1260, and several semivolatiles (mainly PAHs).

Mercury was retained as a COPC in IR 7 surface soils since its maximum detected concentration exceeded twice its average background concentration and threshold value (Table 7-33). Antimony was conservatively retained as a surface soil COPC since its maximum exceeded two times average background and no threshold was available. Six organic compounds were retained as COPCs in IR 7 surface soils. The pesticides 4,4'-DDD and 4,4'-DDT exceeded thresholds, and the other four compounds were conservatively retained as COPCs due to the absence of suitable thresholds. These consisted of bis(2-ethylhexyl)phthalate, 4-methyl-2-pentanone, acetone, and vinyl acetate. For terrestrial plants, the inorganics lead, mercury, and zinc were retained as COPCs since their maximum concentrations in soil exceeded two times average background and thresholds (Table 7-34). Four pesticides, five volatile compounds, and one phthalate compound were conservatively retained as terrestrial plant COPCs since no suitable thresholds were available.

TABLE 7-30

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER (µg/L) - IR 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	2/5	ND	3.6 - 16.2	4,300	0.00	Eliminated - does not exceed threshold
Arsenic	1/5	4.54	47	50	0.94	Eliminated - does not exceed threshold
Barium	5/5	10.2	35.2 - 52.6	10,000	0.00	Eliminated - does not exceed threshold
Iron	3/5	41.72	18.3 - 1,400	300	4.67	Retained - exceeds 2 X background and HQ > 1
Lead	1/5	1.39	35.3	5.6	6.30	Retained - exceeds 2 X background and HQ > 1
Manganese	1/5	3.78	4.5	10	0.45	Eliminated - does not exceed 2 X background
Mercury	3/5	0.1	0.11 - 0.12	0.025	4.60	Eliminated - does not exceed 2 X background
Nickel	2/5	ND	8.1 - 29.3	8.2	3.57	Retained - HQ > 1
Zinc	2/5	2.82	107 - 120	86	1.24	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs						
4,4'-DDD	1/5	ND	0.029	0.025	1.16	Retained - HQ > 1
4,4'-DDE	1/5	ND	0.028	0.14	0.2	Eliminated - does not exceed threshold
4,4'-DDT	1/5	ND	0.026	0.0006	43.3	Retained - HQ > 1
Aldrin	2/5	ND	0.012 - 0.016	0.00014	114.29	Retained - HQ > 1
alpha-BHC	3/5	ND	0.016 - 0.1	1,400	0.00	Eliminated - does not exceed threshold
delta-BHC	3/5	ND	0.016 - 0.019	0.016	1.06	Retained - HQ > 1
Endosulfan I	4/5	ND	0.012 - 0.019	0.0087	2.18	Retained - HQ > 1
Endosulfan sulfate	1/5	ND	0.05	0.0087	5.86	Retained - HQ > 1
Dieldrin	5/5	ND	0.025 - 0.03	0.00014	203.57	Retained - HQ > 1
gamma-BHC (lindane)	4/5	ND	0.016 - 1.1	0.016	66.56	Retained - HQ > 1
Heptachlor	2/5	ND	0.011 - 0.012	0.00021	57.14	Retained - HQ > 1
Endrin	2/5	ND	0.022 - 0.025	0.0023	10.65	Retained - HQ > 1

ND = Not detected.

7.7.4.1.3 Tissue Analysis

The inorganics aluminum, arsenic, barium, cadmium, copper, manganese, mercury, vanadium, silver, and zinc were detected in crabs collected near IR 7 (Table 7-35). The same inorganics (except vanadium) were detected in lobsters collected from the same locations (Table 7-36). Several organochlorine pesticides and their metabolites were detected in crabs and lobsters. Aluminum, barium, chromium, lead, manganese, mercury, and zinc were detected in turtle grass, as were several organochlorine pesticides and their metabolites (Table 7-37).

7.7.4.1.4 Foodchain Modeling

Aluminum, antimony, arsenic, zinc, and copper were the major contributors to potential risks to the cotton rat at IR 7 for both the maximum and mean contaminant concentration exposure scenarios (Tables 7-38 and 7-39). Total HI values for the maximum and mean exposure scenarios were 1.45 and 0.92, respectively. Ingestion of contaminated food accounted for the slight majority of contaminant exposure for the maximum contaminant scenario and ingestion of contaminated soil accounted for the majority of contaminant exposure for the mean scenario. For the kestrel, 4,4'-DDT, zinc, mercury, 4,4'-DDE, and antimony were the major contributors to potential risk using maximum contaminant concentrations and 4,4'-DDT, zinc, mercury, 4,4'-DDE, and 4,4'-DDD were the major contributors to potential risks using mean contaminant concentrations (Tables 7-40 and 7-41). Total HI values for the maximum and mean exposure scenarios were 3.73 and 2.05, respectively. Since ingestion of soil and water were not considered in the model for this raptor, ingestion of contaminated prey accounted for 100 percent of total contaminant exposure. Beta-BHC was the only contributor of risk to the raccoon for the maximum contaminant scenario, and the total HI was only 0.06 (Table 7-42). The total HI for the mean contaminant scenario was 0.01 (Table 7-43).

7.7.4.2 Discussion

HQ values for the four inorganic COPCs in groundwater (nickel, iron, lead, and zinc) were indicative of potential risks. Nickel was detected in 2 of 5 groundwater samples in 1996 and was not detected in surface water or sediment. Zinc was not elevated (and was not a COPC) in surface water or sediment. Iron was not elevated in sediment relative to background (Appendix H Part 3), and its HQ in surface water was relatively low (HQ=1.9). Lead was detected in only 1 of 10 surface-water samples; its concentrations in sediment exceeded the most conservative threshold in only 3 of 24 samples (HQ = 1.4 in sediment),

TABLE 7-31

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L) - IR 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						
Aluminum	1/2	24.97	447	1,500	0.30	Eliminated - does not exceed threshold
Antimony	9/10	33.71	148 - 229	4,300	0.05	Eliminated - does not exceed threshold
Barium	10/10	6.93	3.6 - 42.9	10,000	0.0004	Eliminated - does not exceed 2 X background
Copper	1/10	2.26	42.5	2.4	17.7	Retained - exceeds 2 X background and HQ > 1
Cyanide	1/2	ND	430	1	430	Retained - HQ > 1
Iron	2/2	24.70	8 - 556	300	1.9	Retained - exceeds 2 X background and HQ > 1
Lead	1/10	ND	72.2	5.6	12.9	Retained - HQ > 1
Mercury	5/10	0.52	0.21 - 0.63	0.025	25.2	Eliminated - does not exceed 2 X background
Tin	1/8	ND	34.7	73	0.5	Eliminated - does not exceed threshold
Zinc	7/10	7.19	5 - 8.2	86	0.095	Eliminated - does not exceed 2 X background
SEMIVOLATILE ORGANIC COMPOUNDS						
Naphthalene	1/10	ND	0.25	24	0.01	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 7-32

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 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 Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	16/16	1331.89	224.5 - 1,010	NA	-	Eliminated - does not exceed 2 X background
Arsenic	20/24	2.63	0.66 - 9.7	7.24/70	1.3/0.1	Retained - exceeds 2 X background and HQ > 1
Barium	24/24	9.27	3.4 - 16.8	40	0.4	Eliminated - does not exceed 2 X background
Beryllium	3/24	0.06	0.16 - 0.24	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	2/24	0.22	1.1	0.676/9.6	1.6/0.1	Retained - exceeds 2 X background and HQ > 1
Chromium	16/24	5.01	3.3 - 8.7	52.3	0.2	Eliminated - does not exceed 2 X background
Cobalt	1/24	0.47	0.35	50	0.007	Eliminated - does not exceed 2 X background
Copper	24/24	8.88	2.4 - 115	18.7/270	6.1/0.4	Retained - exceeds 2 X background and HQ > 1
Cyanide	1/14	ND	23	0.1	230.0	Retained - HQ > 1
Lead	23/24	17.97	4.6 - 42.2	30.2/218	1.4/0.2	Retained - exceeds 2 X background and HQ > 1
Manganese	16/16	15.39	3.2 - 292	460	0.06	Eliminated - does not exceed 2 X background
Mercury	16/24	0.05	0.02 - 0.14	0.13/0.71	1.1/0.2	Retained - exceeds 2 X background and HQ > 1
Nickel	10/24	2.15	1.1 - 3.8	15.9	0.2	Eliminated - does not exceed 2 X background
Silver	3/24	0.27	2.8 - 7	0.733/3.7	9.5/1.9	Retained - exceeds 2 X background and HQ > 1
Tin	1/9	2.85	9.5	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	17/24	5.08	1.9 - 6.5	NA	-	Eliminated - does not exceed 2 X background
Zinc	15/24	25.74	5.0 - 58.6	124/410	0.5	Eliminated - does not exceed threshold
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	4/16	13.0	1.6 - 4.5	1.22/7.81	3.7/0.6	Retained - HQ > 1
4,4'-DDE	5/16	19.82	1.6 - 23.2	2.07/27	11.2/0.9	Retained - HQ > 1
4,4'-DDT	4/16	13.02	7.9 - 32.1	1.19/4.77	27.0/6.8	Retained - HQ > 1
alpha-BHC	1/16	7.11	2.2	6	0.4	Eliminated - does not exceed threshold

TABLE 7-32

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 7
NAS KEY WEST
PAGE 2 OF 3

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
PESTICIDES/PCBs (µg/kg) (continued)						
Aroclor-1254	1/16	ND	47	60/340	0.8	Eliminated - does not exceed threshold
Aroclor-1260	1/16	70.57	146	5/240	29.2/0.6	Retained - HQ > 1
beta-BHC	1/16	ND	170	5	34.0	Retained - HQ > 1
delta-BHC	1/16	7.35	1.5	3	0.5	Eliminated - does not exceed threshold
gamma-BHC (lindane)	4/16	6.72	1.2 - 2	0.32/0.99	6.3/2.0	Retained - HQ > 1
Dieldrin	1/16	ND	20.8	0.715/95	29.1/0.2	Retained - HQ > 1
Endosulfan I	3/16	6.7	2.4 - 10.7	2.9	3.7	Retained - HQ > 1
Endosulfan sulfate	1/16	ND	10.6	5.4	2.0	Retained - HQ > 1
Endrin	1/16	12.89	13.6	3.3/3.5	4.1/3.9	Retained - HQ > 1
Endrin aldehyde	1/10	ND	0.64	3.3/3.5	0.2	Eliminated - does not exceed threshold
Heptachlor	2/16	6.51	0.56 - 11	4.9	2.2	Retained - HQ > 1
Heptachlor epoxide	1/16	ND	1.5	5/50	0.3	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Acenaphthene	1/14	ND	300	6.71/500	44.7/0.6	Retained - HQ > 1
Anthracene	1/14	ND	140	46.9/245	3.0/0.6	Retained - HQ > 1
Benzo(a)anthracene	1/14	ND	640	74.8/1,600	8.6/0.4	Retained - HQ > 1
Benzo(a)pyrene	1/14	ND	540	88.8/1,600	6.1/0.3	Retained - HQ > 1
Benzo(b)fluoranthene	1/14	966.92	630	655	0.96	Eliminated - does not exceed threshold
Benzo(g,h,i)perylene	1/14	ND	310	655	0.47	Eliminated - does not exceed threshold
Benzo(k)fluoranthene	1/14	ND	610	655	0.93	Eliminated - does not exceed threshold
Bis(2-ethylhexyl)phthalate	5/6	1992.17	260 - 570	128/2,647	0.2	Retained - HQ > 1
Chrysene	1/14	961.38	950	108/2,800	8.8/0.3	Retained - HQ > 1
Dibenzo(a,h)anthracene	1/14	ND	190	6.22/260	30.5/0.7	Retained - HQ > 1

TABLE 7-32

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 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 Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg) (continued)						
Dibenzofuran	1/6	ND	170	540	0.3	Eliminated - does not exceed threshold
Fluoranthene	1/14	982.38	1,900	113/5,100	16.8/0.4	Retained - HQ > 1
Fluorene	1/14	ND	180	21.2/144	8.5/1.2	Retained - HQ > 1
Ideno(1,2,3-cd)pyrene	1/14	ND	280	655/9,600	0.4	Eliminated - does not exceed threshold
Naphthalene	1/14	ND	120	34.6/391	3.5/0.3	Retained - HQ > 1
Phenanthrene	3/14	ND	32 - 2,100	86.7/1,100	24.2/1.9	Retained - HQ > 1
Pyrene	3/14	968.46	42 - 1,700	153/2,600	11.1/0.7	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
Acetone	2/6	30.9	23 - 51	64	0.8	Eliminated - does not exceed threshold
Methylene chloride	6/14	7.5	3 - 36	427	0.08	Eliminated - does not exceed threshold

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

TABLE 7-33

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - IR 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	2/2	1887.29	547 - 599	600	1.0	Eliminated - does not exceed 2 X background
Antimony	1/1	0.39	4.80	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Arsenic	2/2	1.29	1.4 - 1.6	60	0.03	Eliminated - does not exceed 2 X background
Barium	2/2	10.51	5.60	440	0.01	Eliminated - does not exceed 2 X background
Chromium	2/2	6.02	4.5 - 8.6	0.4	21.5	Eliminated - does not exceed 2 X background
Copper	2/2	5.43	9.3 - 24	50	0.5	Eliminated - does not exceed threshold
Lead	2/2	15.66	18.7 - 73.5	500	0.1	Eliminated - does not exceed threshold
Manganese	2/2	17.65	16.1 - 23.8	100	0.2	Eliminated - does not exceed 2 X background
Mercury	1/1	0.03	0.31	0.1	3.1	Retained - exceeds 2 X background and HQ > 1
Nickel	2/2	1.67	3.1 - 3.6	200	0.02	Eliminated - does not exceed threshold
Vanadium	2/2	3.97	1.9 - 2.9	20	0.2	Eliminated - does not exceed 2 X background
Zinc	2/2	15.22	21.7 - 90.3	200	0.5	Eliminated - does not exceed threshold
PESTICIDES (µg/kg)						
4,4'-DDD	1/1	22.46	160	100	1.6	Retained - HQ > 1
4,4'-DDE	1/2	63.23	40	100	0.4	Eliminated - does not exceed threshold
4,4'-DDT	2/2	46.78	35 - 1,900	100	19.0	Retained - HQ > 1
beta-BHC	1/1	ND	59	100	0.6	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Bis(2-ethylhexyl)phthalate	1/2	470.55	290	NA	-	Retained - no suitable threshold available
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
1,2-dichloroethene	2/2	ND	3	300	0.01	Eliminated - does not exceed threshold
4-methyl-2-pentanone	1/1	ND	0.3	NA	-	Retained - no suitable threshold available
Acetone	1/1	3.67	15	NA	-	Retained - no suitable threshold available
Methylene chloride	2/2	2.8	17 - 69	300	0.2	Eliminated - does not exceed threshold

TABLE 7-33

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - IR 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)
VOLATILE ORGANIC COMPOUNDS (µg/kg) (continued)						
Toluene	1/1	1.62	1	100	0.01	Eliminated - does not exceed threshold
Vinyl acetate	1/1	ND	0.4	NA	-	Retained - no suitable threshold available

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

TABLE 7-34

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - IR 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	2/2	1887.29	547 - 599	50	12.0	Eliminated - does not exceed 2 X background
Antimony	1/1	0.39	4.80	5	0.96	Eliminated - does not exceed threshold
Arsenic	2/2	1.29	1.4 - 1.6	10	0.16	Eliminated - does not exceed 2 X background
Barium	2/2	10.51	5.60	500	0.011	Eliminated - does not exceed 2 X background
Chromium	2/2	6.02	4.5 - 8.6	1	8.6	Eliminated - does not exceed 2 X background
Copper	2/2	5.43	9.3 - 24	100	0.24	Eliminated - does not exceed threshold
Lead	2/2	15.66	18.7 - 73.5	50	1.47	Retained - exceeds 2 X background and HQ > 1
Manganese	2/2	17.65	16.1 - 23.8	500	0.05	Eliminated - does not exceed 2 X background
Mercury	1/1	0.03	0.31	0.3	1.03	Retained - exceeds 2 X background and HQ > 1
Nickel	2/2	1.67	3.1 - 3.6	30	0.12	Eliminated - does not exceed threshold
Vanadium	2/2	3.97	1.9 - 2.9	2	1.45	Eliminated - does not exceed 2 X background
Zinc	2/2	15.22	21.7 - 90.3	50	1.81	Retained - exceeds 2 X background and HQ > 1
PESTICIDES (µg/kg)						
4,4'-DDD	1/1	22.46	160.00	NA	-	Retained - no suitable threshold available
4,4'-DDE	1/2	63.23	40.00	NA	-	Retained - no suitable threshold available
4,4'-DDT	2/2	46.78	35 - 1900	NA	-	Retained - no suitable threshold available
beta-BHC	1/1	ND	59.00	NA	-	Retained - no suitable threshold available
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Bis(2-ethylhexyl)phthalate	1/2	470.55	290.00	NA	-	Retained - no suitable threshold available

TABLE 7-34

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - IR 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)
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
1,2-dichloroethene	2/2	ND	3.00	NA	-	Retained - no suitable threshold available
4-methyl-2-pentanone	1/1	ND	0.30	NA	-	Retained - no suitable threshold available
Acetone	1/1	3.67	15.00	NA	-	Retained - no suitable threshold available
Methylene chloride	2/2	2.8	17 - 69	NA	-	Retained - no suitable threshold available
Toluene	1/1	1.62	1.00	200	0.005	Eliminated - does not exceed threshold
Vinyl acetate	1/1	ND	0.40	NA	-	Retained - no suitable threshold available

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

TABLE 7-35

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CRABS FROM IR 7 AND BACKGROUND SITES, NAS KEY WEST
PAGE 1 OF 2

	IR 7			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum						
Spiny Spider Crab	1/2	6.20	3.58	0/4		
Arsenic						
Spiny Spider Crab	2/2	4.50-5.30	4.90	3/4	4.10-7.70	4.69
Stone Crab	2/2	11.70-22.70	17.20	10/10	6.70-31.00	20.07
Barium						
Spiny Spider Crab	1/2	5.00	3.13	3/4	2.00-2.50	1.93
Stone Crab	1/2	1.60	0.99	4/10	1.10-3.50	0.85
Cadmium						
Stone Crab	1/2	0.69	0.50	3/4	1.10-2.50	1.44
Copper						
Spiny Spider Crab	2/2	7.70-10.90	9.30	3/4	6.00-9.50	6.63
Stone Crab	2/2	17.00-39.40	28.20	10/10	5.50-60.50	26.25
Manganese						
Spiny Spider Crab	1/2	2.60	1.85	3/4	1.40-3.60	1.91
Stone Crab	1/2	1.80	1.09	9/10	0.36-2.30	1.12
Mercury						
Spiny Spider Crab	1/2	0.02	0.02	0/4		
Stone Crab	2/2	0.06-0.14	0.10	7/10	0.04-0.17	0.08
Vanadium						
Spiny Spider Crab	1/2	0.88	0.66	0/4		
Silver						
Stone Crab	1/2	0.26	0.21	6/10	0.27-0.92	0.41
Zinc						
Spiny Spider Crab	2/2	7.10-11.10	9.10	4/4	8.50-12.80	10.78
Stone Crab	2/2	17.70-66.80	42.25	10/10	9.00-58.00	43.85
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD						
Stone Crab	2/2	0.16-0.61	0.39	8/10	0.41-1.60	1.02
4,4'-DDT						
Spiny Spider Crab	1/2	0.46	1.03	2/4	0.68-1.60	1.40
Stone Crab	2/2	0.16-1.10	0.63	2/10	0.48-0.71	1.44
Aldrin						
Stone Crab	1/2	0.65	0.75	7/10	0.13-3.40	0.75
delta-BHC						
Spiny Spider Crab	1/2	0.08	0.46	1/4	0.35	0.73
Stone Crab	1/2	0.07	0.46	0/10		
gamma-BHC (lindane)						
Spiny Spider Crab	1/2	0.17	0.51	1/4	0.69	0.81
Chlorobenzilate						
Stone Crab	1/2	5.80	7.15	7/10	4.40-140.00	31.03
Dieldrin						
Stone Crab	2/2	0.19-0.59	0.39	6/10	0.38-2.30	1.24

TABLE 7-35

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CRABS FROM IR 7 AND BACKGROUND SITES, NAS KEY WEST
PAGE 2 OF 2

	IR 7			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
PESTICIDE/PCBs (µg/kg) (continued)						
Endosulfan II						
Stone Crab	1/2	0.14	0.90	3/10	0.14-2.60	1.48
Endrin						
Spiny Spider Crab	1/2	0.09	0.87	3/4	0.22-1.60	1.09
Stone Crab	1/2	1.00	1.30	7/10	0.31-2.70	1.11
Endrin aldehyde						
Spiny Spider Crab	2/2	0.54-0.99	0.77	4/4	1.10-2.30	1.85
Stone Crab	1/2	3.40	2.50	9/10	0.34-2.80	1.62
Heptachlor						
Stone Crab	1/2	0.72	0.78	3/10	0.05-0.52	0.68
Heptachlor epoxide						
Stone Crab	1/2	0.83	0.84	2/10	0.37-8.20	1.54

1 One-half the detection limit used for all non-detected values.

TABLE 7-36

SUMMARY STATISTICS FOR ANALYTES DETECTED IN LOBSTERS FROM IR 7 AND BACKGROUND SITES NAS KEY WEST

	IR 7			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum	2/10	2.60-9.90	2.25	0/19		
Arsenic	10/10	12.20-23.00	17.09	19/19	4.70-20.70	13.43
Barium	2/10	1.20-1.30	0.53	4/19	1.10-1.60	0.52
Cadmium	2/10	0.58-0.81	0.37	12/19	0.65-1.50	0.66
Copper	10/10	18.90-38.60	26.07	19/19	14.20-37.10	26.18
Manganese	3/10	0.18-0.53	0.37	5/19	1.30-1.70	0.65
Mercury	5/10	0.03-0.14	0.06	5/19	0.02-0.08	0.02
Silver	1/10	0.42	0.18	5/19	0.26-0.45	0.19
Zinc	10/10	16.10-28.90	21.35	19/19	12.50-25.80	20.51
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	4/10	0.13-1.20	1.21	4/19	0.72-0.86	1.46
4,4'-DDE	2/10	0.58-0.67	1.44	1/19	0.31	1.58
4,4'-DDT	3/10	0.12-2.00	1.38	0/19		
Aldrin	1/10	0.05	0.77	5/19	0.08-0.21	0.66
beta-BHC	4/10	0.13-0.72	0.65	3/19	0.11-0.20	0.74
delta-BHC	4/10	0.05-0.60	0.59	0/19		
gamma-BHC (lindane)	2/10	0.12-0.13	0.70	3/19	0.03-0.14	0.73
Chlorobenzilate	1/10	15.00	9.15	0/19		
Dieldrin	4/10	0.32-0.76	1.18	1/19	0.56	1.59
Endosulfan I	1/10	0.23	0.79	0/19		
Endosulfan II	6/10	0.11-0.25	0.76	8/19	0.12-0.67	1.08
Endosulfan sulfate	3/10	0.80-3.90	1.95	0/19		
Endrin	3/10	0.10-0.50	1.23	9/19	0.06-0.56	0.98
Endrin aldehyde	4/10	0.10-2.20	1.45	5/19	0.65-3.10	1.54
Heptachlor	4/10	0.07-0.37	0.60	10/19	0.07-0.33	0.50
Heptachlor epoxide	1/10	0.44	0.81	0/19		

1 One-half the detection limit used for all non-detected values.

TABLE 7-37

SUMMARY STATISTICS FOR ANALYTES DETECTED IN AQUATIC VEGETATION (TURTLE GRASS) FROM IR 7 AND BACKGROUND SITES NAS KEY WEST

	IR 7			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum	4/9	2.00-19.50	5.54	8/9	12.20-36.50	18.94
Barium	1/9	3.10	0.62	0/9		
Chromium	1/9	1.60	0.44	0/9		
Lead	3/9	0.32-0.72	0.29	3/9	0.43-0.93	0.38
Manganese	9/9	4.70-11.90	8.02	9/9	3.20-15.90	9.34
Mercury	3/9	0.01	0.01	2/9	0.01-0.02	0.01
Zinc	8/9	3.10-12.70	6.58	9/9	1.10-14.60	7.34
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	3/9	0.51-0.82	1.33	2/9	0.21-0.79	1.39
4,4'-DDE	2/9	0.30-0.32	1.36	2/9	0.52-0.70	1.42
4,4'-DDT	1/9	0.20	1.49	0/9		
Aldrin	1/9	0.37	0.80	1/9	0.48	0.81
delta-BHC	6/9	0.10-5.50	1.15	1/9	0.68	0.83
gamma-BHC (lindane)	4/9	0.08-0.30	0.55	7/9	0.13-0.64	0.46
Dieldrin	1/9	0.54	1.53	1/9	0.25	1.49
Endrin	1/9	0.86	1.57	1/9	0.10	1.48
Endrin aldehyde	3/9	0.26-6.00	1.83	5/9	3.30-18.00	6.28
Heptachlor	3/9	0.09-0.33	0.63	0/9		
Methoxychlor	1/9	6.80	8.31	0/9		

1 One-half the detection limit used for all non-detected values.

TABLE 7-38

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - IR 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	0.65	44.9
Antimony	0.56	38.8
Arsenic	0.06	3.9
Zinc	0.06	3.8
Copper	0.04	3.0
All others	0.08	5.7
Total receptor HI	1.45	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.71	48.8
Food	0.74	51.2

TABLE 7-39

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MEAN CONTAMINANT CONCENTRATION SCENARIO - IR 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	0.62	67.6
Antimony	0.12	13.0
Arsenic	0.05	5.7
Zinc	0.03	3.7
Copper	0.03	3.3
All others	0.07	6.7
Total receptor HI	0.92	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.67	72.8
Food	0.25	27.2

TABLE 7-40

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - IR 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
4,4'-DDT	2.99	80.0
Zinc	0.49	13.2
Mercury	0.08	2.3
4,4'-DDE	0.06	1.6
Antimony	0.05	1.3
All others	0.06	1.6
Total receptor HI	3.73	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	3.73	100.0

TABLE 7-41

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MEAN CONTAMINANT CONCENTRATION SCENARIO - IR 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
4,4'-DDT	1.53	74.2
Zinc	0.31	15.0
Mercury	0.08	4.0
4,4'-DDE	0.06	3.1
4,4'-DDD	0.04	2.1
All others	0.03	1.4
Total receptor HI	2.05	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	2.05	100.0

TABLE 7-42

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - IR 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
beta-BHC	0.05	86.2
Aroclor-1260	0.00	7.5
Endrin	0.00	1.8
Heptachlor	0.00	1.3
alpha-BHC	0.00	1.1
All others	0.00	2.2
Total receptor HI	0.06	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.06	97.4
Food	0.00	2.6

TABLE 7-43

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MEAN CONTAMINANT CONCENTRATION SCENARIO - IR 7 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
beta-BHC	0.00	45.9
Aroclor-1260	0.00	20.7
alpha-BHC	0.00	10.6
Endrin	0.00	8.7
Heptachlor	0.00	5.5
All others	0.00	8.7
Total receptor HI	0.01	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.01	85.3
Food	0.00	14.7

and its maximum concentration in sediments did not exceed the less conservative sediment threshold used in this assessment. Thus, significant migration of inorganics in groundwater to surface water and sediment does not appear to be occurring.

Ten pesticides and daughter products were retained as groundwater COPCs, including aldrin, delta-BHC, endosulfan I, endosulfan sulfate, dieldrin, lindane, heptachlor, endrin, 4,4'-DDD, and 4,4'-DDT. Some HQ values for these chemicals (based on surface-water thresholds) were indicative of moderate to high potential risks. However, no pesticides were detected in surface-water samples, and most were detected infrequently in sediment. Aldrin was not detected in sediments. Delta-BHC, dieldrin, and endrin were each detected in only 1 of 16 sediment samples. Endosulfan I and endosulfan sulfate were detected in 3 of 16 and 1 of 16 sediment samples, respectively, and HQ values were indicative of low potential risks (HQ = 3.7 and 2.0, respectively). Lindane was detected in 4 of 16 sediment samples, and its HQ (using the most conservative threshold available) was 6.3. All four detected values of lindane were less than the average concentration of lindane in Key West background sediments, although this compound is not naturally occurring. Heptachlor was detected in 2 of 5 groundwater samples and in 2 of 16 sediment samples but only one detected value in sediment exceeded the sediment threshold (HQ = 2.2). The compounds 4,4'-DDD and 4,4'-DDT were detected in only one monitoring well (I7MW7-2) near the shoreline in 1996 samples.

Interpretation of iron and cyanide in surface water at IR 7 is difficult since only two samples were analyzed for these inorganics. Iron is an essential nutrient that is toxic only at high concentrations. Its maximum concentration was the only detection of that metal that exceeded its threshold, and the resulting HQ was indicative of relatively low risk (HQ = 1.9). The HQ for cyanide was indicative of high potential risk (HQ = 430), but it was not detected in the other surface-water sample. Cyanide was detected in only 2 of 19 groundwater samples, was not detected in groundwater samples collected in 1996, and was detected in only 1 of 14 sediment samples. In addition, cyanide was not detected in surface or subsurface soil. Thus, its presence in a single surface-water sample does not appear to be site-related. Overall, potential risks to aquatic receptors from surface-water contaminants appear to be low, based on analyses of surface-water samples collected by IT Corporation in 1990 and 1993. Surface-water samples were not collected during current sampling. FDEP and USEPA approved this deviation from the work plan (ABB, 1995) since analyses of additional samples from open ocean areas near the site would not add useful data regarding the determination of potential contaminant sources. Instead, emphasis will be placed on the results of sediment analyses, which are discussed below.

Nine inorganics were retained as sediment COPCs, but most of these were infrequently detected or had low HQs. The maximum concentrations of arsenic (HQ = 1.3) and lead (HQ = 1.4) exceeded the most conservative thresholds in only 2 of 24 and 3 of 24 samples, respectively, and they did not exceed the less conservative thresholds used in this assessment. Cadmium was detected in only 2 of 24 sediment samples (HQ = 1.6). Mercury was detected in 16 of 24 samples, but most concentrations were similar to background values, and only one sample exceeded the most conservative threshold (HQ = 1.1). Silver was detected in only 3 of 24 samples, tin in 1 of 9 samples, beryllium in 3 of 24 samples, and cyanide in 1 of 14 samples. Conversely, copper was detected in 24 of 24 sediment samples. Copper concentrations in seven sediment samples exceeded the most conservative threshold (HQ = 9.5), but no values exceeded the less conservative threshold. Eight of 24 samples exceeded twice the average background concentration of copper in sediment.

Ten pesticides and daughter products were COPCs in sediments at IR 7. Eight of these were also groundwater COPCs, as discussed earlier. The remaining two sediment COPCs were beta-BHC and 4,4'-DDE. Beta-BHC was detected in only 1 of 16 samples and was not detected in samples collected in 1993 or 1996. The organochlorine 4,4'-DDE was detected in 5 of 16 sediment samples. Its hazard quotient (HQ = 11.2) was indicative of moderate potential risks, but no detected values exceeded the less conservative threshold.

The PCB mixture Aroclor-1260 was detected in only 1 of 16 sediment samples. Its maximum concentration exceeded the most conservative threshold (HQ = 29.2), but did not exceed a less conservative value. Aroclor-1260 was not detected in groundwater or soil from IR 7 and was not detected in lobsters, crabs, or turtle grass from nearshore waters. Thus, the presence of Aroclor-1260 in 1 of 16 sediment samples does not appear to be site-related. Furthermore, potential risks to aquatic receptors from this PCB mixture are low.

Several semivolatiles (mainly PAHs) were COPCs in IR 7 sediments. Bis(2-ethylhexyl)phthalate was detected in 5 of 6 sediment samples and had an HQ of 4.5 using its maximum concentration, and the most conservative threshold. All detected values were considerably less than the less conservative threshold used in this ERA, and phthalates are ubiquitous environmental contaminants. Phenanthrene and pyrene, two PAHs, were each detected in only 3 of 14 samples and were not detected in 1996 samples. All of the remaining sediment COPCs were also PAH compounds. Each of these was detected only in only one sample (I7S-2) collected in 1990. PAH compounds were not detected in sediment samples from other locations at IR 7 or in sediment samples collected near sampling station I7S-2 (I7SS-7 in 1993 and I7SS-6 in 1996). The infrequent detection of PAHs in sediments suggests that their presence may be due to boat traffic in the area rather than IR 7-related inputs.

In the Phase I assessment antimony, chromium, vanadium, zinc, and 4,4'-DDT were identified as COCs in soils (IT Corporation, 1994). The current assessment identified few surface soil COPCs (Table 7-33). Soil COPCs do not appear to have significantly migrated into groundwater or sediment, based on a comparison of soil COPCs to groundwater and sediment COPCs, with the possible exception of 4,4'-DDT and daughter products. Only three inorganics were retained as terrestrial plant COPCs, and all HQs were indicative of low potential risks (HQs < 1.8). Several organic compounds were conservatively retained as plant COPCs since no suitable threshold was available, but plants do not translocate organics appreciably (Will and Suter, 1995b).

The collection of only two spiny spider crabs and two stone crabs from nearshore waters of IR 7 prevents an extensive interpretation of contaminants in crabs. However, the data from these four crabs show no evidence of accumulation of site-related contaminants. Several metals and pesticides were detected in crab tissue but with only two exceptions, all concentrations of analytes were similar to or lower than concentrations in crabs collected from background sites in the Key West area (Table 7-35). The two exceptions were aluminum and barium. Aluminum was detected in one of four crabs from IR 7 but was not detected in background crabs, and the barium concentration in one stone crab (5.0 mg/kg) was greater than in background crabs. However, neither aluminum nor barium were COPCs in groundwater, surface water, soil, or sediment at IR 7. Concentrations of 4,4'-DDT and daughter products were not elevated in crabs from IR 7.

Ten lobster samples were collected from IR 7 nearshore waters. Several metals and pesticides were detected in lobster tissue, but frequencies of detections and concentrations of all analytes (with three exceptions) were similar to or lower than those in background lobsters (Table 7-32). Delta-BHC was detected in 4 of 10 lobsters from IR 7 and was not detected in 19 background lobsters. However, the maximum detected concentration was only 0.60 mg/kg. The pesticide 4,4'-DDT was detected in 3 of 10 lobsters from IR 7 and was not detected in 19 background lobsters. All detected concentrations of delta-BHC and 4,4'-DDT were well below values considered to be protective of wildlife species (Appendix C, Table C.3-26). Aluminum was detected in 2 of 10 lobsters from IR 7 and was not detected in background lobsters. Since aluminum was not detected in 8 of 10 lobsters, and was not a COPC in site media, its occurrence in two IR 7 lobsters is unremarkable.

Concentrations of analytes in turtle grass from nearshore waters of IR 7 were generally similar to those in background samples or were infrequently detected (Table 7-37). Delta-BHC was detected more often and at greater concentrations than in background samples, but the average value was only slightly greater than in background samples. Heptachlor was detected in three of nine turtle grass samples from IR 7 and was not detected in background samples, but its maximum concentration was only 0.33 mg/kg.

Overall, the data indicate that concentrations of analytes in tissue from aquatic samples at IR 7 are similar to concentrations in background samples and pose low potential risks to ecological receptors. All concentrations of organic compounds in aquatic organisms were well below the 100 mg/kg concentration for chlorinated compounds considered to be indicative of low potential risk (Gibson and Dillon, 1989). Pesticides and PCBs (including 4,4'-DDT and daughter products) are not accumulating in tissue although they were detected in slightly elevated concentrations in some soil, groundwater, and sediment samples.

Potential risks to the cotton rat from soil-related contaminants at IR 7 were relatively low for the maximum concentration scenario (total HI = 1.45) and were insignificant for the mean concentration scenario (total HI = 0.92). HI values for the raccoon for both the maximum and mean exposure scenarios were less than 1.0, indicating minuscule potential risks to this semi-aquatic receptor from consumption of crustaceans and incidental ingestion of sediment. Potential risks to the kestrel were indicative of low potential risks as well. Total HI values for the maximum and mean concentration scenarios were 3.73 and 2.05, respectively. The estimated potential risks to this raptor, as well as the other terrestrial receptors, are also mitigated by the conservative assumptions used in the foodchain model. The model assumed an absorption fraction of 80 percent (i.e., 80 percent of the ingested contaminant was absorbed) for the dose calculations describing the intake of vegetation, prey, and soil. Actual absorption fractions range widely but are often considerably less than 80 percent (Hrudey et al., 1996). In addition, the model assumed that these species forage on the site 100 percent of the time. This would be true for the cotton rat, but not for the kestrel and raccoon. IR 7 would comprise only a small portion of their home ranges.

7.7.4.3 Ecological Risk Summary

IR 7 is a 30-acre inactive landfill located on Fleming Key. The landfill has been inactive for 35 years. The landfilled area extends from the east to west shore of the island. The former landfill consists primarily of the USDA Animal Import Center and surrounding grounds. Terrestrial habitat over most of the site consists of turf grass, weedy areas, and a wooded area dominated by Australia pine and Brazilian pepper. Thus, the site provides poor habitat for terrestrial receptors. The shoreline and nearshore areas provide excellent aquatic habitat for a variety of marine organisms.

The Phase I ecological risk assessment for IR 7 concluded that the greatest potential risk to aquatic organisms from inorganics is through direct contact via groundwater discharges, and to a much lesser extent sediment. Contaminants in groundwater and sediment were considered to pose moderate to high potential risks to ecological receptors at the site. The nature and extent in surface and subsurface soils were determined to be adequately characterized. Additional ecological investigations to more fully characterize ecological risks were warranted (IT Corporation, 1994).

In this Phase II ERA, analyses of non-biological media at IR 7 indicate that migration of site-related contaminants from groundwater or soil to sediment and surface water has not significantly occurred, with the possible exception of the organochlorine compounds 4,4'-DDT and daughter products (4,4'-DDD and 4,4'-DDE). These compounds were detected in some sediment samples. Their use in the lower Florida Keys was previously widespread, and they remain in soil and sediment for extremely long periods. These compounds were detected in only one of five shoreline groundwater samples in 1996. 4,4'-DDT and daughter products were not elevated in sediment sample I7SS-3, the sample collected closest to the only groundwater monitoring well where these compounds were detected. Furthermore, these compounds do not appear to be bioaccumulating in the tissues of aquatic organisms. For these reasons, potential risks to aquatic and benthic biota from these compounds appear to be insignificant. HQs and frequencies of detection of other COPCs in non-biological media also indicate low potential risks to aquatic, benthic, and terrestrial biota.

Crabs, lobsters, and turtle grass do not appear to be accumulating site-related contaminants, and tissue concentrations of contaminants appear to pose insignificant risks to ecological receptors. Results of the foodchain modeling indicate low potential risks to the cotton rat and kestrel (representative terrestrial receptors). Risks to the raccoon (representative semi-aquatic receptor) appear to be negligible. The relatively low HI values for these species were also mitigated by some conservative assumptions used in the modeling.

In summary, the Phase I and the Phase II ecological risk assessments appear to be sufficient to characterize potential ecological risks at IR 7. Contaminants in groundwater, surface water, soil, and sediment do not appear to pose environmental risks. Site-related contaminants have not accumulated in vegetation, crabs, or lobsters; potential risks to terrestrial receptors, aquatic receptors, and benthic organisms appear to be low. Therefore, additional ecological studies or remediation based on ecological risks are not necessary, and therefore, are not recommended.

7.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of investigation at IR 7 were to the identify the existing nature and extent of contamination (after interim remedial action) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

IR 7 is a 30-acre inactive landfill located on the northern portion of Fleming Key. The landfill has been inactive for 35 years. The eastern and western edges of the site are bordered by the Gulf of Mexico, and erosion protection on the eastern shoreline is provided by grass cover and concrete rubble riprap. In

1995, BEI performed an IRA at IR 7 to prevent ponding and promote runoff from two areas at IR 7. Metals and pesticides are the most widespread contaminants detected at the site. VOCs and SVOCs are present in sediment and groundwater, and PCBs, to a limited extent, are also present in soil and sediment.

The human health risk for current receptors caused by the low level of contaminants at IR 7 exceeds FDEP's 1E-06 target risk in several exposure scenarios, are within or below the EPA target risk range of 1.0E-04 to 1.0E-06 for cancer-causing chemicals, and are below the 1.0 hazard index for noncancer-causing chemicals. Contaminants are present at concentrations indicating that adverse noncarcinogenic health effects might occur for the hypothetical future resident exposure scenario. The cancer risk to the future resident exceeds FDEP's 1E-06 target risk and remains in the 1.0E-04 to 1.0E-06 range. Antimony is the main contributor to the noncarcinogenic risk.

The ecological risk assessment at IR 7 indicates that contaminants in groundwater, surface water, soil, and sediment do not pose environmental risks. Site-related contaminants have not accumulated in vegetation, crabs, or lobsters; potential risks to ecological receptors appear to be low.

Although metal contaminants (i.e., antimony) are present at concentrations that might contribute to the risk for the hypothetical future resident, there appear to be no ecological risks posed by the contaminants present. Based on the minimal human health and ecological risks posed by the site, it is recommended that an NFA decision document be prepared for IR 7, with the provision that a future residential scenario is prevented by institutional controls. Additionally, the Navy will develop a groundwater monitoring program for IR 7.

8.0 INSTALLATION RESTORATION SITE 8 (IR 8)

This chapter describes the site-specific evaluation of data for IR 8 (Fleming Key South Landfill). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 8.8 presents a summary and conclusions with recommendations for IR 8.

8.1 UNIT DESCRIPTION

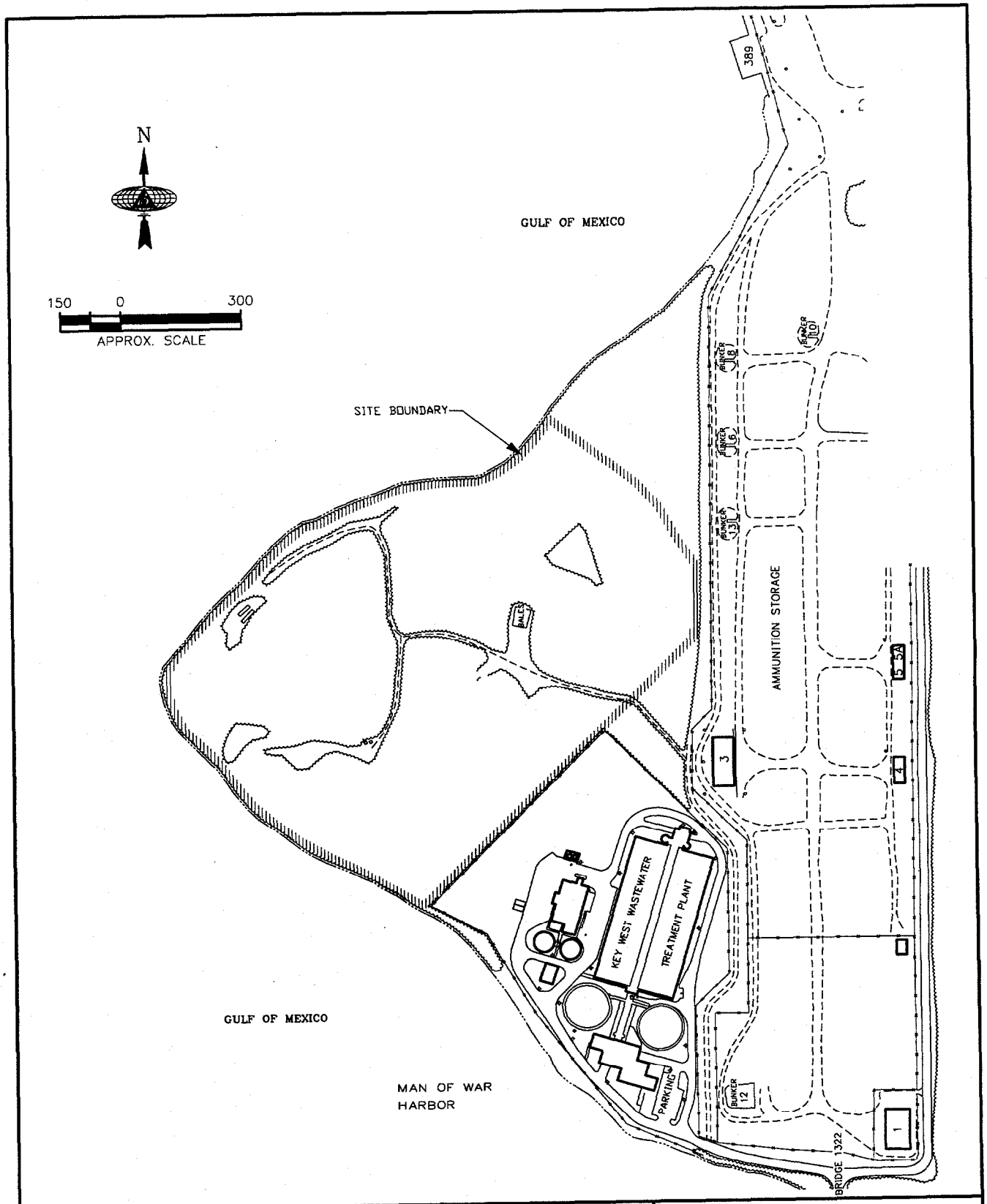
The Fleming Key South Landfill (IR 8) covers approximately 45 acres in the southwestern portion of Fleming Key (Figure 8-1). The southeastern portion of the site is bordered by the city of Key West Sewage Treatment Plant. A munitions storage area is located along the east boundary of the site. The remainder of the site is bordered by ocean water (Man of War Harbor). A closed canopy of Australian pines covers most of the site. The western portion of the site contains piles of metal debris (heavy equipment, desks, marine equipment, etc.).

As much as 8,000 tons of unknown wastes reportedly were disposed at the landfill annually between 1962 and 1982. The waste disposal activities of the city of Key West were combined with those of the Navy from 1968 to 1982 at this site. Waste materials and fill from Sigsbee Key (Dredgers Key) were also disposed of at the site between 1948 and 1951.

The open trench disposal method was practiced at this site, with the trenches being constructed in a manner similar to that at Fleming Key North Landfill (IR 7). Trenches were typically 25 feet wide, 10 feet deep, and 500 to 1,000 feet long (IT Corporation, 1994). Due to seepage from groundwater, the trenches were partially full of sea water when waste disposal occurred. Combustible wastes were taken to the western portion of the site and burned. The ash and unburned wastes were then deposited in the western portion of the landfill.

8.2 INVESTIGATION HISTORY

Several investigations have been performed at IR 8 since the mid-1980s to identify, confirm, or delineate contamination. The previous investigations are summarized in Section 8.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 8.2.2.



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SURVEYED BY: TCB	SURVEY DATE: 9/25/97
SCALE: AS SHOWN	
CAD DWG. NO.: IR8704681	PROJ. NO.: 7046

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FIGURE 8-1
SITE LOCATION MAP
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

8.2.1 Previous Investigations

An initial investigation of this site was conducted by Geraghty and Miller in 1986. This investigation involved the installation of five shallow monitoring wells. Volatile organic carbons and metals (e.g., arsenic, copper and mercury) were found in samples collected from the wells. In 1990, IT Corporation conducted a preliminary RI, that included the installation of ten soil borings (six of the soil borings were converted to monitoring wells) and the excavation of 20 test pits to characterize the waste type and distribution patterns. Wastes encountered at the site consisted of vehicle, household, construction, and electrical debris. Vehicle debris included car/truck parts and sheet metal. Oil, gas and antifreeze were encountered in one test pit. Household debris consisted of cafeteria trays, silverware, food containers, glass, rubber, and plastic. Construction debris consisted of large concrete slabs, steel cables, wood, and roofing shingles. Minimal electrical debris was found, consisting mainly of electrical conduit. Groundwater samples from the site indicated metals (e.g., arsenic, chromium, mercury, and lead) were present in concentrations above established standards. Surface-water samples also indicated concentrations of the same metals exceeding the standards, and PCBs, such as Aroclor-1242, were detected exceeding the standards.

Subsequently, IT Corporation conducted soil, sediment, surface-water, and groundwater sampling during the 1993 RFI/RI. Characterization of contamination at the site indicated that groundwater and sediment appeared to be the most extensively impacted by metals (antimony, arsenic, mercury and lead). The Final RFI/RI prepared by IT Corporation recommended that a receptor identification and tissue analysis be performed to confirm uptake of contaminants, conduct initial remedial actions to prevent further contact between the surface water and the waste materials along the shoreline, perform a baseline risk assessment, conduct a preliminary feasibility study, and conduct a baseline human health risk assessment based on post initial remedial action sampling data.

In February 1997, BEI began installation of a "Shoreline Protection System" at IR 8 (BEI, 1997).

8.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at IR 8 and the scope of those field activities performed from August to October 1996. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 8-2 through 8-5

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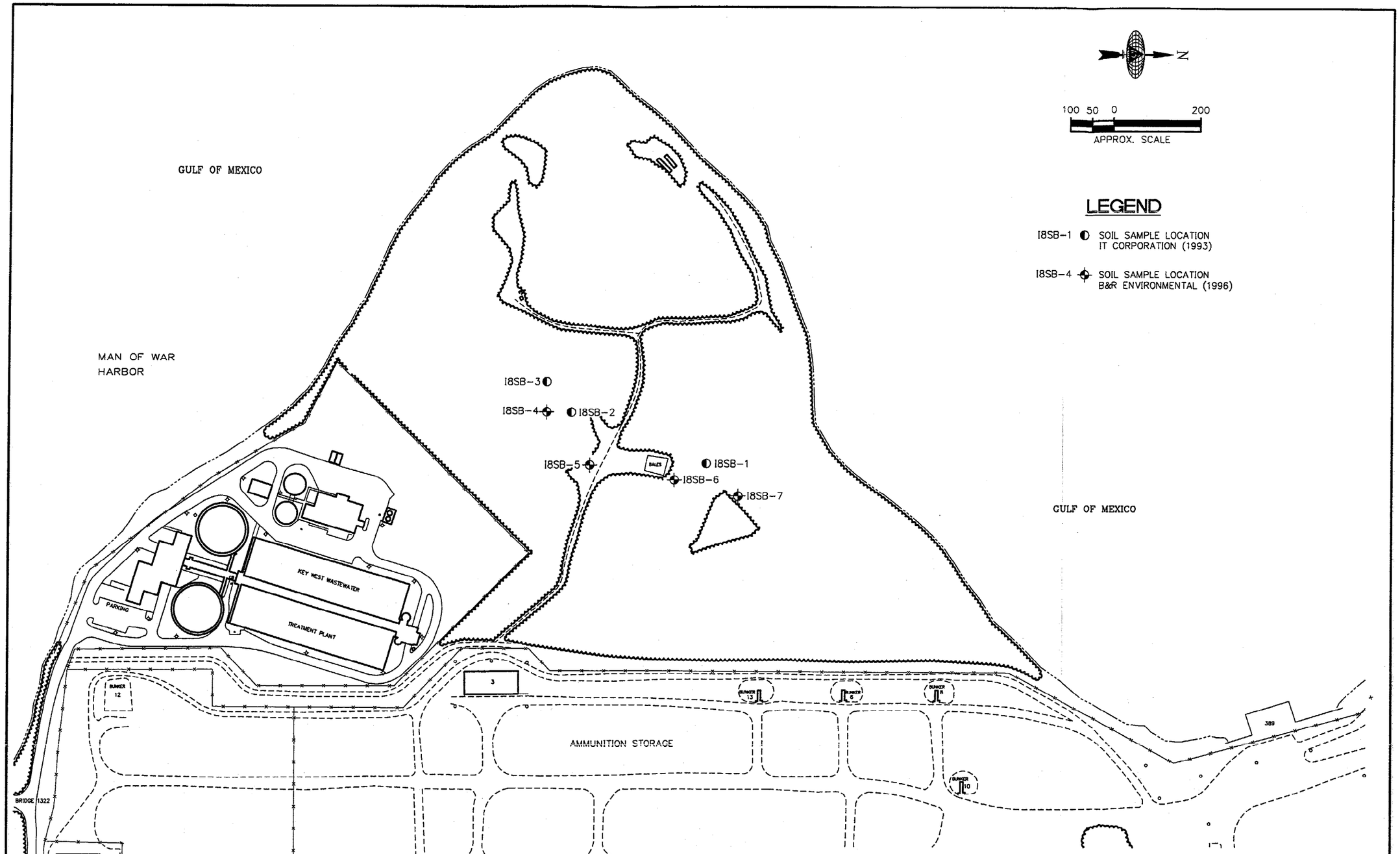

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CAD DWG. NO.: IR8704682	PROJ. NO.: 7046

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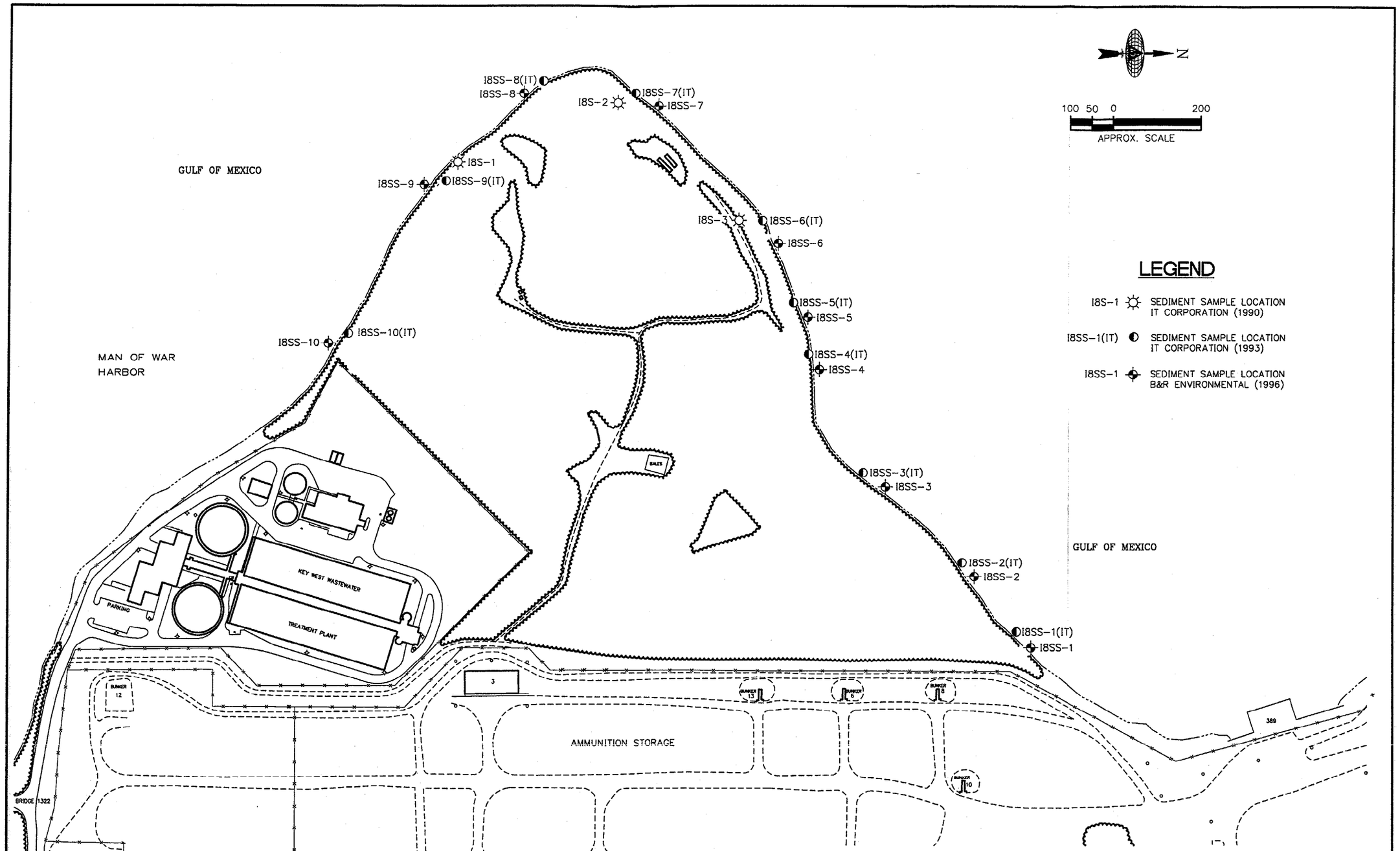
FIGURE 8-2
SOIL SAMPLE LOCATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

01015377



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CAD DWG. NO.: IR8704683	PROJ. NO.: 7046

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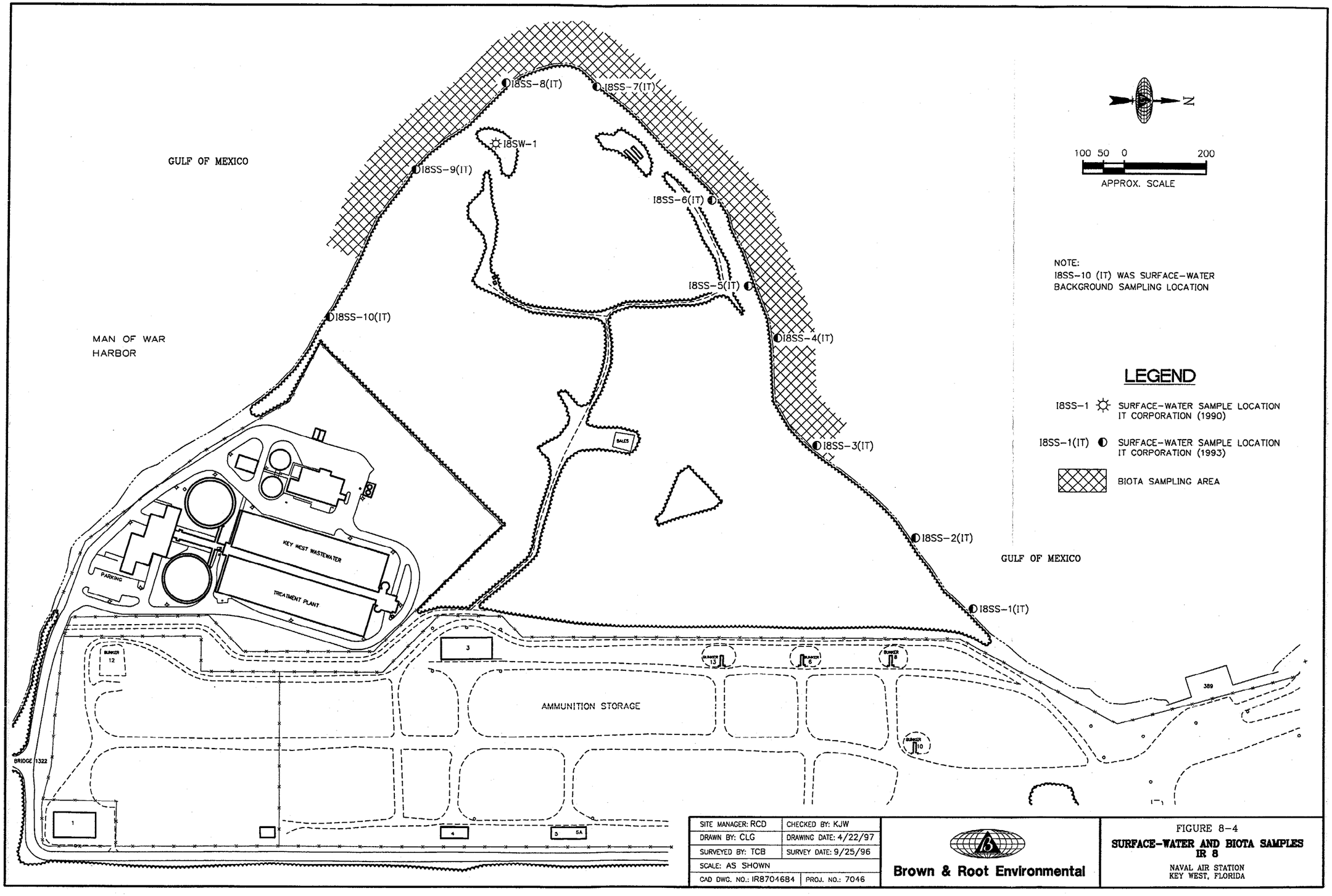
FIGURE 8-3
SEDIMENT SAMPLE LOCATIONS IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA



SITE MANAGER: RCD	CHECKED BY: KJW
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SURVEYED BY: TCB	SURVEY DATE: 9/25/96
SCALE: AS SHOWN	
CAD DWG. NO.: IR87046B4	PROJ. NO.: 7046

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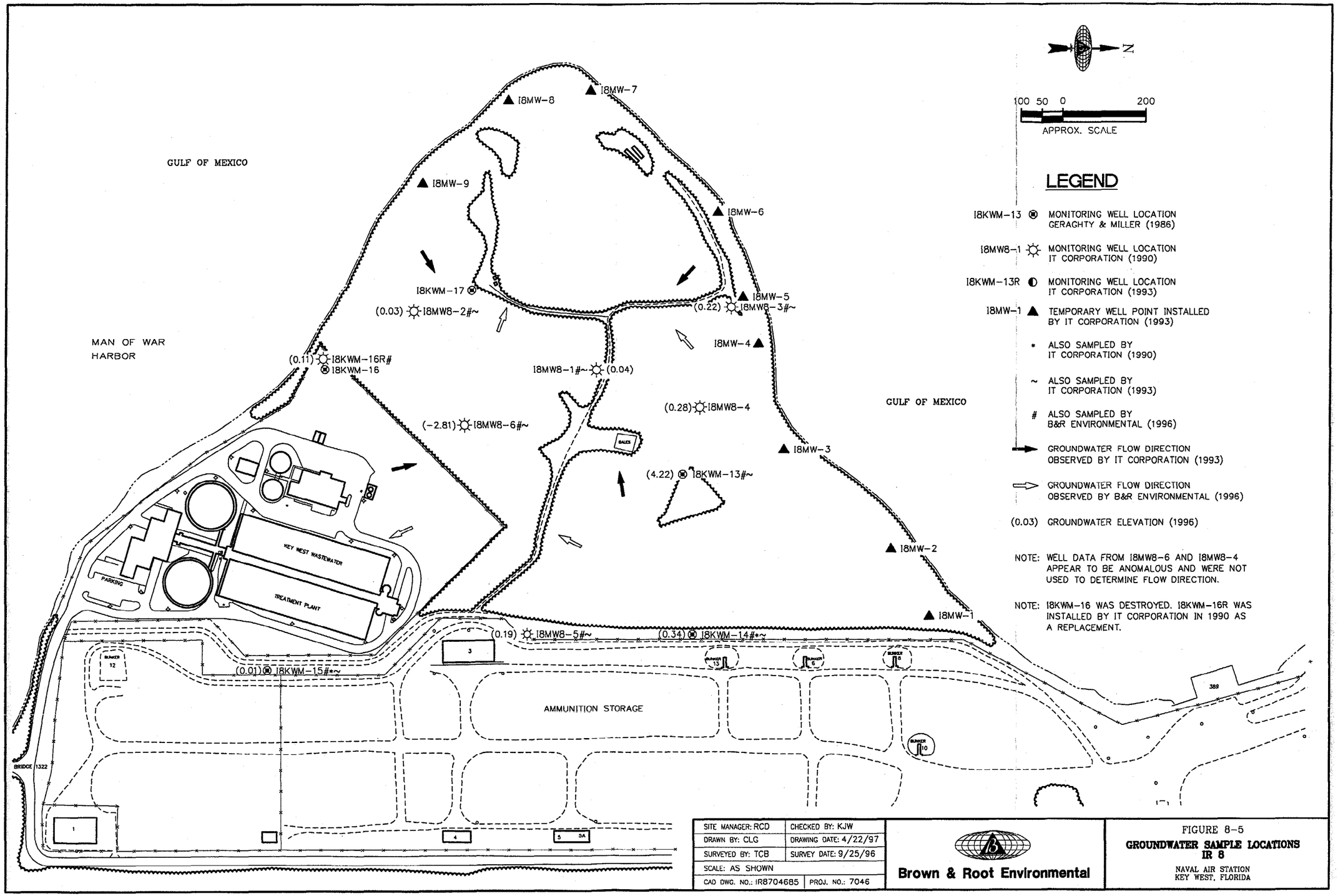
FIGURE 8-4
SURFACE-WATER AND BIOTA SAMPLES IR 8
NAVAL AIR STATION KEY WEST, FLORIDA


N
100 50 0 200
APPROX. SCALE
LEGEND
I8KWM-13 MONITORING WELL LOCATION GERAGHTY & MILLER (1986)
I8MW8-1 MONITORING WELL LOCATION IT CORPORATION (1990)
I8KWM-13R MONITORING WELL LOCATION IT CORPORATION (1993)
I8MW-1 TEMPORARY WELL POINT INSTALLED BY IT CORPORATION (1993)
* ALSO SAMPLED BY IT CORPORATION (1990)
~ ALSO SAMPLED BY IT CORPORATION (1993)
# ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)
GROUNDWATER FLOW DIRECTION OBSERVED BY IT CORPORATION (1993)
GROUNDWATER FLOW DIRECTION OBSERVED BY B&R ENVIRONMENTAL (1996)
(0.03) GROUNDWATER ELEVATION (1996)
NOTE: WELL DATA FROM I8MW8-6 AND I8MW8-4 APPEAR TO BE ANOMALOUS AND WERE NOT USED TO DETERMINE FLOW DIRECTION.
NOTE: I8KWM-16 WAS DESTROYED. I8KWM-16R WAS INSTALLED BY IT CORPORATION IN 1990 AS A REPLACEMENT.
GULF OF MEXICO
MAN OF WAR HARBOR
GULF OF MEXICO
I8MW-8
I8MW-7
I8MW-9
I8MW-6
I8KWM-17
(0.03) I8MW8-2#~
(0.22) I8MW8-3#~
I8MW-5
I8MW-4
(0.11) I8KWM-16R#
I8KWM-16
I8MW8-1#~ (0.04)
(0.28) I8MW8-4
(-2.81) I8MW8-6#~
I8MW-3
(4.22) I8KWM-13#~
I8MW-2
I8MW-1
KEY WEST WASTEWATER
TREATMENT PLANT
PARKING
(0.19) I8MW8-5#~
(0.34) I8KWM-14#*~
(0.01) I8KWM-15#*~
AMMUNITION STORAGE
BRIDGE 1322
SITE MANAGER: RCD
CHECKED BY: KJW
DRAWN BY: CLG
DRAWING DATE: 4/22/97
SURVEYED BY: TCB
SURVEY DATE: 9/25/96
SCALE: AS SHOWN
CAD DWG. NO.: IR8704685
PROJ. NO.: 7046
Brown & Root Environmental
FIGURE 8-5
GROUNDWATER SAMPLE LOCATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

show the location of soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as those from previous investigations.

8.2.2.1 Investigation Rationale

Additional sampling of sediment and groundwater was conducted at IR 8 to provide more information upon which appropriate risk assessments can be based. As requested by regulators, resampling of sediments at the original RFI/RI field program locations, was performed to confirm the presence or absence of contamination indicated in earlier findings. The additional data should provide a statistically representative data set for the risk assessment. All existing permanent monitoring wells were resampled to confirm previously-detected levels of contamination. It is believed that concentrations of metals in groundwater may have been influenced by turbidity in previous investigations.

8.2.2.2 Scope of Current Field Investigation

Supplemental field activities at IR 8 included the collection of soil, sediment, and groundwater samples to confirm and verify previously-detected levels of contamination.

8.2.2.2.1 Surface Soil

Limited resampling of soils was performed to verify the presence of pesticides. All IR 8 surface soil samples were analyzed for the following parameters:

- Appendix IX pesticides
- Appendix IX PCBs

8.2.2.2.2 Surface Water and Sediment

Surface-water samples were not collected during Supplemental RFI/RI sampling activities. Resampling of sediments at previous sample locations was performed to confirm and verify the presence of pesticides, PCBs, herbicides, metals and cyanide at IR 8. All IR 8 sediment samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides

- Appendix IX PCBs
- TAL metals

8.2.2.2.3 Groundwater

Resampling of groundwater at each of the permanent monitoring wells was performed to confirm and verify the presence of pesticides, PCBs, herbicides, metals, and cyanide at IR 8. The focus of the groundwater sampling was on reducing the levels of turbidity that may have previously attributed to elevated concentrations of metals. Low-flow pumping methods were used to control the levels of turbidity. All IR 8 groundwater samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals

8.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at Key West, Florida is included in Section 1.4 (Base Environmental Setting) of this document. Applicable site-specific physical characteristics are discussed below.

8.3.1 Hydrogeology

The depths to groundwater during the Supplemental RFI/RI ranged from 2.27 feet to 8.89 feet bls. Groundwater elevation data obtained during this monitoring event vary from 0.01 feet to 0.34 feet above msl. Data from two wells (I8MW8-1 and I8MW-6) appear to be anomalous and were not used to determine groundwater flow directions. The groundwater flow data indicates influence by tides from the Man of War Harbor located to the north, south, and west of the site. Groundwater elevations collected by IT Corporation in August 1990 ranged from approximately 1.7 to 3.1 feet msl. Sea level fluctuations ranged from approximately 0.9 to 1.5 feet msl. IT Corporation indicated that the water table was encountered from 5 to 10 feet bls during the drilling of monitoring well boreholes. Groundwater flow directions were generally as indicated on Figure 8-5. The groundwater gradient varies from 0.0005 to 0.001 foot/foot.

8.3.2 Soils

The water table is at approximately 5 to 10 feet bls. Material encountered above the water table at the site consist of poorly sorted limestone fill with reworked limestone and gravel. Geotechnical data obtained by IT Corporation in 1991 indicated the soil is very coarse sand. The total organic content was 5,700 mg/kg. The pH was a very basic at 8.5, as expected due to the abundance of carbonate rocks and soils. Material encountered below the water table consisted of poor to moderately sorted sandy limestone. Debris (i.e., glass, plastic, and metal) was encountered throughout all borings.

8.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from subsurface and surface soil, sediment, surface water, and groundwater at the Fleming Key South Landfill. The results of these analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various state and Federal agencies and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media, in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables that accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix H contains the full data set used in site characterization and assessment. Appendix I contains the analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI.

8.4.1 Subsurface Soil

Data from a single sampling effort, the 1993 IT Corporation RFI/RI, was considered in the analysis of subsurface soil contamination at IR 8. Samples were collected at two subsurface depths (5 feet and 15 feet) at I8SB-2. Other samples were collected at a depth of 5 feet. VOCs, SVOCs, pesticides, and inorganics were tested for in all subsurface soil samples. PCBs were not analyzed in any of the three subsurface soil samples collected from a depth of 5 feet but were analyzed in the single 15 foot sample. Chemicals that were detected in subsurface soil samples are listed in Table 8-1. Figure 8-6 shows the occurrence of analytes that exceeded screening values and indicate possible subsurface soil

TABLE 8-1

CHEMICALS DETECTED IN SUBSURFACE SOIL AT IR 8
NAS KEY WEST

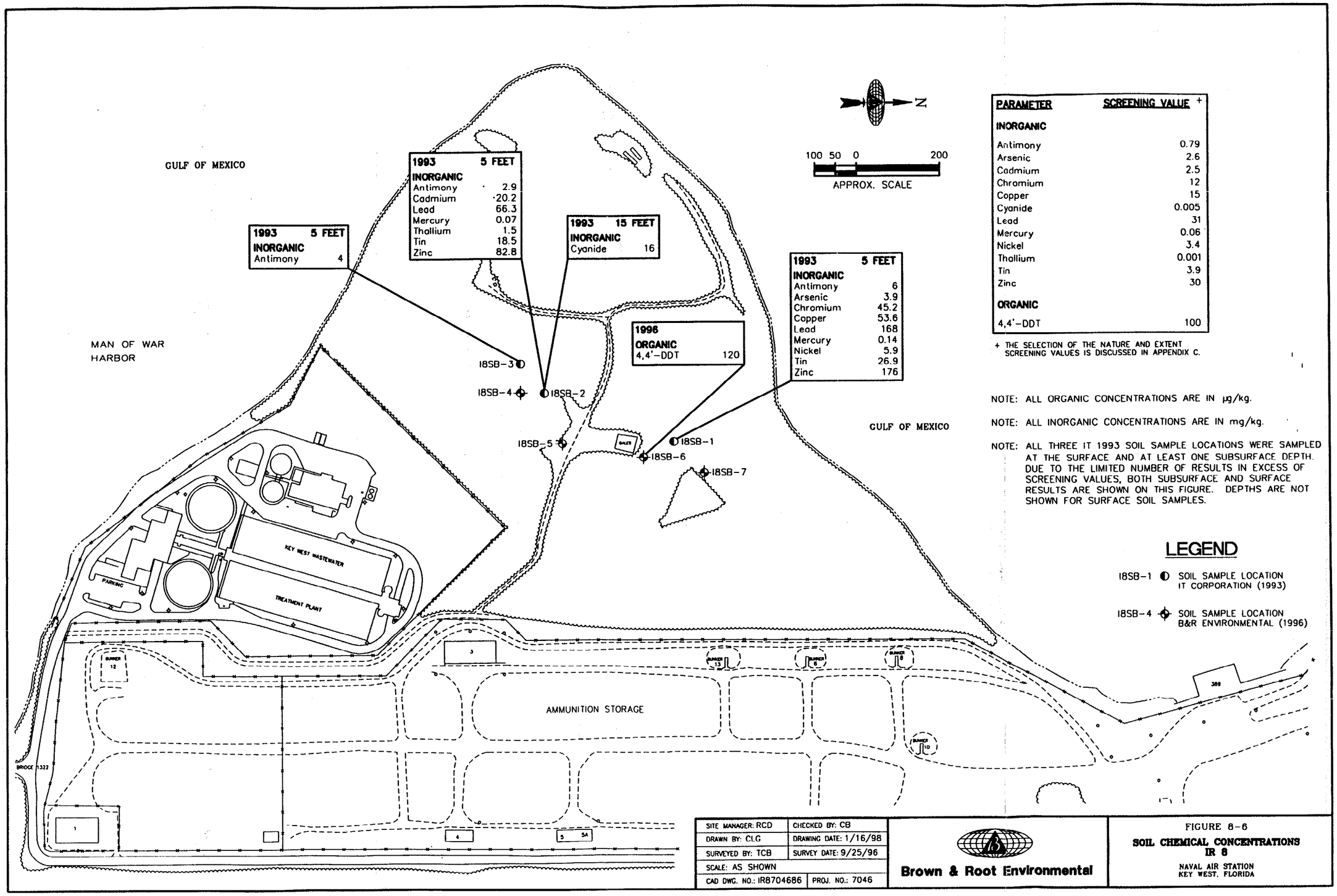
Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
I8SB-2	15	IT 1993	Aluminum	454	
I8SB-1	5	IT 1993	Antimony	6	B_1
I8SB-3	5	IT 1993	Antimony	4	B_1
I8SB-2	5	IT 1993	Antimony	2.9	B_1
I8SB-1	5	IT 1993	Arsenic	3.9	
I8SB-2	5	IT 1993	Arsenic	2.1	B_1
I8SB-3	5	IT 1993	Arsenic	0.88	B_1
I8SB-2	5	IT 1993	Barium	17.1	B_1
I8SB-1	5	IT 1993	Barium	11.4	B_1
I8SB-3	5	IT 1993	Barium	8.6	B_1
I8SB-2	15	IT 1993	Barium	7.7	B_1
I8SB-3	5	IT 1993	Beryllium	0.14	B_1
I8SB-2	5	IT 1993	Cadmium	20.2	
I8SB-1	5	IT 1993	Chromium	45.2	
I8SB-2	5	IT 1993	Chromium	8.8	
I8SB-3	5	IT 1993	Chromium	6.2	
I8SB-2	15	IT 1993	Chromium	5.3	
I8SB-1	5	IT 1993	Copper	53.6	
I8SB-2	5	IT 1993	Copper	11.2	
I8SB-3	5	IT 1993	Copper	4.8	
I8SB-2	15	IT 1993	Copper	1.9	B_1
I8SB-2	15	IT 1993	Cyanide	16	
I8SB-2	15	IT 1993	Iron	506	
I8SB-1	5	IT 1993	Lead	168	
I8SB-2	5	IT 1993	Lead	66.3	
I8SB-3	5	IT 1993	Lead	9.4	
I8SB-2	15	IT 1993	Lead	6.2	
I8SB-2	15	IT 1993	Manganese	7.6	
I8SB-1	5	IT 1993	Mercury	0.14	
I8SB-2	5	IT 1993	Mercury	0.07	
I8SB-2	15	IT 1993	Mercury	0.04	
I8SB-3	5	IT 1993	Mercury	0.03	
I8SB-1	5	IT 1993	Nickel	5.9	
I8SB-2	5	IT 1993	Selenium	1.1	
I8SB-2	5	IT 1993	Thallium	1.5	
I8SB-1	5	IT 1993	Tin	26.9	
I8SB-2	5	IT 1993	Tin	18.5	B_1
I8SB-3	5	IT 1993	Vanadium	2.4	B_1
I8SB-1	5	IT 1993	Vanadium	2.3	B_1
I8SB-2	5	IT 1993	Vanadium	1.5	B_1
I8SB-2	15	IT 1993	Vanadium	1.4	B_1
I8SB-1	5	IT 1993	Zinc	176	
I8SB-2	5	IT 1993	Zinc	82.8	
I8SB-3	5	IT 1993	Zinc	17	
I8SB-2	15	IT 1993	Zinc	6.3	
PESTICIDES/PCBs (µg/kg)					
I8SB-3	5	IT 1993	4,4'-DDE	4	C
I8SB-2	5	IT 1993	Dieldrin	17.3	C
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
I8SB-2	5	IT 1993	1,2-dichlorobenzene	4.6	
I8SB-2	5	IT 1993	1,4-dichlorobenzene	62.5	D1:5
VOLATILE ORGANIC COMPOUNDS (µg/kg)					
I8SB-2	5	IT 1993	1,1,2-trichloroethane	0.15	
I8SB-2	15	IT 1993	Acetone	24	
I8SB-2	15	IT 1993	Carbon disulfide	5	J
I8SB-2	5	IT 1993	Ethylbenzene	2.8	
I8SB-2	15	IT 1993	Methylene chloride	21	B_2
I8SB-2	5	IT 1993	Xylenes, total	8.8	

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

1 Depths are in feet and represent top of sampling interval.

2 Data Sources:
IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation

3. 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.
- B_2 - Analyte was found in the blank as well as the sample.
- C - Confirmed.
- D1:5 - Qualifier definition not available.



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	0.79
Arsenic	2.6
Cadmium	2.5
Chromium	12
Copper	15
Cyanide	0.005
Lead	31
Mercury	0.06
Nickel	3.4
Thallium	0.001
Tin	3.9
Zinc	30
ORGANIC	
4,4'-DDT	100

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: ALL THREE IT 1993 SOIL SAMPLE LOCATIONS WERE SAMPLED AT THE SURFACE AND AT LEAST ONE SUBSURFACE DEPTH. DUE TO THE LIMITED NUMBER OF RESULTS IN EXCESS OF SCREENING VALUES, BOTH SUBSURFACE AND SURFACE RESULTS ARE SHOWN ON THIS FIGURE. DEPTHS ARE NOT SHOWN FOR SURFACE SOIL SAMPLES.

LEGEND

18SB-1 ◐ SOIL SAMPLE LOCATION IT CORPORATION (1993)

18SB-4 ⌖ SOIL SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/25/96
SCALE: AS SHOWN	
CAD DWG. NO.: IR8704686	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 8-6
SOIL CHEMICAL CONCENTRATIONS IR 8
NAVAL AIR STATION KEY WEST, FLORIDA

0101E387

contamination. Metals accounted for most of the chemicals found in the subsurface soil at the Fleming Key South Landfill. In general, metals were found near the center of the site, west of the ammunition storage area.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of subsurface soil samples.

8.4.1.1 Volatile Organic Compounds

No VOCs were detected in excess of screening values in subsurface soil at IR 8; however, a number of VOCs were detected below their screening values at a single sample location, I8SB-2. VOCs detected there at a depth of 5 feet included 1,1,2-trichloroethane (0.15 µg/kg), ethylbenzene (2.8 µg/kg), and xylene (8.8 µg/kg). Acetone (24 µg/kg), carbon disulfide (5 µg/kg), and methylene chloride (21 µg/kg) were detected there at a depth of 15 feet. No VOCs were detected at either of the other subsurface soil sampling locations.

8.4.1.2 Semivolatile Organic Compounds

No SVOCs exceeded the screening values in subsurface soil samples at IR 8. Two SVOCs, 1,2-dichlorobenzene and 1,4-dichlorobenzene, were detected at levels below their screening values at a single subsurface soil sample location, I8SB-2 (5 foot depth). This is the same sample location where several VOCs were detected below their screening values. No SVOCs were detected at either of the other subsurface sampling locations or in the sample collected at 15 feet at I8SB-2.

8.4.1.3 Pesticides

No pesticides were detected in excess of screening values in subsurface soil at IR 8. 4,4'-DDE was detected below its 153.24-µg/kg screening value at I8SB-3 (4 µg/kg). Dieldrin was detected below its 40 µg/kg screening value at I8SB-2 (17.3 µg/kg; 5 foot depth). No other pesticides were detected in the subsurface soil at IR 8.

8.4.1.4 Polychlorinated Biphenyls

PCBs were not detected in the single subsurface soil sample in which they were tested (I8SB-2; 15 feet).

8.4.1.5 Inorganics

Several metals were detected in excess of their screening values in subsurface soil at IR 8. Most exceedances were detected in a single sample. However, antimony was detected in excess of its 0.79-mg/kg screening value in three of the four samples. Lead, mercury, tin, and zinc were detected in excess of their screening values at I8SB-1 and I8SB-2 (5 feet). Other metals detected were each detected in excess of screening values at a single sample location. Concentrations that exceeded respective screening values only at I8SB-1 included arsenic (3.9 mg/kg), chromium (45.2 mg/kg), copper (53.6 mg/kg), and nickel (5.9 mg/kg). Metals detected in excess of screening values only at I8SB-2 (5-foot depth) included cadmium (20.2 mg/kg) and thallium (1.5 mg/kg). Cyanide was tested for only in the subsurface sample collected from a depth of 15 feet at I8SB-2; it was detected in excess of its 0.005 mg/kg screening value at a concentration of 16 mg/kg. Other inorganics detected at IR 8 but below screening values included aluminum, barium, beryllium, iron, manganese, selenium, and vanadium.

8.4.2 Surface Soil

Data from two sampling efforts, the 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of surface soil contamination at IR 8. Samples from this Supplemental RFI/RI were tested for pesticides and PCBs only. The single surface soil sample from IT Corporation's 1993 RFI/RI was tested for VOCs, SVOCs, pesticides, PCBs, and inorganics. Chemicals that were detected in surface soil samples are listed in Table 8-2. This table includes analytical results from all applicable historical sampling events as well as the Supplemental RFI/RI. Figure 8-6 shows the occurrence of compounds that exceeded screening values in surface soil. Metals accounted for most of the chemicals found in the soil at the Fleming Key South Landfill. In general, surface-soil metals were found near the center of the site, west of the ammunition storage area.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

TABLE 8-2

CHEMICALS DETECTED IN SURFACE SOIL AT IR 8
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
I8SB-3	IT 1993	Aluminum	228	
I8SB-3	IT 1993	Arsenic	0.84	B_1
I8SB-3	IT 1993	Barium	5.9	B_1
I8SB-3	IT 1993	Chromium	4.5	
I8SB-3	IT 1993	Copper	3.7	
I8SB-3	IT 1993	Iron	391	
I8SB-3	IT 1993	Lead	26.9	
I8SB-3	IT 1993	Manganese	5.7	
I8SB-3	IT 1993	Mercury	0.04	
I8SB-3	IT 1993	Vanadium	1.2	B_1
I8SB-3	IT 1993	Zinc	13.7	
PESTICIDES/PCBs (µg/kg)				
I8SB-6	B&RE 1996	4,4'-DDD	61.5	
I8SB-7	B&RE 1996	4,4'-DDD	5.7	J
I8SB-6	B&RE 1996	4,4'-DDE	51.8	
I8SB-5	B&RE 1996	4,4'-DDE	2.8	
I8SB-4	B&RE 1996	4,4'-DDE	0.98	J
I8SB-6	B&RE 1996	4,4'-DDT	120	
I8SB-7	B&RE 1996	4,4'-DDT	14.2	
I8SB-5	B&RE 1996	4,4'-DDT	2.8	
I8SB-4	B&RE 1996	4,4'-DDT	2.5	J
I8SB-7	B&RE 1996	Aroclor-1260	85	
I8SB-4	B&RE 1996	Aroclor-1260	15.6	
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
I8SB-3	IT 1993	Methylene chloride	6	B_2

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2. Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.

8.4.2.1 Volatile Organic Compounds

No VOCs were detected in excess of screening values in surface soil samples at IR 8. Methylene chloride was detected below its 300 µg/kg screening value at I8SB-3 (6 µg/kg). VOCs were not tested for in samples collected by B&R Environmental in 1996 as per the approved Sampling and Analysis Plan (ABB, 1995).

8.4.2.2 Semivolatile Organic Compounds

No SVOCs were detected in excess of screening values in surface soil at IR 8. SVOCs were not tested for in B&R Environmental samples collected in 1996 as per the Sampling and Analysis Plan (ABB, 1995).

8.4.2.3 Pesticides

A single pesticide, 4,4'-DDT, was detected in excess of its screening value in surface soil at IR 8. 4,4'-DDT was detected at all four B&R Environmental samples collected in 1996; however, it exceeded its 110-µg/kg screening value at a single sample location, I8SB-6 (120 µg/kg). 4,4'-DDD and 4,4'-DDE were also detected in the surface soil at IR 8 at levels below their screening values. 4,4'-DDT and its degradation products were the only pesticides detected in surface soil samples at IR 8.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situation where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Aroclor-1260 was selected as an ecological COPC (see Section 8.7.4.1.2) because no suitable ecological threshold was available. The selected nature and extent screening values for Aroclor-1260 was not ecological screening levels.

8.4.2.4 Polychlorinated Biphenyls

No PCBs were detected in excess of screening values in surface soil at IR 8. A single PCB, Aroclor-1260, was detected below its 96.33 µg/kg-screening criterion at I8SB-4 (15.6 µg/kg) and I8SB-7 (85 µg/kg).

8.4.2.5 Inorganics

No inorganics were detected in excess of screening values in surface soil at IR 8. Several metals were detected at levels below their screening criteria in the single sample that was tested for inorganics, I8SB-3. Metals detected there included aluminum, arsenic, barium, chromium, copper, iron, lead,

manganese, mercury, vanadium, and zinc. B&R Environmental did not test for inorganics in their 1996 sampling as per the Sampling and Analysis Plan (ABB, 1995).

8.4.3 Sediment

Data from a number of sampling efforts including the 1990 IT Corporation RI, the 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of sediment contamination at IR 8. Samples from this Supplemental RFI/RI were tested for pesticides, PCBs, and inorganics. Sediment samples from both IT Corporation investigations were tested for VOCs, SVOCs, pesticides, and inorganics. The majority of the IT Corporation 1993 samples were tested only for the polyaromatic hydrocarbon SVOCs. Two IT Corporation 1993 samples were tested for the longer list of SVOCs and PCBs, as were all IT Corporation 1990 samples. Chemicals that were detected in sediment samples are listed in Table 8-3. This table lists analytical results from all applicable historical sampling events, as well as this Supplemental RFI/RI. Sediment samples were taken on the perimeter of the site on the north, west, and south sides towards the Gulf of Mexico. Figure 8-7 shows the occurrence of analytes that exceeded screening values and indicate possible sediment contamination. Metals accounted for most of the contaminants detected in sediment at the Fleming Key South Landfill. In general, metal and pesticide concentrations increased from the east to the west side of the site. SVOCs were also detected in excess of screening criteria, but predominantly on the north and south perimeters.

Screening values were obtained from a variety of sources including: FDEPs, SQAGs, EPA Region IV Screening Values, EPA SQCs for Marine and Freshwater Sediments, ER-L Criteria, ER-M Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples.

8.4.3.1 Volatile Organic Compounds

A single VOC, acetone, was detected in excess of its 64-µg/kg screening value in sediment at IR 8. Acetone was detected at I8SS-10(IT) (72 µg/kg) and I8S-1 (5 µg/kg); however it was only in excess of its screening value at I8SS-10(IT) located on the southern perimeter of the site just west of the Key West Wastewater Treatment Plant. Other VOCs detected in sediment at IR 8 at concentrations below their screening values included methylene chloride and toluene. Methylene chloride was detected in all three

TABLE 8-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 8
NAS KEY WEST
PAGE 1 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
I8S-2	IT 1990	Aluminum	17,400	
I8S-3	IT 1990	Aluminum	3,850	
I8S-1	IT 1990	Aluminum	1,840	
I8SS-10	B&RE 1996	Aluminum	1,720	
I8SS-7	B&RE 1996	Aluminum	1,410	
I8SS-8	B&RE 1996	Aluminum	1,320	
I8SS-4	B&RE 1996	Aluminum	586	
I8SS-9	B&RE 1996	Aluminum	479	
I8SS-10(IT)	IT 1993	Aluminum	368	
I8SS-6	B&RE 1996	Aluminum	296	
I8SS-1	B&RE 1996	Aluminum	226	
I8SS-3	B&RE 1996	Aluminum	206.5	
I8SS-5	B&RE 1996	Aluminum	195	
I8SS-2	B&RE 1996	Aluminum	159	
I8S-3	IT 1990	Antimony	20.7	
I8S-2	IT 1990	Antimony	20.3	
I8SS-7	B&RE 1996	Antimony	8.6	
I8SS-10(IT)	IT 1993	Antimony	5.7	B_1
I8SS-7(IT)	IT 1993	Antimony	5	B_1
I8S-2	IT 1990	Arsenic	43.5	
I8SS-7	B&RE 1996	Arsenic	33.9	
I8SS-8	B&RE 1996	Arsenic	18.3	
I8S-3	IT 1990	Arsenic	15.8	
I8SS-7(IT)	IT 1993	Arsenic	8.1	
I8SS-5	B&RE 1996	Arsenic	8	
I8S-1	IT 1990	Arsenic	6.7	
I8SS-9	B&RE 1996	Arsenic	4.7	
I8SS-4(IT)	IT 1993	Arsenic	4.4	
I8SS-2(IT)	IT 1993	Arsenic	4.1	
I8SS-5(IT)	IT 1993	Arsenic	2.8	
I8SS-10(IT)	IT 1993	Arsenic	2.5	
I8SS-6(IT)	IT 1993	Arsenic	2.4	
I8SS-10	B&RE 1996	Arsenic	2.2	
I8SS-9(IT)	IT 1993	Arsenic	2.2	

Location	Source[1]	Parameter	Result	Qual.[2]
I8SS-4	B&RE 1996	Arsenic	1.9	
I8SS-6	B&RE 1996	Arsenic	1.9	
I8SS-3	B&RE 1996	Arsenic	1.65	
I8SS-1	B&RE 1996	Arsenic	1.6	
I8SS-3(IT)	IT 1993	Arsenic	1.4	B_1
I8SS-2	B&RE 1996	Arsenic	1.3	
I8SS-1(IT)	IT 1993	Arsenic	1	B_1
I8S-3	IT 1990	Barium	304	
I8S-2	IT 1990	Barium	105	
I8SS-7	B&RE 1996	Barium	47.8	
I8S-1	IT 1990	Barium	38.8	
I8SS-4(IT)	IT 1993	Barium	7.8	B_1
I8SS-3(IT)	IT 1993	Barium	7.1	B_1
I8SS-2(IT)	IT 1993	Barium	6.9	B_1
I8SS-1(IT)	IT 1993	Barium	5.8	B_1
I8SS-10(IT)	IT 1993	Barium	5.7	B_1
I8SS-5(IT)	IT 1993	Barium	5.6	B_1
I8SS-9(IT)	IT 1993	Barium	4.4	B_1
I8SS-7(IT)	IT 1993	Barium	4.3	B_1
I8SS-6(IT)	IT 1993	Barium	4	B_1
I8S-2	IT 1990	Cadmium	11.4	
I8S-3	IT 1990	Cadmium	3.3	
I8SS-7	B&RE 1996	Cadmium	2	
I8SS-8	B&RE 1996	Cadmium	1.4	
I8S-1	IT 1990	Cadmium	0.94	
I8SS-5	B&RE 1996	Cadmium	0.21	
I8S-2	IT 1990	Chromium	70.7	
I8SS-7	B&RE 1996	Chromium	52.5	
I8SS-5	B&RE 1996	Chromium	32.5	
I8S-3	IT 1990	Chromium	28	
I8SS-8	B&RE 1996	Chromium	27.2	
I8S-1	IT 1990	Chromium	12.1	
I8SS-9	B&RE 1996	Chromium	11.8	
I8SS-7(IT)	IT 1993	Chromium	10.3	
I8SS-3(IT)	IT 1993	Chromium	6.5	

TABLE 8-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 8
NAS KEY WEST
PAGE 2 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I8SS-4(IT)	IT 1993	Chromium	5.6	
I8SS-2(IT)	IT 1993	Chromium	5.5	
I8SS-5(IT)	IT 1993	Chromium	4.7	
I8SS-10(IT)	IT 1993	Chromium	4.6	
I8SS-1(IT)	IT 1993	Chromium	4.5	
I8SS-6(IT)	IT 1993	Chromium	4.3	
I8SS-10	B&RE 1996	Chromium	4.3	
I8SS-3	B&RE 1996	Chromium	3.6	
I8SS-1	B&RE 1996	Chromium	3.4	
I8SS-9(IT)	IT 1993	Chromium	3.3	
I8SS-4	B&RE 1996	Chromium	3	
I8SS-6	B&RE 1996	Chromium	2.9	
I8SS-2	B&RE 1996	Chromium	2.3	
I8S-2	IT 1990	Cobalt	10.1	
I8SS-7	B&RE 1996	Cobalt	8.1	
I8SS-8	B&RE 1996	Cobalt	6.5	
I8S-3	IT 1990	Cobalt	5.1	B_1
I8SS-7(IT)	IT 1993	Cobalt	4.3	B_1
I8SS-5	B&RE 1996	Cobalt	2.3	
I8SS-9	B&RE 1996	Cobalt	1	
I8SS-6	B&RE 1996	Cobalt	0.4	
I8SS-10	B&RE 1996	Cobalt	0.37	
I8S-3	IT 1990	Copper	1,100	
I8S-2	IT 1990	Copper	685	
I8SS-7	B&RE 1996	Copper	492	
I8S-1	IT 1990	Copper	121	
I8SS-8	B&RE 1996	Copper	85.3	
I8SS-6	B&RE 1996	Copper	76.9	
I8SS-5	B&RE 1996	Copper	38.1	
I8SS-3	B&RE 1996	Copper	15.2	
I8SS-1	B&RE 1996	Copper	14.5	
I8SS-10	B&RE 1996	Copper	13	
I8SS-2	B&RE 1996	Copper	12.7	
I8SS-9	B&RE 1996	Copper	10.4	
I8SS-7(IT)	IT 1993	Copper	9.5	

Location	Source[1]	Parameter	Result	Qual.[2]
I8SS-6(IT)	IT 1993	Copper	7.9	
I8SS-3(IT)	IT 1993	Copper	5.4	
I8SS-10(IT)	IT 1993	Copper	4.9	
I8SS-2(IT)	IT 1993	Copper	4.5	B_1
I8SS-4(IT)	IT 1993	Copper	4.1	B_1
I8SS-1(IT)	IT 1993	Copper	3.4	B_1
I8SS-5(IT)	IT 1993	Copper	3.2	B_1
I8SS-9(IT)	IT 1993	Copper	1.5	B_1
I8S-3	IT 1990	Iron	27,100	
I8S-1	IT 1990	Iron	4,060	
I8SS-10(IT)	IT 1993	Iron	646	
I8S-2	IT 1990	Lead	1,680	
I8S-3	IT 1990	Lead	597	
I8SS-7	B&RE 1996	Lead	371	
I8S-1	IT 1990	Lead	252	
I8SS-8	B&RE 1996	Lead	229	J
I8SS-6	B&RE 1996	Lead	125	
I8SS-6(IT)	IT 1993	Lead	53.1	
I8SS-3	B&RE 1996	Lead	37.7	
I8SS-3(IT)	IT 1993	Lead	27.4	
I8SS-2(IT)	IT 1993	Lead	23.6	
I8SS-9	B&RE 1996	Lead	22.7	
I8SS-5	B&RE 1996	Lead	21.9	
I8SS-10(IT)	IT 1993	Lead	21.6	
I8SS-5(IT)	IT 1993	Lead	19.3	
I8SS-1	B&RE 1996	Lead	18.5	
I8SS-2	B&RE 1996	Lead	18.2	
I8SS-10	B&RE 1996	Lead	16.5	J
I8SS-7(IT)	IT 1993	Lead	16.4	
I8SS-4	B&RE 1996	Lead	15.6	
I8SS-4(IT)	IT 1993	Lead	15.4	
I8SS-1(IT)	IT 1993	Lead	14.8	
I8SS-9(IT)	IT 1993	Lead	4.9	
I8SS-7	B&RE 1996	Manganese	546	
I8S-2	IT 1990	Manganese	524	

TABLE 8-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 8
NAS KEY WEST
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Location	Source[1]	Parameter	Result	Qual.[2]
I8SS-8	B&RE 1996	Manganese	286	
I8SS-5	B&RE 1996	Manganese	230	
I8S-3	IT 1990	Manganese	210	
I8SS-4	B&RE 1996	Manganese	76.3	
I8SS-9	B&RE 1996	Manganese	70.6	
I8S-1	IT 1990	Manganese	54	
I8SS-10	B&RE 1996	Manganese	33.8	J
I8SS-6	B&RE 1996	Manganese	14.3	
I8SS-1	B&RE 1996	Manganese	6.2	
I8SS-3	B&RE 1996	Manganese	6.1	
I8SS-10(IT)	IT 1993	Manganese	5.3	
I8SS-2	B&RE 1996	Manganese	4.7	
I8S-2	IT 1990	Mercury	1.6	
I8SS-10(IT)	IT 1993	Mercury	0.27	
I8SS-3(IT)	IT 1993	Mercury	0.2	
I8SS-2(IT)	IT 1993	Mercury	0.17	
I8SS-4(IT)	IT 1993	Mercury	0.1	
I8S-3	IT 1990	Mercury	0.09	
I8SS-5(IT)	IT 1993	Mercury	0.08	
I8SS-3	B&RE 1996	Mercury	0.075	J
I8SS-7	B&RE 1996	Mercury	0.06	J
I8SS-1(IT)	IT 1993	Mercury	0.06	
I8SS-2	B&RE 1996	Mercury	0.06	J
I8SS-1	B&RE 1996	Mercury	0.06	J
I8SS-6(IT)	IT 1993	Mercury	0.05	
I8SS-6	B&RE 1996	Mercury	0.04	J
I8SS-8	B&RE 1996	Mercury	0.04	J
I8SS-7	B&RE 1996	Nickel	248	
I8S-2	IT 1990	Nickel	65.4	
I8SS-8	B&RE 1996	Nickel	29.3	J
I8SS-5	B&RE 1996	Nickel	24.9	
I8S-3	IT 1990	Nickel	18.6	
I8S-1	IT 1990	Nickel	17	
I8SS-7(IT)	IT 1993	Nickel	6.7	
I8SS-9	B&RE 1996	Nickel	5.2	

Location	Source[1]	Parameter	Result	Qual.[2]
I8SS-10	B&RE 1996	Nickel	2.6	
I8SS-6	B&RE 1996	Nickel	2.1	
I8SS-2	B&RE 1996	Nickel	1.4	
I8SS-1	B&RE 1996	Nickel	1.2	
I8SS-3	B&RE 1996	Nickel	1.1	
I8SS-4	B&RE 1996	Nickel	1.1	
I8SS-7	B&RE 1996	Selenium	4.8	
I8S-3	IT 1990	Silver	17.7	
I8S-2	IT 1990	Silver	2.4	
I8SS-7	B&RE 1996	Silver	0.63	
I8S-2	IT 1990	Thallium	168	
I8S-3	IT 1990	Thallium	46.7	
I8SS-7(IT)	IT 1993	Tin	55.6	
I8SS-10(IT)	IT 1993	Tin	12.8	B_1
I8SS-7	B&RE 1996	Vanadium	25.7	
I8S-1	IT 1990	Vanadium	20.1	
I8S-2	IT 1990	Vanadium	15.2	
I8SS-8	B&RE 1996	Vanadium	14.4	
I8S-3	IT 1990	Vanadium	12.1	
I8SS-7(IT)	IT 1993	Vanadium	11	
I8SS-5	B&RE 1996	Vanadium	5.6	
I8SS-9	B&RE 1996	Vanadium	4.9	
I8SS-10	B&RE 1996	Vanadium	3.9	
I8SS-4	B&RE 1996	Vanadium	3.2	
I8SS-4(IT)	IT 1993	Vanadium	3.1	B_1
I8SS-1(IT)	IT 1993	Vanadium	3.1	B_1
I8SS-3(IT)	IT 1993	Vanadium	2.6	B_1
I8SS-2(IT)	IT 1993	Vanadium	2.4	B_1
I8SS-5(IT)	IT 1993	Vanadium	2.3	B_1
I8SS-10(IT)	IT 1993	Vanadium	2.1	B_1
I8SS-6(IT)	IT 1993	Vanadium	1.9	B_1
I8SS-5	B&RE 1996	Zinc	2,180	
I8S-2	IT 1990	Zinc	1,620	
I8S-3	IT 1990	Zinc	1,370	
I8SS-7	B&RE 1996	Zinc	707	

TABLE 8-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 8
NAS KEY WEST
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Location	Source[1]	Parameter	Result	Qual.[2]
I8SS-8	B&RE 1996	Zinc	656	
I8S-1	IT 1990	Zinc	420	
I8SS-7(IT)	IT 1993	Zinc	112	
I8SS-6	B&RE 1996	Zinc	60.9	
I8SS-10(IT)	IT 1993	Zinc	39.9	
I8SS-3(IT)	IT 1993	Zinc	24.7	
I8SS-2(IT)	IT 1993	Zinc	24.1	
I8SS-6(IT)	IT 1993	Zinc	21.3	
I8SS-5(IT)	IT 1993	Zinc	19.1	
I8SS-4	B&RE 1996	Zinc	18.9	
I8SS-4(IT)	IT 1993	Zinc	16.6	
I8SS-3	B&RE 1996	Zinc	13.6	
I8SS-1(IT)	IT 1993	Zinc	12	
I8SS-9	B&RE 1996	Zinc	7.6	
I8SS-9(IT)	IT 1993	Zinc	6.5	
I8SS-10	B&RE 1996	Zinc	5.2	
PESTICIDES/PCBs (µg/kg)				
I8SS-4	B&RE 1996	2,4-D	58.8	J
I8SS-1	B&RE 1996	2,4-D	27.6	J
I8SS-6	B&RE 1996	2,4-D	20.2	J
I8SS-7	B&RE 1996	2,4-D	17.9	J
I8SS-3	B&RE 1996	2,4-D	15.7	
I8SS-5	B&RE 1996	2,4-D	11	J
I8SS-8(IT)	IT 1993	4,4'-DDD	100	
I8SS-7	B&RE 1996	4,4'-DDD	12.7	J
I8SS-1(IT)	IT 1993	4,4'-DDD	9	C
I8S-2	IT 1990	4,4'-DDE	180	D
I8SS-6(IT)	IT 1993	4,4'-DDE	28	C
I8S-3	IT 1990	4,4'-DDE	15	J
I8SS-8	B&RE 1996	4,4'-DDE	5.2	
I8SS-3(IT)	IT 1993	4,4'-DDE	4	C
I8S-2	IT 1990	4,4'-DDT	46	DJ
I8SS-8(IT)	IT 1993	4,4'-DDT	43	DJ
I8S-3	IT 1990	4,4'-DDT	27	
I8SS-6(IT)	IT 1993	4,4'-DDT	14	C
I8SS-8	B&RE 1996	4,4'-DDT	9.7	
I8SS-1(IT)	IT 1993	4,4'-DDT	8	C
I8SS-8(IT)	IT 1993	alpha-BHC	30	DJ
I8SS-8	B&RE 1996	Aroclor-1254	26.1	
I8SS-8(IT)	IT 1993	beta-BHC	32	DJ
I8SS-8(IT)	IT 1993	delta-BHC	48	DJ
I8SS-8	B&RE 1996	Endosulfan I	1.3	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)				
I8SS-3(IT)	IT 1993	Anthracene	20	
I8SS-10(IT)	IT 1993	Benzo(a)anthracene	130	J
I8SS-8(IT)	IT 1993	Benzo(a)anthracene	110	J
I8SS-3(IT)	IT 1993	Benzo(a)anthracene	80	
I8SS-2(IT)	IT 1993	Benzo(a)anthracene	22	
I8SS-7(IT)	IT 1993	Benzo(a)anthracene	15	
I8SS-10(IT)	IT 1993	Benzo(a)pyrene	130	J
I8SS-3(IT)	IT 1993	Benzo(a)pyrene	120	
I8SS-8(IT)	IT 1993	Benzo(a)pyrene	83	J
I8SS-1(IT)	IT 1993	Benzo(a)pyrene	41	
I8SS-2(IT)	IT 1993	Benzo(a)pyrene	41	
I8SS-10(IT)	IT 1993	Benzo(b)fluoranthene	160	J
I8SS-8(IT)	IT 1993	Benzo(b)fluoranthene	110	J
I8SS-3(IT)	IT 1993	Benzo(b)fluoranthene	100	
I8SS-2(IT)	IT 1993	Benzo(b)fluoranthene	35	
I8SS-1(IT)	IT 1993	Benzo(b)fluoranthene	21	
I8SS-3(IT)	IT 1993	Benzo(g,h,i)perylene	100	
I8S-3	IT 1990	Benzo(g,h,i)perylene	93	J
I8SS-2(IT)	IT 1993	Benzo(g,h,i)perylene	46	
I8SS-1(IT)	IT 1993	Benzo(g,h,i)perylene	36	
I8SS-10(IT)	IT 1993	Benzo(k)fluoranthene	140	J
I8SS-8(IT)	IT 1993	Benzo(k)fluoranthene	83	J
I8SS-3(IT)	IT 1993	Benzo(k)fluoranthene	50	
I8SS-2(IT)	IT 1993	Benzo(k)fluoranthene	20	
I8SS-1(IT)	IT 1993	Benzo(k)fluoranthene	9.8	
I8S-1	IT 1990	Bis(2-ethylhexyl)phthalate	1,100	
I8SS-8(IT)	IT 1993	Bis(2-ethylhexyl)phthalate	820	B_1

TABLE 8-3

CHEMICALS DETECTED IN SEDIMENT* AT IR 8
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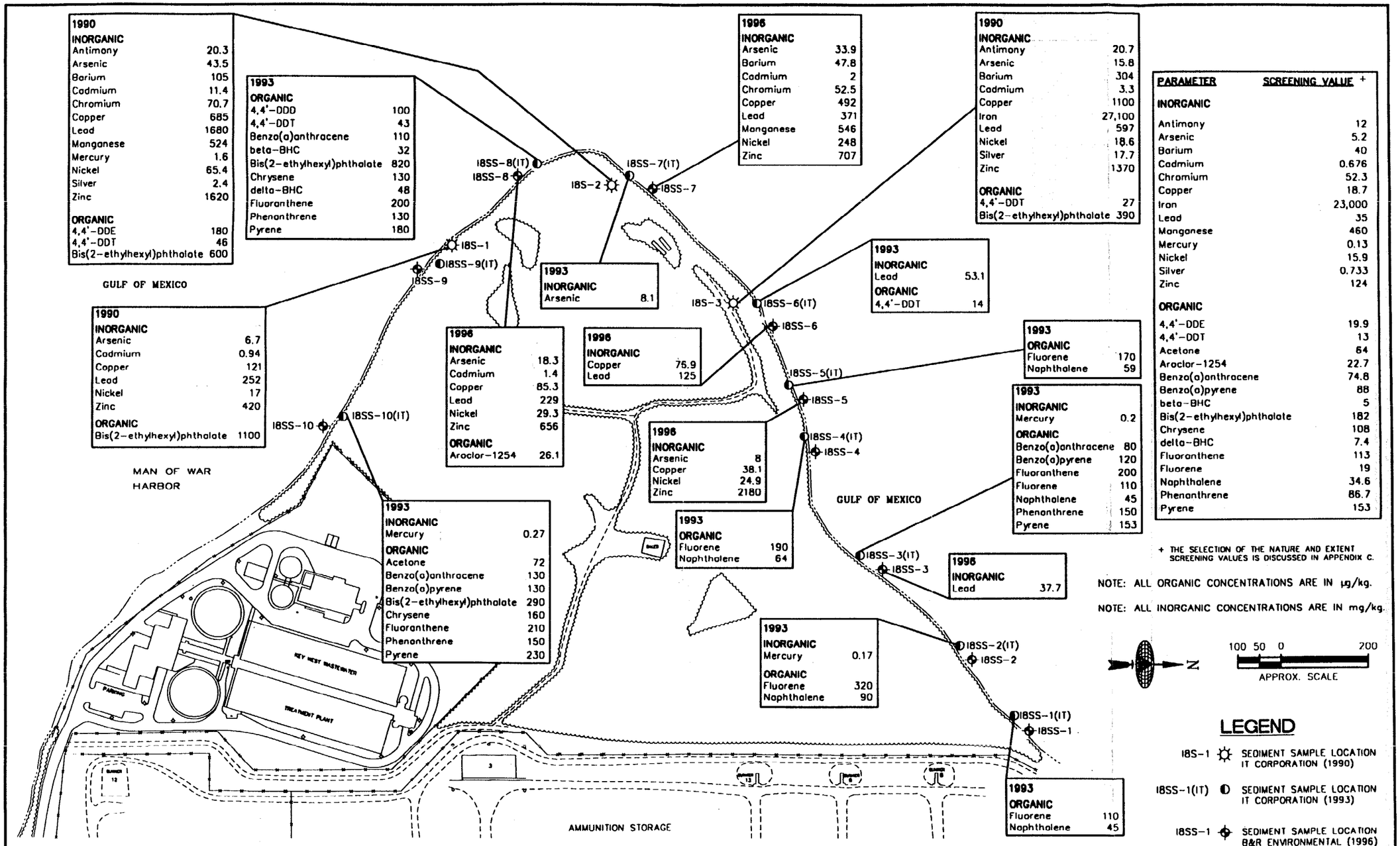
Location	Source[1]	Parameter	Result	Qual.[2]
I8S-2	IT 1990	Bis(2-ethylhexyl)phthalate	600	J
I8S-3	IT 1990	Bis(2-ethylhexyl)phthalate	390	J
I8SS-10(IT)	IT 1993	Bis(2-ethylhexyl)phthalate	290	J
I8SS-10(IT)	IT 1993	Chrysene	160	J
I8SS-8(IT)	IT 1993	Chrysene	130	J
I8SS-3(IT)	IT 1993	Chrysene	87	
I8SS-2(IT)	IT 1993	Chrysene	29	
I8SS-7(IT)	IT 1993	Chrysene	16	
I8SS-8(IT)	IT 1993	Di-n-butyl phthalate	160	J
I8SS-10(IT)	IT 1993	Fluoranthene	210	J
I8SS-3(IT)	IT 1993	Fluoranthene	200	
I8SS-8(IT)	IT 1993	Fluoranthene	200	J
I8SS-4(IT)	IT 1993	Fluoranthene	49	
I8SS-7(IT)	IT 1993	Fluoranthene	48	
I8SS-2(IT)	IT 1993	Fluoranthene	45	
I8SS-5(IT)	IT 1993	Fluoranthene	26	
I8SS-2(IT)	IT 1993	Fluorene	320	
I8SS-4(IT)	IT 1993	Fluorene	190	
I8SS-5(IT)	IT 1993	Fluorene	170	
I8SS-3(IT)	IT 1993	Fluorene	110	
I8SS-1(IT)	IT 1993	Fluorene	110	
I8SS-3(IT)	IT 1993	Indeno(1,2,3-cd)pyrene	100	
I8SS-10(IT)	IT 1993	Indeno(1,2,3-cd)pyrene	80	J
I8SS-8(IT)	IT 1993	Indeno(1,2,3-cd)pyrene	53	J
I8SS-2(IT)	IT 1993	Indeno(1,2,3-cd)pyrene	30	
I8SS-1(IT)	IT 1993	Indeno(1,2,3-cd)pyrene	17	
I8SS-2(IT)	IT 1993	Naphthalene	90	
I8SS-4(IT)	IT 1993	Naphthalene	64	
I8SS-5(IT)	IT 1993	Naphthalene	59	
I8SS-3(IT)	IT 1993	Naphthalene	45	
I8SS-1(IT)	IT 1993	Naphthalene	45	
I8SS-3(IT)	IT 1993	Phenanthrene	150	
I8SS-10(IT)	IT 1993	Phenanthrene	150	J
I8SS-8(IT)	IT 1993	Phenanthrene	130	J
I8SS-4(IT)	IT 1993	Phenanthrene	60	
I8SS-2(IT)	IT 1993	Phenanthrene	58	
I8SS-5(IT)	IT 1993	Phenanthrene	44	
I8SS-1(IT)	IT 1993	Phenanthrene	24	
I8SS-10(IT)	IT 1993	Pyrene	230	J
I8SS-8(IT)	IT 1993	Pyrene	180	J
I8SS-3(IT)	IT 1993	Pyrene	153	
I8SS-4(IT)	IT 1993	Pyrene	40	
I8SS-2(IT)	IT 1993	Pyrene	39	
I8SS-7(IT)	IT 1993	Pyrene	28	
I8SS-5(IT)	IT 1993	Pyrene	28	
VOLATILE ORGANIC COMPOUNDS (µg/kg)				
I8SS-10(IT)	IT 1993	Acetone	72	
I8S-1	IT 1990	Acetone	5	J
I8SS-10(IT)	IT 1993	Methylene chloride	22	B_2
I8S-1	IT 1990	Methylene chloride	14	
I8S-2	IT 1990	Methylene chloride	7	
I8S-3	IT 1990	Methylene chloride	7	
I8S-1	IT 1990	Toluene	5	J

All sediment samples at IR 8 were surface sediment.
Shading indicates a concentration in excess of the screening values (See Table C.3-2).

1 Data Sources:
IT 1990 - RI (IT Corporation, 1991) conducted in 1990 by IT Corporation
IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
C - Confirmed.
D - Compound analyzed at a secondary dilution factor.
B_2 - Analyte was found in the blank as well as the sample.



SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 1/16/98
SURVEYED BY: TCB	SURVEY DATE: 9/25/96
SCALE: AS SHOWN	
CAD DWG. NO.: IR8704687	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 8-7
SEDIMENT CHEMICAL CONCENTRATIONS IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

0101F392

IT Corporation 1990 samples, and in I8SS-10(IT) from the 1993 IT Corporation RFI/RI. Toluene was detected in a single IT Corporation 1990 sample (I8S-1) that also contained acetone and methylene chloride.

8.4.3.2 Semivolatile Organic Compounds

A number of SVOCs were detected in excess of screening values in sediment at IR 8. Maximum concentrations were mostly detected at I8SS-10(IT) including benzo(a)anthracene (130 µg/kg), benzo(a)pyrene (130 µg/kg), chrysene (160 µg/kg), fluoranthene (210 µg/kg), phenanthrene (150 µg/kg), and pyrene (230 µg/kg). The maximum concentration of bis(2-ethylhexyl)phthalate (1,100 µg/kg) was also detected on the southwestern side of IR 8, at I8S-1. Maximum concentrations detected on the northeastern side of IR 8 included fluorene (320 µg/kg) and naphthalene (90 µg/kg). The maximum concentration of phenanthrene (150 µg/kg) was also detected on the northeastern shoreline. Other SVOCs detected in sediment at IR 8 at concentrations below their screening values included anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, di-n-butylphthalate, and indeno(1,2,3-cd)pyrene. The majority of detected SVOCs occurred in multiple samples. Pyrene and fluoranthene were the most frequently detected SVOCs, each occurring in seven samples. Naphthalene, bis(2-ethylhexyl)phthalate, and fluorene were the compounds most frequently in excess of sediment screening values. Each exceeded its respective screening value in all five samples in which it was detected. B&R Environmental did not test for SVOCs in its 1996 sampling effort. Nearly all SVOCs were detected only in IT Corporation 1993 samples. Bis(2-ethylhexyl)phthalate and benzo(g,h,i)perylene were the only SVOCs detected in 1990.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene were identified as COPCs (Section 8.6.2.2) in the human health risk assessment based on a qualitative evaluation for benzo(g,h,i)perylene and since they are all from the same family as other COPCs although they do not have their own RBCs. Their concentrations in sediment at IR 8 were less than the Residential Soil RBCs [benzo(b)fluoranthene and benzo(k)fluoranthene] and EPA Region III BTAG Sediment Screening Levels [benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene] selected for nature and extent screening.

8.4.3.3 Pesticides

A number of pesticides were detected in excess of screening values in sediment at IR 8. Maximum concentrations of pesticides detected at the western-most sampling point included 4,4'-DDD (100 µg/kg), beta-BHC (32 µg/kg), and delta-BHC (48 µg/kg). Maximum concentrations of 4,4'-DDE (180 µg/kg) and 4,4'-DDT (46 µg/kg) were detected at I8S-2. 4,4'-DDT and its degradation products were detected in excess of screening values at several sample locations; however, detections occurred predominantly in IT Corporation samples. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were each detected in one 1996 sample, at concentrations well below the previously detected maximums. Other pesticides detected in sediment at IR 8 at concentrations below the screening criteria included 2,4-D and endosulfan I. Both were detected only in 1996 samples, with 2,4-D occurring in six samples and endosulfan I in a single sample.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels, 2,4-D was identified as an ecological COPC (Section 8.7.4.1.2) since no ecological threshold was available. Alpha-BHC was selected as an ecological COPC (see Section 8.7.4.1.2) since its HQ was greater than one. However, all concentrations of 2,4,-D and alpha-BHC in sediment at IR 8 were less than RCRA ALs selected for nature and extent screening.

8.4.3.4 Polychlorinated Biphenyls

A single PCB, Aroclor-1254, was detected in excess of its screening value in sediment at IR 8. Aroclor-1254 was detected at a single sample location (I8SS-8; 26.1 µg/kg) slightly in excess of its 22.7-µg/kg-screening value.

8.4.3.5 Inorganics

Several inorganics were detected in excess of screening values in sediment at IR 8. Maximum concentrations were consistently detected along the northwestern edge of IR 8 including antimony (20.7 mg/kg), arsenic (43.5 mg/kg), barium (304 mg/kg), cadmium (11.4 mg/kg), chromium (70.7 mg/kg), copper (1,100 mg/kg), iron (27,100 mg/kg), lead (1,680 mg/kg), manganese (546 mg/kg), mercury (1.6 mg/kg), nickel (248 mg/kg), silver (17.7 mg/kg), and zinc (2,180 mg/kg). The overall frequency of detection was greatest for arsenic, chromium, and lead; each was detected in all 22 samples, copper, in 21 of 22 samples, and zinc, in 20 of 22 samples. Lead was most frequently detected in excess of screening values (eight of 22 samples), followed by arsenic and copper (seven of 22 samples, each).

Other inorganics detected in sediment at IR 8 included aluminum, cobalt, selenium, thallium, tin, and vanadium.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Aluminum and thallium were identified as COPCs (see Section 8.6.2.2) in the human health risk assessment. Aluminum did not exceed its selected nature and extent screening level due to the conservative non-cancer hazard index applied to the EPA RBCs during the risk assessment process. Thallium did not have an applicable nature and extent screening level. Aluminum, selenium, thallium, and vanadium were selected as ecological COPCs (see Section 8.7.4.1.2) based on a comparison with twice the average background concentration because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels, and were higher than twice the average background concentrations.

8.4.4 Surface Water

No surface-water samples were collected at IR 8 during this Supplemental RFI/RI investigation because the surface water is open ocean water (see Appendix D, Section 7).

Data from two sampling efforts, the 1990 IT Corporation RI and the 1993 IT Corporation RFI/R, were considered in the analysis of surface-water contamination in at IR 8. VOCs, polyaromatic hydrocarbon SVOCs, pesticides, and inorganics were tested for in all samples. Other SVOCs and PCBs were tested only in three of the 10 surface-water samples. Chemicals that were detected in surface-water samples are listed in Table 8-4. This table lists analytical results from all applicable historical sampling events. Figure 8-8 shows the occurrence of analytes that exceeded screening values and indicate possible surface-water contamination. Inorganics were the dominant class of contaminants detected in these samples.

Screening values were obtained from a variety of sources including FDEP SWQSs, EPA Region IV Freshwater and Marine Screening Values, AWQCs for Fresh and Marine Waters, Proposed RCRA ALs, EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples.

TABLE 8-4

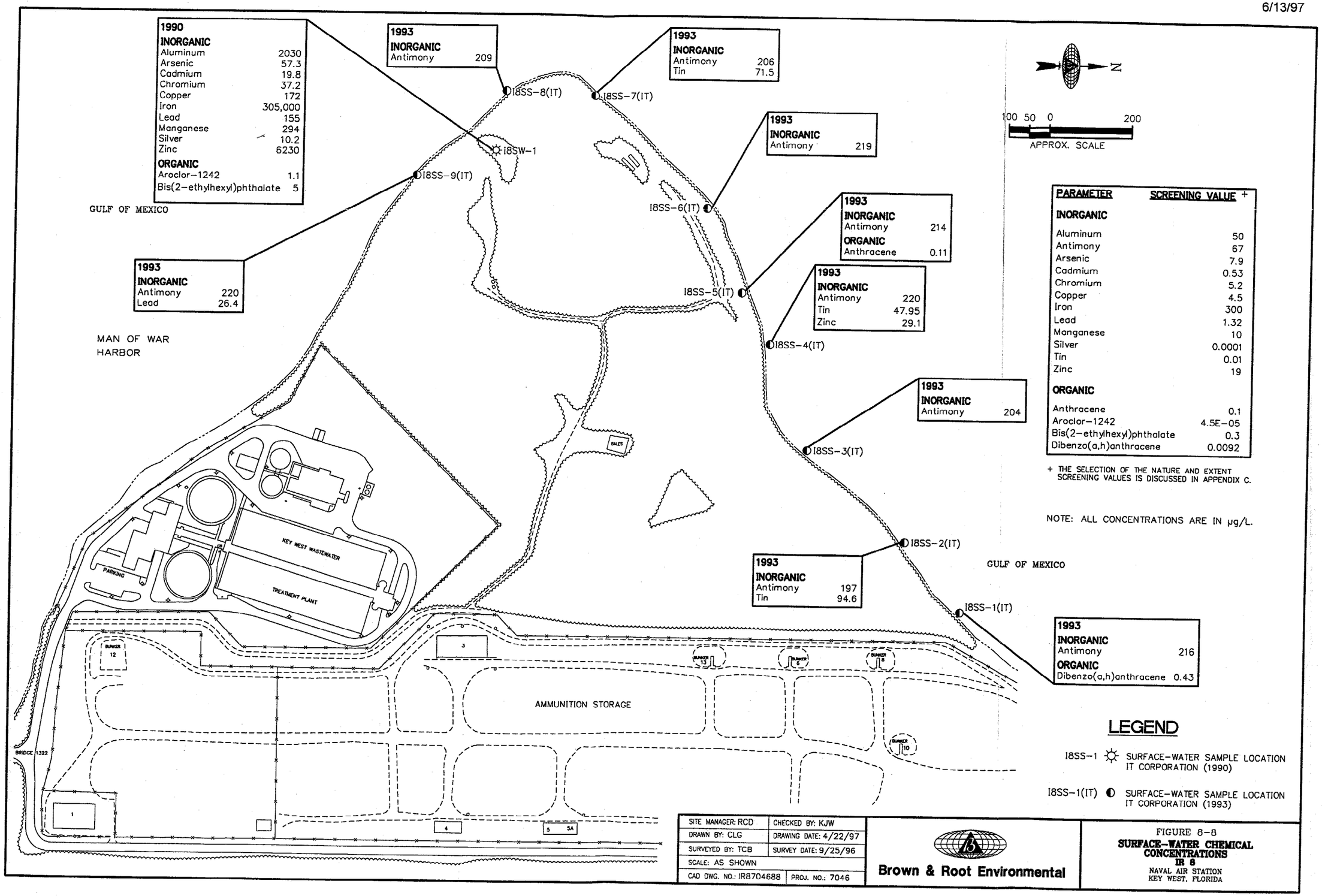
CHEMICALS DETECTED IN SURFACE WATER AT IR 8
NAS KEY WEST

Location	Source	Parameter	Result	Qual.[1]
INORGANICS (µg/L)				
I8SW-1	IT 1990	Aluminum	2,030	
I8SS-9(IT)	IT 1993	Antimony	220	
I8SS-4(IT)	IT 1993	Antimony	220	
I8SS-6(IT)	IT 1993	Antimony	219	
I8SS-1(IT)	IT 1993	Antimony	216	
I8SS-5(IT)	IT 1993	Antimony	214	
I8SS-8(IT)	IT 1993	Antimony	209	
I8SS-7(IT)	IT 1993	Antimony	206	
I8SS-3(IT)	IT 1993	Antimony	204	
I8SS-2(IT)	IT 1993	Antimony	197	
I8SW-1	IT 1990	Arsenic	57.3	
I8SW-1	IT 1990	Barium	107	B_1
I8SS-7(IT)	IT 1993	Barium	5.8	B_1
I8SS-9(IT)	IT 1993	Barium	5.5	B_1
I8SS-8(IT)	IT 1993	Barium	5.5	B_1
I8SS-6(IT)	IT 1993	Barium	5.3	B_1
I8SS-5(IT)	IT 1993	Barium	5.1	B_1
I8SS-1(IT)	IT 1993	Barium	5	B_1
I8SS-4(IT)	IT 1993	Barium	5	B_1
I8SS-3(IT)	IT 1993	Barium	4.8	B_1
I8SS-2(IT)	IT 1993	Barium	4.6	B_1
I8SW-1	IT 1990	Cadmium	19.8	
I8SW-1	IT 1990	Chromium	37.2	
I8SW-1	IT 1990	Copper	172	
I8SW-1	IT 1990	Iron	305,000	
I8SS-8(IT)	IT 1993	Iron	10.5	B_1
I8SW-1	IT 1990	Lead	155	
I8SS-9(IT)	IT 1993	Lead	26.4	
I8SW-1	IT 1990	Manganese	294	
I8SW-1	IT 1990	Mercury	0.43	
I8SS-2(IT)	IT 1993	Mercury	0.2	
I8SS-5(IT)	IT 1993	Mercury	0.2	
I8SW-1	IT 1990	Silver	10.2	
I8SS-2(IT)	IT 1993	Tin	94.6	B_1
I8SS-7(IT)	IT 1993	Tin	71.5	B_1
I8SS-4(IT)	IT 1993	Tin	48	B_1
I8SW-1	IT 1990	Vanadium	42.5	B_1
I8SW-1	IT 1990	Zinc	6,230	
I8SS-4(IT)	IT 1993	Zinc	29.1	B_1
I8SS-9(IT)	IT 1993	Zinc	9.4	B_1
I8SS-3(IT)	IT 1993	Zinc	9	B_1
I8SS-5(IT)	IT 1993	Zinc	8.8	B_1
I8SS-7(IT)	IT 1993	Zinc	8.1	B_1
I8SS-8(IT)	IT 1993	Zinc	7.1	B_1
I8SS-2(IT)	IT 1993	Zinc	7	B_1
I8SS-1(IT)	IT 1993	Zinc	6.3	B_1
I8SS-6(IT)	IT 1993	Zinc	5.8	B_1
PESTICIDES/PCBs (µg/L)				
I8SW-1	IT 1990	Aroclor-1242	1.1	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
I8SS-5(IT)	IT 1993	Anthracene	0.11	
I8SS-5(IT)	IT 1993	Benzo(g,h,i)perylene	0.54	
I8SW-1	IT 1990	Bis(2-ethylhexyl)phthalate	5	B_2J
I8SS-1(IT)	IT 1993	Dibenzo(a,h)anthracene	0.43	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
I8SW-1	IT 1990	Acetone	46	B_2

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

1 Data Sources:
IT 1990 - RI (IT Corporation, 1991) conducted in 1990 by IT Corporation
IT 1993 - RFI/RI (IT Corporation, 1994) conducted in 1993 by IT Corporation

2. Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
B_2 - Analyte was found in the blank as well as the sample.
J - The associated value is an estimated quantity.


1990
INORGANIC
Aluminum 2030
Arsenic 57.3
Cadmium 19.8
Chromium 37.2
Copper 172
Iron 305,000
Lead 155
Manganese 294
Silver 10.2
Zinc 6230
ORGANIC
Aroclor-1242 1.1
Bis(2-ethylhexyl)phthalate 5
1993
INORGANIC
Antimony 209
1993
INORGANIC
Antimony 206
Tin 71.5
1993
INORGANIC
Antimony 219
1993
INORGANIC
Antimony 214
ORGANIC
Anthracene 0.11
1993
INORGANIC
Antimony 220
Tin 47.95
Zinc 29.1
1993
INORGANIC
Antimony 204
1993
INORGANIC
Antimony 197
Tin 94.6
1993
INORGANIC
Antimony 216
ORGANIC
Dibenzo(a,h)anthracene 0.43
1993
INORGANIC
Antimony 220
Lead 26.4
I8SS-8(IT)
I8SS-7(IT)
I8SW-1
I8SS-9(IT)
I8SS-6(IT)
I8SS-5(IT)
I8SS-4(IT)
I8SS-3(IT)
I8SS-2(IT)
I8SS-1(IT)
GULF OF MEXICO
MAN OF WAR HARBOR
GULF OF MEXICO
KEY WEST WASTEWATER TREATMENT PLANT
PARKING
AMMUNITION STORAGE
BALES
BRIDGE 1322
N
100 50 0 200
APPROX. SCALE
PARAMETER SCREENING VALUE +
INORGANIC
Aluminum 50
Antimony 67
Arsenic 7.9
Cadmium 0.53
Chromium 5.2
Copper 4.5
Iron 300
Lead 1.32
Manganese 10
Silver 0.0001
Tin 0.01
Zinc 19
ORGANIC
Anthracene 0.1
Aroclor-1242 4.5E-05
Bis(2-ethylhexyl)phthalate 0.3
Dibenzo(a,h)anthracene 0.0092
+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.
NOTE: ALL CONCENTRATIONS ARE IN µg/L.
LEGEND
I8SS-1 SURFACE-WATER SAMPLE LOCATION IT CORPORATION (1990)
I8SS-1(IT) SURFACE-WATER SAMPLE LOCATION IT CORPORATION (1993)
SITE MANAGER: RCD
CHECKED BY: KJW
DRAWN BY: CLG
DRAWING DATE: 4/22/97
SURVEYED BY: TCB
SURVEY DATE: 9/25/96
SCALE: AS SHOWN
CAD DWG. NO.: IR8704688
PROJ. NO.: 7046
Brown & Root Environmental
FIGURE 8-8
SURFACE-WATER CHEMICAL CONCENTRATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

8.4.4.1 Volatile Organic Compounds

No VOCs were detected in excess of screening values in surface water at IR 8. A single VOC, acetone, was detected below its 3,700 µg/L screening value at a single sample location [I8SW-1 (46 µg/L)].

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Acetone was identified as a COPC (see Section 8.6.2.2) in the human health risk assessment based on quantitative toxicity since it does not have an RBC. Acetone concentrations in surface water at IR 8 were less than Tap Water RBCs selected for nature and extent screening.

8.4.4.2 Semivolatile Organic Compounds

Three SVOCs were detected in excess of screening values in surface water at IR 8; however each was detected at a single sample location. Anthracene was detected slightly in excess of its 0.1-µg/L-screening value at I8SS-5(IT) (0.11 µg/L). Bis(2-ethylhexyl)phthalate was detected in excess of its 0.3-µg/L-screening value at I8SW-1 (5 µg/L). Dibenzo(a,h)anthracene was detected in excess of its 0.0092-µg/L-screening value at I8SS-1(IT) (0.43 µg/L). Only one other SVOC was detected in surface water at IR 8. Benzo(g,h,i)perylene was detected below its 300 µg/L screening value at a single sample location [I8SS-5(IT); 0.54 µg/L].

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Benzo(g,h,i)perylene was identified as a COPC (see Section 8.6.2.2) in the human health risk assessment based on a qualitative evaluation and since it is in the same family as other COPCs since it does not have a RBC. Benzo(g,h,i)perylene concentrations in surface water at IR 8 were less than EPA Region III Marine BTAG Surface Water Screening Levels selected for nature and extent screening.

8.4.4.3 Pesticides

No pesticides were detected in surface water at IR 8.

8.4.4.4 Polychlorinated Biphenyls

A single PCB, Aroclor-1242, was detected in excess of its 4.5E-05 µg/L screening criteria at a single sample location, I8SW-1 (1.1 µg/L).

8.4.4.5 Inorganics

A number of inorganics were detected in excess of screening values in surface water at IR 8. Aluminum, arsenic, cadmium, chromium, copper, iron, manganese, and silver were detected in excess of their screening values at a single sample location, I8SW-1, near the western point of IR 8. Antimony, lead, and tin exceeded screening values each time they were detected in surface water at IR 8. Antimony was detected in excess of its 67-µg/L screening value at nine of 10 sample locations, with the maximum (220 µg/L) occurring at I8SS-9(IT). Lead was detected in two samples with the maximum concentration (155 µg/L) occurring in I8SW-1, while tin, detected in three samples, had its maximum (94.6 µg/L) at I8SS-2(IT). Zinc was the only other inorganic detected in excess of its screening value in surface water at IR 8. It exceeded its 19-µg/L screening value in two of the 10 samples in which it was detected, with the maximum concentration (6,230 µg/L) occurring in I8SW-1. Other inorganics detected in surface water at IR 8 included barium, mercury, and vanadium. Overall detection was greatest for barium and zinc, in 10 of 11 samples, and antimony, in nine of 11 samples.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Barium and vanadium were identified as COPCs (see Section 8.6.2.2) in the human health risk assessment based on quantitative toxicity since they do not have RBCs. Barium and vanadium concentrations in surface water at IR 8 were less than their nature and extent screening criteria selected from proposed RCRA ALs and Tap Water RBCs, respectively.

8.4.5 Groundwater

Data from a number of sampling efforts including the 1986 Geraghty & Miller Initial Investigation, the 1990 IT Corporation RI, the 1993 IT Corporation RFI/RI, and this Supplemental RFI/RI were considered in the analysis of groundwater contamination at IR 8. Both the 1986 and 1990 investigations tested for VOCs, SVOCs, pesticides, PCBs, and inorganics. The majority of the 1993 samples were tested for VOCs, polyaromatic hydrocarbon SVOCs, inorganics, and pesticides; however, a single 1993 sample was also tested for other SVOCs and PCBs. In 1996, B&R Environmental tested only for pesticides, PCBs, and

inorganics as per the approved Sampling and Analysis Plan (ABB, 1995). Chemicals that were detected in groundwater samples are listed in Table 8-5. This table includes analytical results from all applicable historical sampling, as well as this Supplemental RFI/RI. Figures 8-9 through 8-12 show the occurrence of analytes that exceeded screening values and indicate possible groundwater contamination. Groundwater contamination beneath the site is predominantly attributable to metals.

Screening values were obtained from a variety of sources including SDWA MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

8.4.5.1 Volatile Organic Compounds

Several VOCs were detected in excess of groundwater screening criteria at IR 8 by Geraghty & Miller in 1986. Methylene chloride was detected in excess of its 4.1-µg/L screening value at two sample locations (I8KWM-16 and I8KWM-14). All other VOCs that exceeded screening values in 1986 were detected only once. This included benzene and chlorobenzene detected at I8KWM-13 and bromodichloromethane, bromoform, chlorofrom, and dibromochloromethane detected at I8KWM-17. Ethylbenzene, toluene, and xylene were detected in 1986 sampling, but did not exceed screening values.

A single VOC, chlorobenzene, was detected in excess of its 39-µg/L screening value at a single sample location (I8MW8-6) in 1990 sampling by IT Corporation. Other VOCs detected below screening values included 1,1-dichloroethene, acetone, carbon disulfide, and methylene chloride, none of which had been detected previously, except methylene chloride.

No VOCs were detected in excess of screening values in groundwater in IR 8 during IT Corporation's 1993 sampling effort. Three VOCs, carbon disulfide, chlorobenzene, and methylene chloride were detected at levels below their screening values. These compounds were detected only in I8MW8-6, and all concentrations were reduced from previously detected levels.

VOCs were not tested for by B&R Environmental in their 1996 sampling effort as per the Sampling and Analysis Plan (ABB, 1995).

TABLE 8-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 8
NAS KEY WEST
PAGE 1 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
I8MW8-2	IT 1990	Aluminum	72,000	
I8MW8-6	IT 1990	Aluminum	31,300	
I8MW8-1	IT 1990	Aluminum	14,500	
I8MW8-3	IT 1990	Aluminum	11,200	
I8MW8-4	IT 1990	Aluminum	8,050	
I8MW8-5	IT 1990	Aluminum	3,380	
I8MW8-6	IT 1993	Aluminum	2,800	
I8KWM-14	IT 1990	Aluminum	2,530	
I8KWM-15	IT 1990	Aluminum	148	B_1
I8MW-2	IT 1993	Antimony	236	
I8MW8-3	IT 1993	Antimony	231	
I8MW-3	IT 1993	Antimony	225	
I8MW-8	IT 1993	Antimony	223	
I8MW-5	IT 1993	Antimony	222	
I8MW-4	IT 1993	Antimony	207.5	
I8KWM-16R	IT 1993	Antimony	197	
I8MW-9	IT 1993	Antimony	188	
I8MW-1	IT 1993	Antimony	177	
I8MW8-2	IT 1993	Antimony	172	
I8MW8-4	IT 1993	Antimony	165	
I8MW8-5	IT 1993	Antimony	161	
I8MW-6	IT 1993	Antimony	160	
I8MW-7	IT 1993	Antimony	150	
I8KWM-14	IT 1993	Antimony	126	
I8MW8-6	IT 1993	Antimony	111	
I8MW8-3	IT 1990	Antimony	95.4	
I8KWM-13	IT 1993	Antimony	78.4	
I8KWM-15	IT 1993	Antimony	77	
I8MW8-1	IT 1993	Antimony	61.6	
I8MW8-2	IT 1990	Antimony	57.5	B_1
I8MW8-6	IT 1990	Antimony	56.4	
I8MW8-4	B&RE 1996	Antimony	42.3	
I8MW8-2	B&RE 1996	Antimony	13.9	

Location	Source[1]	Parameter	Result	Qual.[2]
I8MW8-6	B&RE 1996	Antimony	5	
I8MW8-3	B&RE 1996	Antimony	4.1	
I8MW8-6	IT 1993	Arsenic	104	
I8MW8-6	IT 1990	Arsenic	81.2	
I8MW8-2	IT 1990	Arsenic	50.5	
I8KWM-16	IT 1993	Arsenic	25.9	
I8MW8-3	IT 1990	Arsenic	24.5	W
I8MW8-1	IT 1990	Arsenic	20.8	
I8MW8-4	IT 1990	Arsenic	14.7	W
I8KWM-13R	IT 1993	Arsenic	11.3	B_1
I8MW8-1	IT 1993	Arsenic	11.1	
I8MW8-3	IT 1993	Arsenic	10.1	B_1
I8KWM-17	G&M 1986	Arsenic	7	
I8KWM-14	G&M 1986	Arsenic	6	
I8KWM-15	G&M 1986	Arsenic	6	
I8MW-6	IT 1993	Arsenic	5.4	B_1
I8KWM-15	IT 1993	Arsenic	5.2	B_1
I8MW-9	IT 1993	Arsenic	4.4	B_1
I8MW-2	IT 1993	Arsenic	4.2	B_1
I8MW8-5	IT 1993	Arsenic	2.7	B_1
I8MW8-2	IT 1990	Barium	333	E
I8MW8-6	IT 1990	Barium	314	
I8MW8-3	IT 1990	Barium	295	
I8MW8-1	IT 1990	Barium	204	
I8MW8-4	B&RE 1996	Barium	179	
I8MW8-2	B&RE 1996	Barium	162	
I8MW8-4	B&RE 1996	Barium	157	
I8MW8-2	IT 1993	Barium	131	B_1
I8KWM-13R	IT 1993	Barium	127	B_1
I8MW8-4	IT 1993	Barium	115	B_1
I8MW8-1	B&RE 1996	Barium	109	
I8MW8-4	IT 1990	Barium	106	B_1
I8MW8-3	IT 1993	Barium	96.8	B_1
I8MW8-5	IT 1990	Barium	90.4	B_1

TABLE 8-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 8
NAS KEY WEST
PAGE 2 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I8MW8-1	IT 1993	Barium	87.6	B_1
I8MW8-6	B&RE 1996	Barium	81.2	
I8MW8-5	IT 1993	Barium	57	B_1
I8MW8-3	B&RE 1996	Barium	54.7	
I8KWM-16R	IT 1993	Barium	53.8	B_1
I8KWM-14	IT 1990	Barium	51.8	B_1
I8KWM-14	B&RE 1996	Barium	48	
I8MW8-6	IT 1993	Barium	42.5	B_1
I8KWM-16R	B&RE 1996	Barium	36.6	
I8KWM-14	IT 1993	Barium	36.4	B_1
I8MW8-5	B&RE 1996	Barium	25.7	
I8MW-2	IT 1993	Barium	21.3	B_1
I8MW-3	IT 1993	Barium	18.4	B_1
I8MW-9	IT 1993	Barium	17.3	B_1
I8MW-6	IT 1993	Barium	16.8	B_1
I8MW-4	IT 1993	Barium	16.7	B_1
I8MW-7	IT 1993	Barium	16.1	B_1
I8KWM-15	IT 1990	Barium	14.4	B_1
I8KWM-15	B&RE 1996	Barium	11.2	
I8MW-5	IT 1993	Barium	11.1	B_1
I8MW-1	IT 1993	Barium	9.3	B_1
I8MW-8	IT 1993	Barium	7.7	B_1
I8KWM-15	IT 1993	Barium	5.9	B_1
I8MW8-2	IT 1990	Beryllium	1.5	B_1
I8MW8-1	IT 1990	Beryllium	1.4	B_1
I8MW-2	IT 1993	Beryllium	1.1	B_1
I8MW8-2	IT 1993	Beryllium	1.1	B_1
I8KWM-13	IT 1993	Beryllium	1	B_1
I8MW8-6	IT 1990	Cadmium	26.4	
I8KWM-14	IT 1990	Cadmium	24	
I8MW8-5	IT 1990	Cadmium	15.6	
I8MW8-1	IT 1990	Cadmium	13	
I8MW8-4	IT 1990	Cadmium	12	
I8MW8-3	IT 1990	Cadmium	11.4	

Location	Source[1]	Parameter	Result	Qual.[2]
I8MW8-6	IT 1990	Chromium	96	
I8MW8-3	IT 1990	Chromium	55.9	
I8MW8-2	IT 1990	Chromium	49.2	
I8MW8-1	IT 1990	Chromium	42.7	
I8MW8-3	IT 1993	Chromium	29.4	
I8MW8-5	IT 1993	Chromium	25.1	
I8KWM-16R	IT 1993	Chromium	14.9	
I8MW8-5	IT 1990	Chromium	14.8	
I8MW8-4	IT 1993	Chromium	14.4	
I8MW8-6	IT 1993	Chromium	13.9	
I8KWM-13	IT 1993	Chromium	12.3	
I8MW8-1	B&RE 1996	Cobalt	2.2	
I8KWM-14	IT 1990	Copper	1,780	
I8MW8-6	IT 1990	Copper	370	
I8MW8-3	IT 1990	Copper	345	
I8KWM-14	IT 1993	Copper	327	
I8KWM-15	G&M 1986	Copper	300	
I8MW-2	IT 1993	Copper	171	
I8MW8-2	IT 1990	Copper	163	
I8MW8-1	IT 1990	Copper	156	
I8MW8-6	IT 1993	Copper	112	
I8MW8-3	IT 1993	Copper	108	
I8MW-3	IT 1993	Copper	99.3	
I8MW8-5	IT 1990	Copper	62.5	
I8MW-6	IT 1993	Copper	62	
I8KWM-16	G&M 1986	Copper	60	
I8KWM-17	G&M 1986	Copper	50	
I8MW-8	IT 1993	Copper	42.4	
I8KWM-13	IT 1993	Copper	36.1	
I8MW8-5	IT 1993	Copper	35.7	
I8KWM-13	G&M 1986	Copper	30	
I8KWM-14	G&M 1986	Copper	30	
I8KWM-16R	IT 1993	Copper	27.6	
I8MW8-2	IT 1993	Copper	20.5	B_1

TABLE 8-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 8
NAS KEY WEST
PAGE 3 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I8MW8-1	IT 1993	Copper	20.2	B_1
I8MW8-4	IT 1993	Copper	11.8	B_1
I8MW-1	IT 1993	Copper	11.4	B_1
I8MW8-4	IT 1990	Copper	10.4	B_1
I8MW8-6	IT 1993	Cyanide	140	
I8MW8-6	IT 1990	Iron	57,200	
I8MW8-2	IT 1990	Iron	30,400	E
I8MW8-3	IT 1990	Iron	23,400	
I8MW8-6	IT 1993	Iron	15,500	
I8MW8-1	IT 1990	Iron	14,600	
I8MW8-4	IT 1990	Iron	5,920	
I8MW8-5	IT 1990	Iron	3,500	
I8KWM-14	IT 1990	Iron	3,340	E_2
I8KWM-15	IT 1990	Iron	167	E_2
I8MW8-3	IT 1990	Lead	1,870	
I8MW8-3	IT 1993	Lead	553	
I8MW8-2	IT 1990	Lead	497	
I8MW8-6	IT 1990	Lead	496.5	
I8MW-3	IT 1993	Lead	248	
I8MW-6	IT 1993	Lead	224	
I8KWM-16R	IT 1993	Lead	169	
I8MW8-6	IT 1993	Lead	149	
I8KWM-13	IT 1993	Lead	114	
I8MW-8	IT 1993	Lead	93.4	
I8MW8-1	IT 1990	Lead	90.9	
I8MW-7	IT 1993	Lead	70.5	
I8MW8-2	IT 1993	Lead	64	
I8MW8-5	IT 1990	Lead	59	W
I8KWM-15	IT 1990	Lead	37.8	
I8MW8-4	IT 1990	Lead	22.3	
I8MW8-1	IT 1993	Lead	22.1	
I8MW8-4	IT 1993	Lead	16.8	
I8MW8-5	IT 1993	Lead	15.7	
I8MW8-6	IT 1990	Manganese	422.5	E_2

Location	Source[1]	Parameter	Result	Qual.[2]
I8MW8-2	IT 1990	Manganese	195	
I8MW8-6	IT 1993	Manganese	180	
I8MW8-1	IT 1990	Manganese	167	
I8MW8-3	IT 1990	Manganese	161	E_2
I8MW8-4	IT 1990	Manganese	96	E_2
I8KWM-14	IT 1990	Manganese	85	
I8MW8-5	IT 1990	Manganese	35.9	E_2
I8KWM-13	G&M 1986	Mercury	620	
I8KWM-17	G&M 1986	Mercury	75	
I8KWM-16	G&M 1986	Mercury	52	
I8KWM-15	G&M 1986	Mercury	52	
I8KWM-14	G&M 1986	Mercury	49	
I8MW8-3	IT 1990	Mercury	11.5	
I8MW8-3	IT 1993	Mercury	3.8	
I8MW8-6	IT 1990	Mercury	3.6	
I8MW8-1	IT 1990	Mercury	1.5	
I8MW-3	IT 1993	Mercury	1.5	
I8MW8-2	IT 1990	Mercury	1.1	W
I8MW8-6	IT 1993	Mercury	0.79	
I8KWM-13	IT 1993	Mercury	0.66	
I8KWM-16R	IT 1993	Mercury	0.65	
I8MW8-2	IT 1993	Mercury	0.57	
I8KWM-14	IT 1990	Mercury	0.53	
I8KWM-14	B&RE 1996	Mercury	0.5	
I8MW8-2	B&RE 1996	Mercury	0.46	
I8MW8-4	IT 1990	Mercury	0.44	
I8MW8-4	IT 1993	Mercury	0.35	
I8MW-2	IT 1993	Mercury	0.31	
I8MW-7	IT 1993	Mercury	0.25	
I8KWM-14	IT 1993	Mercury	0.23	
I8MW-1	IT 1993	Mercury	0.23	
I8MW-8	IT 1993	Mercury	0.22	
I8MW8-5	IT 1990	Mercury	0.22	
I8MW8-5	B&RE 1996	Mercury	0.19	

TABLE 8-5

CHEMICALS DETECTED IN GROUNDWATER AT IR 8
NAS KEY WEST
PAGE 4 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I8MW8-6	B&RE 1996	Mercury	0.13	
I8MW8-2	IT 1990	Nickel	27.2	B_1
I8MW8-6	IT 1990	Nickel	22.6	B_1
I8MW8-1	IT 1990	Nickel	22.4	B_1
I8KWM-14	IT 1990	Silver	21	
I8MW8-4	IT 1990	Silver	7.9	B_1
I8KWM-15	IT 1990	Silver	6.1	B_1
I8MW-9	IT 1993	Thallium	11.6	
I8KWM-16R	B&RE 1996	Thallium	4.3	
I8MW8-3	B&RE 1996	Thallium	4	
I8MW-6	IT 1993	Tin	150	B_1
I8MW8-5	IT 1993	Tin	131	B_1
I8KWM-13	IT 1993	Tin	109	B_1
I8MW8-2	IT 1993	Tin	81	B_1
I8MW8-6	IT 1993	Tin	60.9	B_1
I8MW8-1	IT 1993	Tin	50.9	B_1
I8MW8-6	IT 1990	Vanadium	46.9	
I8MW8-2	IT 1990	Vanadium	45.7	B_1
I8MW8-3	IT 1990	Vanadium	42.5	B_1
I8MW8-1	IT 1990	Vanadium	30.9	B_1
I8MW8-5	IT 1990	Vanadium	27.6	B_1
I8MW8-5	IT 1993	Vanadium	15.1	B_1
I8MW8-4	IT 1990	Vanadium	14.7	B_1
I8MW8-3	IT 1993	Vanadium	13.1	B_1
I8KWM-16R	IT 1993	Vanadium	10.5	B
I8MW8-6	IT 1990	Zinc	2,630	
I8MW8-3	IT 1990	Zinc	1,990	
I8KWM-14	IT 1990	Zinc	840	
I8MW8-3	IT 1993	Zinc	805	
I8MW8-2	IT 1990	Zinc	664	
I8MW8-1	IT 1990	Zinc	585	
I8MW8-5	IT 1990	Zinc	464	
I8MW8-6	IT 1993	Zinc	336	
I8MW8-4	IT 1990	Zinc	323	
I8KWM-16R	IT 1993	Zinc	236	
I8MW-3	IT 1993	Zinc	225	
I8MW-6	IT 1993	Zinc	225	
I8KWM-13	IT 1993	Zinc	199	
I8MW8-2	IT 1993	Zinc	97.5	
I8KWM-14	IT 1993	Zinc	94.6	
I8MW-8	IT 1993	Zinc	78.4	
I8MW8-1	IT 1993	Zinc	62.6	
I8MW8-5	IT 1993	Zinc	58.2	
I8MW-4	IT 1993	Zinc	53.4	
I8MW8-4	IT 1993	Zinc	49.7	
I8MW-2	IT 1993	Zinc	47.4	
I8MW-9	IT 1993	Zinc	26.2	
I8MW-1	IT 1993	Zinc	15.8	B_1
I8MW-5	IT 1993	Zinc	12.5	B_1
I8KWM-15	IT 1993	Zinc	9.9	B_1
PESTICIDES/PCBs (µg/L)				
I8KWM-13	B&RE 1996	2,4,5-TP (silvex)	0.26	
I8KWM-13	B&RE 1996	2,4-D	0.48	J
I8MW8-6	IT 1993	alpha-BHC	0.17	DJZ
I8MW8-1	B&RE 1996	Heptachlor	0.62	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)				
I8MW8-6	IT 1990	1,4-dichlorobenzene	36	
I8MW8-6	IT 1993	1,4-dichlorobenzene	8	J
I8KWM-13	G&M 1986	1,4-dichlorobenzene	4.6	
I8MW8-1	IT 1990	1,4-dichlorobenzene	2	J
I8MW8-6	IT 1990	Bis(2-ethylhexyl)phthalate	16.5	
I8MW8-5	IT 1990	Bis(2-ethylhexyl)phthalate	9	J
I8MW8-3	IT 1990	Bis(2-ethylhexyl)phthalate	3	J
I8MW8-4	IT 1990	Bis(2-ethylhexyl)phthalate	3	J
I8KWM-15	IT 1990	Bis(2-ethylhexyl)phthalate	3	B_2J
I8KWM-14	G&M 1986	Diethyl phthalate	3	
I8KWM-17	G&M 1986	Diethyl phthalate	1.4	
I8MW8-2	IT 1993	Fluorene	0.82	

TABLE 8-5

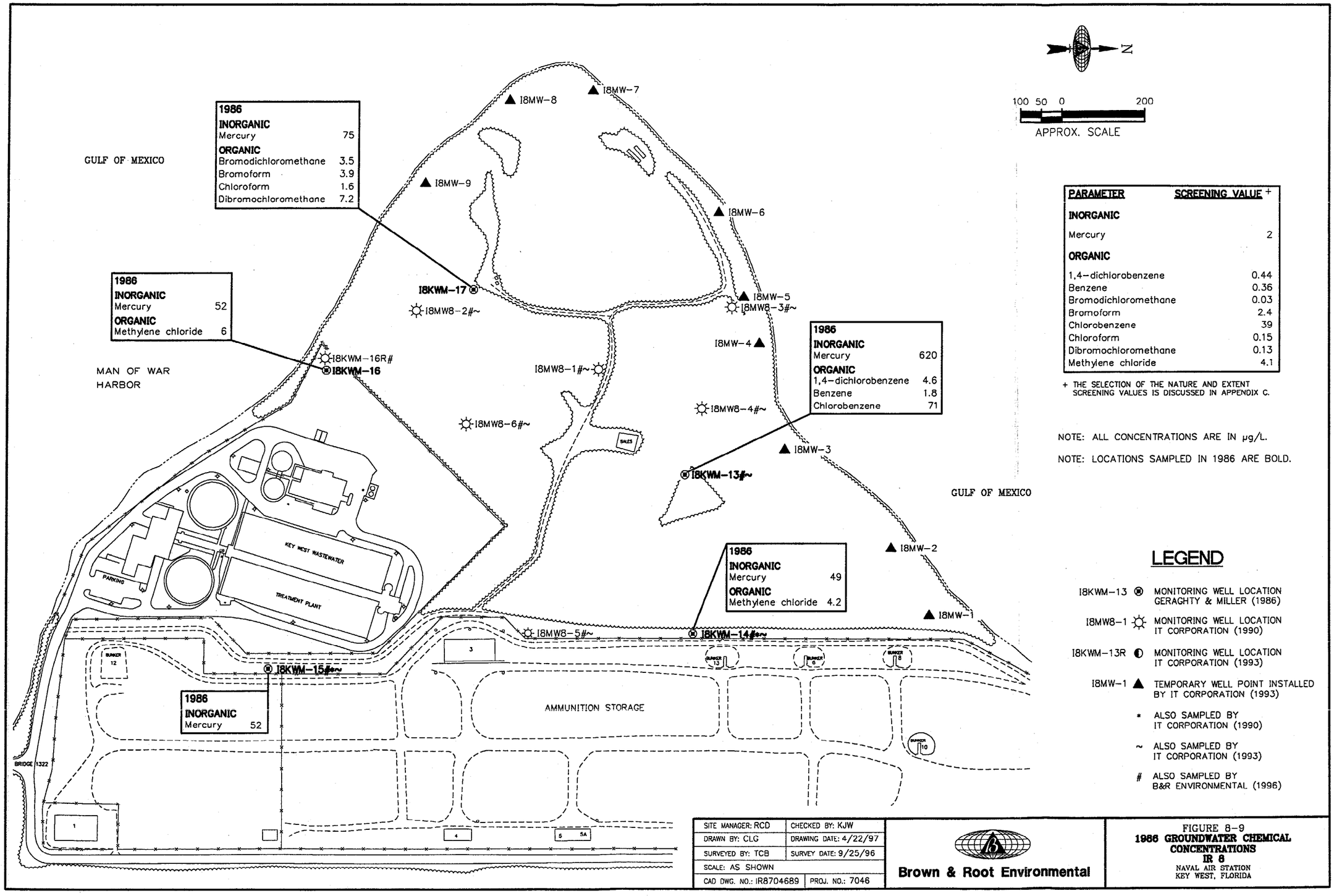
CHEMICALS DETECTED IN GROUNDWATER AT IR 8
NAS KEY WEST
PAGE 5 OF 5

Location	Source[1]	Parameter	Result	Qual.[2]
I8KWM-13	G&M 1986	Naphthalene	2.5	
I8MW8-3	IT 1993	Pyrene	0.6	
I8MW8-1	IT 1993	Pyrene	0.35	
VOLATILE ORGANIC COMPOUNDS (µg/L)				
I8MW8-3	IT 1990	1,1-dichloroethane	2	J
I8MW8-4	IT 1990	Acetone	2	J
I8KWM-13	G&M 1986	Benzene	1.8	
I8KWM-17	G&M 1986	Bromodichloromethane	3.5	
I8KWM-17	G&M 1986	Bromoform	3.9	
I8MW8-4	IT 1990	Carbon disulfide	7	
I8MW8-6	IT 1990	Carbon disulfide	4.5	J
I8MW8-6	IT 1993	Carbon disulfide	4	J
I8MW8-2	IT 1990	Carbon disulfide	3	B_2J
I8MW8-5	IT 1990	Carbon disulfide	3	J
I8KWM-13	G&M 1986	Chlorobenzene	71	
I8MW8-6	IT 1990	Chlorobenzene	63	
I8MW8-6	IT 1993	Chlorobenzene	17	
I8KWM-17	G&M 1986	Chloroform	1.6	
I8KWM-17	G&M 1986	Dibromochloromethane	7.2	
I8KWM-13	G&M 1986	Ethylbenzene	1.3	
I8KWM-17	G&M 1986	Ethylbenzene	1.2	
I8KWM-16	G&M 1986	Methylene chloride	6	BG*
I8KWM-14	G&M 1986	Methylene chloride	4.2	BG*
I8KWM-13	G&M 1986	Methylene chloride	3.8	BG*
I8KWM-17	G&M 1986	Methylene chloride	2.3	BG*
I8KWM-15	G&M 1986	Methylene chloride	2.1	BG*
I8MW8-6	IT 1990	Methylene chloride	2	B_2J
I8MW8-5	IT 1990	Methylene chloride	2	B_2J
I8MW8-4	IT 1990	Methylene chloride	2	B_2J
I8MW8-2	IT 1990	Methylene chloride	2	B_2J
I8MW8-6	IT 1993	Methylene chloride	1	B_2J
I8MW8-3	IT 1990	Methylene chloride	1	B_2J
I8KWM-17	G&M 1986	Toluene	3.2	
I8KWM-17	G&M 1986	Xylenes, total	2.6	

Shading indicates a concentration in excess of the screening values (See Table C.3-4).

1 Data Sources:
G&M 1986 - Verification Study (Geraghty and Miller, 1987) conducted in 1986 by Geraghty and Miller
IT 1990 - RI conducted in 1990 by IT Corporation (1991)
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.
W - Post-digestion spike for GFAA was out of control limits (85 - 115%), while sample absorbance was less than 50% of spike absorbance.
D - Compound analyzed at secondary dilution.
E - Compound exceeded calibration range of the instrument.
E_2 - The reported value is estimated because the presence of interference.
J - The associated value is an estimated quantity.
B_2 - Analyte was found in the blank as well as the sample.
BG*



PARAMETER	SCREENING VALUE +
INORGANIC	
Mercury	2
ORGANIC	
1,4-dichlorobenzene	0.44
Benzene	0.36
Bromodichloromethane	0.03
Bromoform	2.4
Chlorobenzene	39
Chloroform	0.15
Dibromochloromethane	0.13
Methylene chloride	4.1

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1986 ARE BOLD.

LEGEND

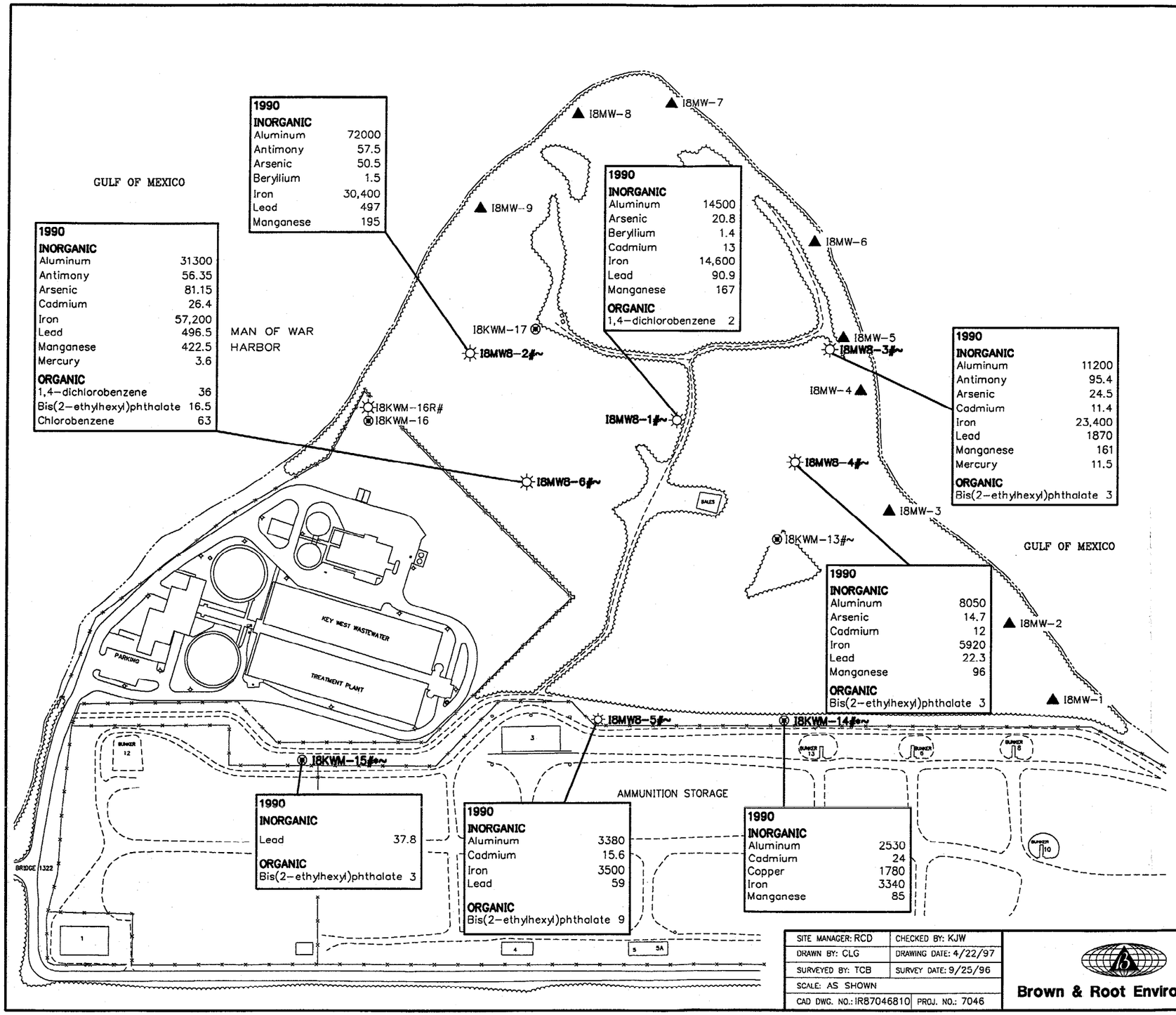
- I8KWM-13 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)
- I8MW8-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)
- I8KWM-13R ◐ MONITORING WELL LOCATION IT CORPORATION (1993)
- I8MW-1 ▲ TEMPORARY WELL POINT INSTALLED BY IT CORPORATION (1993)
- * ALSO SAMPLED BY IT CORPORATION (1990)
- ~ ALSO SAMPLED BY IT CORPORATION (1993)
- # ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: CLG	DRAWING DATE: 4/22/97
SURVEYED BY: TCB	SURVEY DATE: 9/25/96
SCALE: AS SHOWN	
CAD DWG. NO.: IR8704689	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 8-9
1986 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

0101 F B412



N

100 50 0 200
APPROX. SCALE

PARAMETER	SCREENING VALUE +
INORGANIC	
Aluminum	200
Antimony	6
Arsenic	9.3
Beryllium	0.008
Cadmium	5
Copper	1000
Iron	300
Lead	15
Manganese	50
Mercury	2
ORGANIC	
1,4-dichlorobenzene	0.44
Bis(2-ethylhexyl)phthalate	3
Chlorobenzene	39

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1990 ARE BOLD.

LEGEND

I8KWM-13 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)

I8MW8-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)

I8KWM-13R ◐ MONITORING WELL LOCATION IT CORPORATION (1993)

I8MW-1 ▲ TEMPORARY WELL POINT INSTALLED BY IT CORPORATION (1993)

* ALSO SAMPLED BY IT CORPORATION (1990)

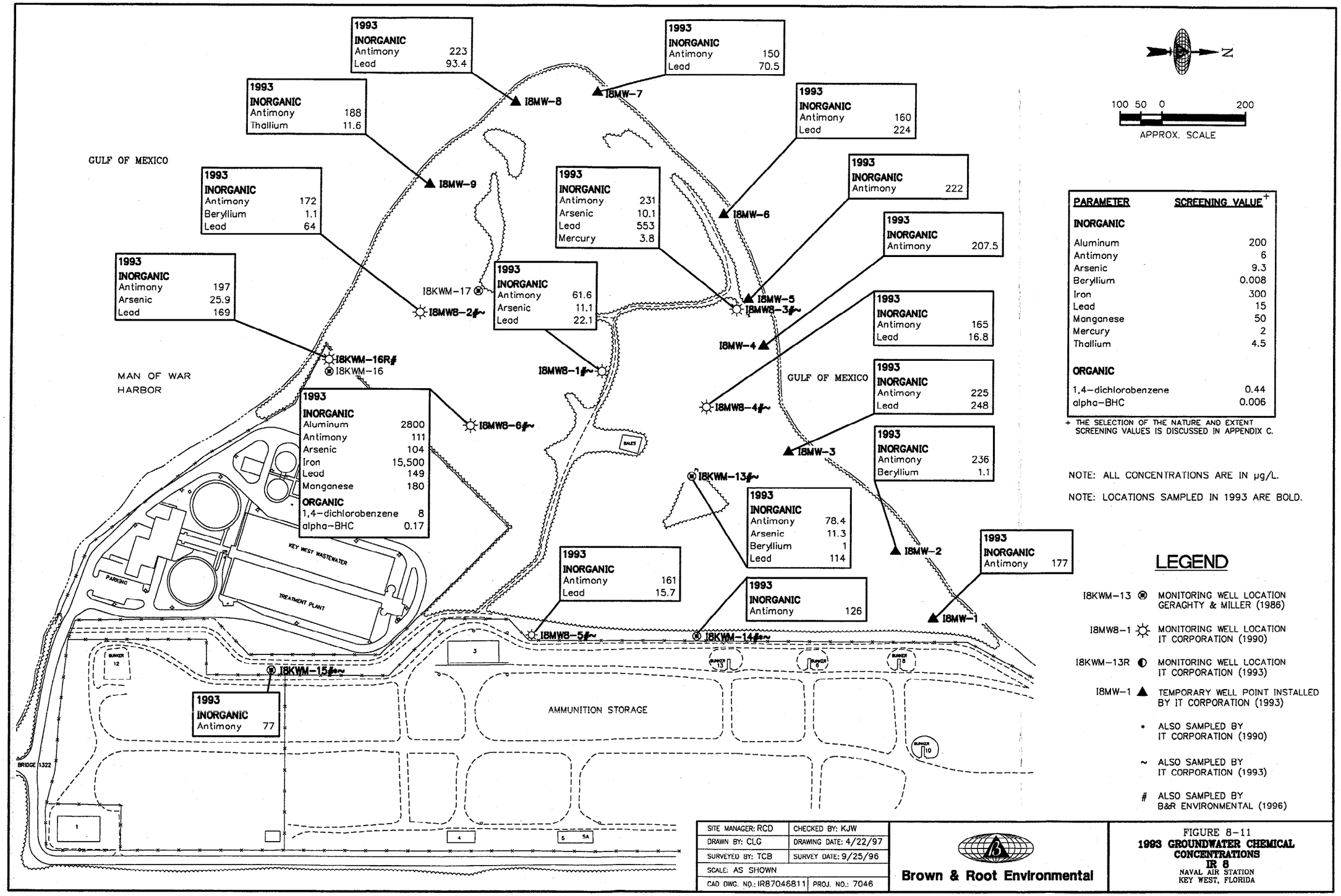
~ ALSO SAMPLED BY IT CORPORATION (1993)

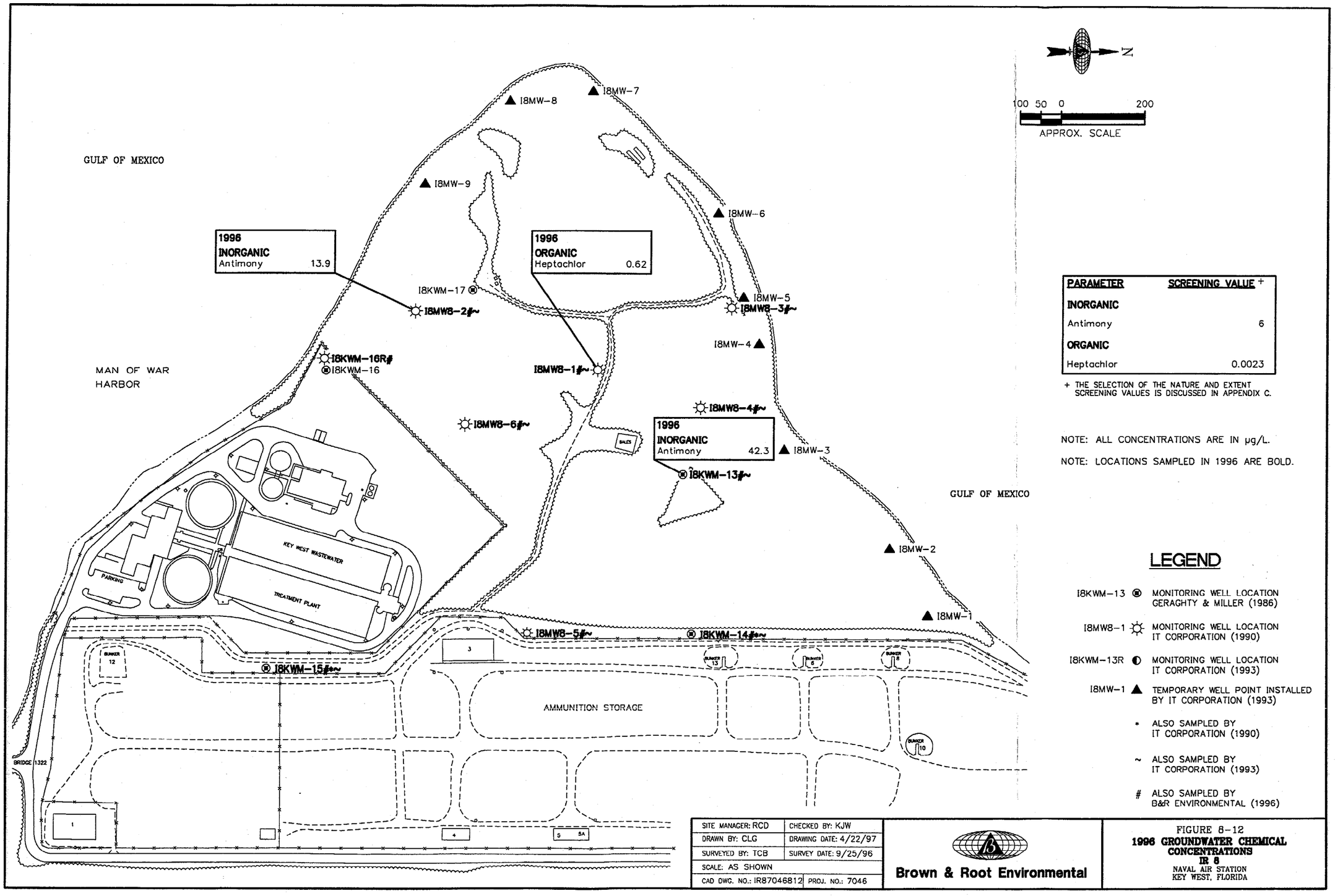
\# ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: CLG	DRAWING DATE: 4/22/97
SURVEYED BY: TCB	SURVEY DATE: 9/25/96
SCALE: AS SHOWN	
CAD DWG. NO.: IR87046810	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 8-10
1990 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA


1993 INORGANIC Antimony 223 Lead 93.4
I8MW-8
1993 INORGANIC Antimony 150 Lead 70.5
I8MW-7
1993 INORGANIC Antimony 188 Thallium 11.6
I8MW-9
1993 INORGANIC Antimony 160 Lead 224
GULF OF MEXICO
1993 INORGANIC Antimony 172 Beryllium 1.1 Lead 64
1993 INORGANIC Antimony 231 Arsenic 10.1 Lead 553 Mercury 3.8
I8MW-6
1993 INORGANIC Antimony 222
1993 INORGANIC Antimony 207.5
1993 INORGANIC Antimony 197 Arsenic 25.9 Lead 169
I8KWM-17
1993 INORGANIC Antimony 61.6 Arsenic 11.1 Lead 22.1
I8MW8-2#~
I8MW-5
I8MW8-3#~
1993 INORGANIC Antimony 165 Lead 16.8
I8KWM-16R#
I8KWM-16
I8MW-4
MAN OF WAR HARBOR
I8MW8-1#~
GULF OF MEXICO
1993 INORGANIC Antimony 225 Lead 248
1993 INORGANIC Aluminum 2800 Antimony 111 Arsenic 104 Iron 15,500 Lead 149 Manganese 180 ORGANIC 1,4-dichlorobenzene 8 alpha-BHC 0.17
I8MW8-6#~
I8MW8-4#~
I8MW-3
1993 INORGANIC Antimony 236 Beryllium 1.1
I8KWM-13#~
1993 INORGANIC Antimony 78.4 Arsenic 11.3 Beryllium 1 Lead 114
I8MW-2
1993 INORGANIC Antimony 177
KEY WEST WASTEWATER TREATMENT PLANT
PARKING
1993 INORGANIC Antimony 161 Lead 15.7
1993 INORGANIC Antimony 126
I8MW-1
I8MW8-5#~
I8KWM-14#~
I8KWM-15#~
1993 INORGANIC Antimony 77
AMMUNITION STORAGE
BRIDGE 1322
N
100 50 0 200
APPROX. SCALE
PARAMETER SCREENING VALUE+
INORGANIC
Aluminum 200
Antimony 6
Arsenic 9.3
Beryllium 0.008
Iron 300
Lead 15
Manganese 50
Mercury 2
Thallium 4.5
ORGANIC
1,4-dichlorobenzene 0.44
alpha-BHC 0.006
+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.
NOTE: ALL CONCENTRATIONS ARE IN µg/L.
NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.
LEGEND
I8KWM-13 MONITORING WELL LOCATION GERAGHTY & MILLER (1986)
I8MW8-1 MONITORING WELL LOCATION IT CORPORATION (1990)
I8KWM-13R MONITORING WELL LOCATION IT CORPORATION (1993)
I8MW-1 TEMPORARY WELL POINT INSTALLED BY IT CORPORATION (1993)
* ALSO SAMPLED BY IT CORPORATION (1990)
~ ALSO SAMPLED BY IT CORPORATION (1993)
# ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)
SITE MANAGER: RCD
CHECKED BY: KJW
DRAWN BY: CLG
DRAWING DATE: 4/22/97
SURVEYED BY: TCB
SURVEY DATE: 9/25/96
SCALE: AS SHOWN
CAD DWG. NO.: IR87046811
PROJ. NO.: 7046
Brown & Root Environmental
FIGURE 8-11
1993 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	6
ORGANIC	
Heptachlor	0.0023

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

NOTE: LOCATIONS SAMPLED IN 1996 ARE BOLD.

LEGEND

- I8KWM-13 ⊗ MONITORING WELL LOCATION GERAGHTY & MILLER (1986)
- I8MW8-1 ☼ MONITORING WELL LOCATION IT CORPORATION (1990)
- I8KWM-13R ◐ MONITORING WELL LOCATION IT CORPORATION (1993)
- I8MW-1 ▲ TEMPORARY WELL POINT INSTALLED BY IT CORPORATION (1993)
- * ALSO SAMPLED BY IT CORPORATION (1990)
- ~ ALSO SAMPLED BY IT CORPORATION (1993)
- # ALSO SAMPLED BY B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: KJW
DRAWN BY: CLG	DRAWING DATE: 4/22/97
SURVEYED BY: TCB	SURVEY DATE: 9/25/96
SCALE: AS SHOWN	
CAD DWG. NO.: IR87046812	PROJ. NO.: 7046

Brown & Root Environmental

FIGURE 8-12
1996 GROUNDWATER CHEMICAL CONCENTRATIONS
IR 8
NAVAL AIR STATION
KEY WEST, FLORIDA

8.4.5.2 Semivolatile Organic Compounds

In 1986, a single SVOC, 1,4-dichlorobenzene, was detected in excess of its screening value at a single sample location, I8KWM-13. Two other SVOCs were detected at levels below their screening values: diethyl phthalate at I8KWM-14 and I8KWM-17, and naphthalene at I8KWM-13.

In 1990, two SVOCs, 1,4-dichlorobenzene and bis(2-ethylhexyl)phthalate, were detected in excess of their screening values in groundwater at IR 8. 1,4-dichlorobenzene was detected in excess of its screening values at two of eight sample locations and bis(2-ethylhexyl)phthalate was detected in excess at five of eight sample locations. No other SVOCs were detected in groundwater at IR 8 during IT Corporation's 1990 sampling effort.

A single SVOC, 1,4-dichlorobenzene, was detected in excess of its 0.44-µg/L screening value during IT Corporation's 1993 sampling effort. 1,4-dichlorobenzene was detected at a single sample location, I8MW8-6, at a concentration of 8 µg/L. This was a 78 percent reduction from the previously detected concentration in the same well. Other SVOCs detected in groundwater at IR 8 by IT Corporation in 1993 included fluorene and pyrene.

B&R Environmental did not test for SVOCs as per the Sampling and Analysis Plan (ABB, 1995).

8.4.5.3 Pesticides

No pesticides were detected in groundwater at IR 8 by Geraghty & Miller during their 1986 sampling effort nor by IT Corporation during their 1990 sampling effort.

A single pesticide, alpha-BHC, was detected in excess of its 0.006-µg/L groundwater screening value at IR 8 during IT Corporation's 1993 sampling effort. This exceedance occurred at a single sample location near the center of the site, I8MW8-6. Alpha-BHC had not been previously detected at IR 8. No other pesticides were detected during IT Corporation's 1993 sampling effort.

In 1996, a single pesticide, heptachlor, was detected in excess of its 0.0023-µg/L groundwater screening value at IR 8. The occurrence of heptachlor (0.17 µg/L) was limited to a single well, I8MW8-1. Other pesticides detected in groundwater at IR 8 during B&R Environmental's 1996 investigation included 2,4,5-TP (silvex) and 2,4-D, both at a single sample location, I8KWM-13.

8.4.5.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at IR 8.

8.4.5.5 Inorganics

In 1986, Geraghty & Miller detected a single inorganic in excess of its screening value in groundwater at IR 8. Mercury exceeded its 2-µg/L screening value at all five sample locations; the maximum concentration detected in the 1986 samples was 620 µg/L at I8KWM-13, in the north-central portion of IR 8. Arsenic and copper were also detected in 1986 but at levels below their screening values. Copper was detected at all five 1986 sample locations, while arsenic was detected at three of the five.

IT Corporation's 1990 sampling effort detected several inorganics in excess of screening criteria in groundwater at IR 8. Maximum concentrations were distributed throughout the site. Maximum concentrations in 1990 samples from the north side at I8MW8-3 included antimony (95.4 µg/L), lead (1,870 µg/L), and mercury (11.5 µg/L). Maximum concentrations detected further south in 1990 included aluminum (72,000 µg/L), arsenic (81.15 µg/L), beryllium (1.5 µg/L), cadmium (26.4 µg/L), iron (57,200 mg/L), and manganese (422.5 µg/L) at I8MW8-2 and I8MW-6. Copper was detected in excess of its 1,000-µg/L screening value in a single 1990 sample from the eastern edge of IR 8 [I8KWM-14 (1,780 µg/L)]. Other inorganics detected in groundwater at IR 8 during IT Corporation's 1990 sampling effort included barium, chromium, nickel, silver, vanadium, and zinc. Aluminum and barium (detected in all eight samples) and copper, lead, manganese, mercury, and zinc (detected in seven of eight samples) were the most frequently detected inorganics in 1990 groundwater samples. Aluminum, iron, and lead were the inorganics most frequently detected in excess of screening values (seven of eight samples, each). Inorganics that were detected in 1990 sampling that were not detected in 1986 sampling included antimony, beryllium, cadmium, chromium, lead, nickel, silver, and zinc. Arsenic and copper were previously detected, but 1986 concentrations were generally lower than those detected in 1990. 1990 mercury concentrations were reduced from those detected in 1986.

In IT Corporation's 1993 sampling effort a number of inorganics were detected in excess of groundwater screening values at IR 8. Maximum 1993 concentrations were detected throughout the site. Aluminum (2,800 µg/L), arsenic (104 µg/L), iron (15,500 µg/L0, and manganese (180 µg/L) were detected at I8MW8-6. This was the only 1993 sample in which aluminum and manganese were detected. Maximum concentrations detected at I8MW-2 included antimony (236 µg/L) and beryllium (1.1 µg/L). Antimony was detected in excess of its 6-µg/L screening value at all 19 sample locations. Maximum detections of lead (553 µg/L) and mercury (3.8 µg/L) were detected in the north-central region of the site at I8MW8-3 in

1993. Although mercury was detected at 12 of the 1993 sample locations, this was the only 1993 detection that exceeded the screening value. Thallium was detected at a single sample location and was in excess of its 4.5-µg/L screening value [I8MW-9 (11.6 µg/L)]. Other inorganics detected in 1993 by IT Corporation included barium, chromium, copper, cyanide, tin, vanadium, and zinc. Barium was detected in all 19 samples (as was antimony); zinc was detected in 18 of 19 samples. Antimony's detection frequency and concentration increased in 1993 from previous levels. Aluminum was only tested for in one 1993 sample, but its concentration in that sample was reduced from the 1990 aluminum concentration from the same location. Generally, there were no well-defined temporal or spatial trends between the 1990 and 1993 groundwater results. Certain analyte concentrations in a given well increased slightly, while others decreased. Overall, 1990 and 1993 concentrations were roughly comparable.

In B&R Environmental's 1996 sampling effort, only a single inorganic, antimony, was detected in excess of screening values. Antimony was detected in excess of its 6-µg/L screening value in 2 of 10 samples [I8KWM-13 (42.3 µg/L) and I8MW8-2 (13.9 µg/L)]. Both of these concentrations were well below the 1993 concentrations at the same sampling locations. Other inorganics detected in groundwater at IR 8 during 1996 sampling included barium, cobalt, mercury, and thallium. Barium was detected in all 10 samples at levels below its screening value.

Overall detection of inorganics decreased in frequency and concentration from 1986 to 1996. Inorganics that were detected in sampling conducted before 1996 were not detected in 1996 sampling or were detected at much lower concentrations. Antimony's historical maximum concentration was 236 µg/L (detected in IT Corporation's 1993 sampling), however, antimony's 1996 maximum concentration was only 42.3 µg/L. Several inorganics that had been previously detected in excess of screening values were not detected in 1996 including aluminum, arsenic, beryllium, iron, lead, manganese, and thallium.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Tin and zinc were selected as ecological COPCs (see Section 8.7.4.1.2) based on a comparison with twice the average background concentration and HQs greater than one because no suitable ecological threshold was available. The selected nature and extent screening values for tin and zinc were not ecological screening levels and were higher than twice the average background concentrations.

8.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at IR 8. Section 8.5.1 presents those chemicals detected in excess of the screening values discussed in the nature and extent sections, along with apparent temporal and spatial trends. Section 8.5.2 addresses potential routes of migration, and Section 8.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential. Section 3.1.5.1 of Appendix C quantifies the physical and chemical properties of the detected contaminants.

8.5.1 Contaminant Summary and Trends

IR 8 covers approximately 45 acres on the southern end of Fleming Key (Figure 8-1). A closed canopy of Australian pine covers most of the site. Waste materials and fill from Sigsbee Key were deposited at the site from 1948 to 1951. Between 1962 and 1982, the site served as a landfill and waste disposal area for the Navy, and, eventually, the City of Key West. During this time as much as 8,000 tons of unknown waste were deposited at the landfill annually. The open trench disposal method, similar to that used at Fleming Key North Landfill (IR 7), was practiced at the site. The trenches were partially full of sea water during disposal activities due to seepage from groundwater. Combustible wastes were taken to the western portion of the site and burned. The ash and unburned wastes were then deposited in the western portion of the landfill. An ammunitions storage area is also located along the east boundary of the site.

Metals were the most common contaminants at IR 8. Generally, metals were detected in soil near the center of the site (Figure 8-6). Section 8.4.1.5 describes the 12 metals detected in excess of the screening criteria in soil at IR 8. Metals were detected in sediment along the northern and western perimeter of the site, with contamination increasing from the east to the west side of the site (Figure 8-7). Metals detected in sediment in excess of nature and extent screening values included antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc (see Section 8.4.3.5). A number of metals were also detected in excess nature and extent of screening values in surface water at IR 8 (Figure 8-8). With the exception of aluminum and tin, all metals detected in excess of the nature and extent screening values in surface water also exceeded nature and extent sediment screening values. The same inorganic compounds that were detected in other media were generally detected in groundwater at IR 8; however, overall detection of inorganics in groundwater decreased in frequency and concentration from 1986 to 1996.

4,4'-DDT was the only pesticide detected in excess of nature and extent screening values in soil. It was detected in all four B&R Environmental samples collected in 1996, but exceeded its nature and extent screening value only at a single location near the center of IR 8 (Figure 8-6). 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, beta-BHC, and delta-BHC were the pesticides detected in excess of nature and extent screening values in sediment at IR 8. Pesticide contamination of sediment also appeared to increase from the east to the west side of the site (Figure 8-7). Overall pesticide contamination in groundwater appeared to be limited to a single pesticide, alpha-BHC, detected in excess of nature and extent screening values at just two sample locations. No pesticides were detected in surface water in excess of screening values.

A single VOC, acetone, was detected in excess of nature and extent screening values in sediment (Figure 8-7), and no VOCs were detected in soil and surface water in excess of nature and extent screening values. In 1986, four VOCs were detected in groundwater in excess of nature and extent screening values, and only one was detected in 1990. VOCs appeared to decrease in magnitude and extent over time in groundwater. SVOCs in the sediment were predominantly detected on the north and south perimeters of the site (Figure 8-7). Three SVOCs were also detected at three different sample locations in excess of nature and extent screening values for surface water at IR 8 (Figure 8-8, and Section 8.4.4.2). Two SVOCs have had multiple exceedances of nature and extent screening values in groundwater, but no SVOCs were detected in groundwater in 1993. Per the Sampling and Analysis Plan (ABB, 1995), B&R Environmental did not test for VOCs and SVOCs during the 1996 investigation.

A single PCB, Aroclor-1254, was detected in excess of its nature and extent screening value in sediment on the western perimeter of the site. Another PCB, Aroclor-1242, was also detected in one surface-water sample near the western perimeter of the site at IR 8 in excess of its nature and extent screening value. No PCBs have been detected in excess of screening values in soil or groundwater at IR 8.

8.5.2 Potential Routes of Migration

The contaminant source at IR 8 consists of the former landfill. The contaminant release pathways from this area include volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in soil could volatilize from surficial material or become airborne via wind erosion. Contaminated fugitive dust can be generated during ground-disturbing activities, such as construction or excavation. The contaminants could then be dispersed in the surrounding environment and transported to downwind locations where they could repartition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. However, the landfill is heavily vegetated, primarily by Australian pines, minimizing the airborne contaminant transport pathway.

Precipitation runoff can carry contaminants to nearby surface water and sediments in Man of War Harbor and the Gulf of Mexico. Infiltrating precipitation can cause the contamination of subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. After reaching the water table, contaminants can be carried with the flow of groundwater to downgradient locations. Groundwater under the landfill is shallow and is connected hydrologically to surface water at the shoreline. Contaminants transported in groundwater to surface water can be deposited subsequently in sediment or surface water, and can potentially accumulate in the tissues of aquatic organisms. In addition, offsite sediments carried along the shoreline into IR 8 by sediment transport through wave action may be another source of contaminants detected in the sediments.

8.5.3 Contaminant Transport Potential and Persistence

Inorganics (i.e., metals) were the predominant parameters detected at IR 8 in the soil, sediment, surface water, and groundwater. However, pesticides were also found in excess of screening levels in soil, sediment, and groundwater. Several VOCs and SVOCs were previously detected in sediment, surface water, and groundwater at IR 8. PCBs were also detected above screening levels in one sample each of sediment and surface water near the west shoreline. Appendix C provides a thorough description of the physical and chemical properties of the contaminants detected at IR 8.

In general, metals are adsorbed onto soil and organic matter, greatly reducing both mobility and potential for transport in the aqueous phase. Geotechnical data collected during the preliminary RI detected a relatively high total organic content of 5,700 mg/kg indicating the media's ability to minimize contaminant migration. In addition, the high pH (8.5) of soil at IR 8 would also reduce the mobility of most metals (e.g., iron, copper, and zinc). Although many metals are water-insoluble, (e.g., zinc and copper) the solubility of some species, like arsenic, is heavily influenced by factors such as pH and speciation. The transport of lead in the environment is strongly influenced by the speciation of the ion. Since sorption appears to exert a dominant effect on the distribution of lead in the environment, lead is strongly complexed to organic materials in soil (Clement Associates, 1985). Although sorption tends to reduce the mobility of inorganics in the subsurface, strong associations with soil particles may increase the persistence of inorganic contamination. Contaminants that persist in the solid media may also continue to be present in groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations would remain low.

Pesticides were also detected in soil and sediment at IR 8. The soil and sediment would be the ultimate sink for these chemicals due to the high affinity for pesticides to bind to organic materials associated with

sediment and soil particles. While pesticides are relatively insoluble in water and have very low vapor pressures, pesticides in excess of nature and extent screening levels were found in groundwater at IR 8 (probably due to the shallow groundwater table and tidal influences exposing fluctuating water table periodically to sediments). As shown in Appendix C, pesticides are some of the most immobile and persistent of environmental organic contaminants.

For the same reasons as pesticides, PCBs are also some of the most immobile and persistent of environmental organic contaminants. However, in the environment, the composition of PCBs may differ from the commercial mixtures (e.g., Aroclor-1242 and -1254). This difference occurs because after release into the environment, the composition of PCB mixtures change over time, through partitioning and chemical transformation, and preferential bioaccumulation (EPA, 1996b). The efficiency of these mechanisms often depend on the chlorine content of the PCB mixture or congener. Of the PCB mixtures detected in excess of screening levels, Aroclor-1254 is the more highly chlorinated with an average chlorine content of 54 percent, while Aroclor-1242 would have the lowest average chlorine content of 42 percent.

Partitioning in the environment of PCB congeners would be by adsorption of PCBs to organic materials, sediments, and soils. This behavior tends to increase with chlorine content of the PCBs and organic content of the other material. Volatilization and solubility of the lower chlorinated congeners (e.g., the PCB congeners present in Aroclor-1242) would occur while limited volatilization and solubility of the higher chlorinated congeners would take place (e.g., the PCB congeners present in Aroclor-1254). During biodegradation of PCBs, anerobic bacteria in sediments selectively remove chlorines from meta and para positions of the PCB congener appearing to reduce the toxicity and bioaccumulation potential of residues. Aerobic bacteria break open the carbon rings through oxidation and also remove chlorines; however, aerobic biodegradation occurs mostly with PCBs containing lower percentages of chlorine (e.g., PCB congeners found in Aroclor-1242 and other congeners that typically contain 1 to 4 chlorines). Photolysis can also slowly break down congeners with high chlorine content.

Because PCB detections were isolated and low in concentration, these chemicals do not have a significant potential for contaminant migration at IR 8.

Organics can be biodegraded, but the rate of degradation is slower for compounds with higher molecular weights (Clement Associates, 1985). For the same reasons as pesticides (i.e., relatively low solubility in water, low vapor pressures, low Henry's Law constants, and high sediment/water partition coefficients), SVOCs are also relatively immobile in sediment unless transported under wave action (Howard et. al, 1991). The VOC present in excess of sediment screening levels (acetone) is considered to be much more

mobile in the environment due to its (1) higher solubility in water, (2) higher vapor pressures, (3) Henry's Law constants, and (4) relatively lower soil and sediment/water partition coefficients (see Appendix C). However, the persistence of this chemical is low due to the relatively high biodegradation rate.

8.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section presents the baseline human health risk assessment for IR 8. It describes a qualitative and quantitative assessment of actual or potential risks for IR 8. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and remedial goal options. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 8.6.8.

8.6.1 Preliminary Risk Evaluation

PRE was conducted at each site to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 8-6 and 8-7 summarize the preliminary risk evaluation for IR 8 for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. However, the risk ratios calculated for the residential land use scenario are greater than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. Therefore, a baseline human health risk assessment is necessary for IR 8. The primary contributor to carcinogenic risk in sediment and surface water is arsenic. The primary contributors to noncarcinogenic risk are aluminum, antimony, arsenic, cadmium, chromium VI, copper, iron, manganese, nickel, thallium, in sediment; and antimony, arsenic, cadmium, chromium VI, copper, iron, manganese, and zinc in surface water.

TABLE 8-6

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
IR 8
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	3.9	43.5	57.3	0.43	0.43	0.045	3.8	9E-06	1E-04	1E-03	1E-06
PESTICIDES/PCBs											
4,4'-DDD	61.5	100	ND	2,700	2,700	0.28	24,000	2E-08	4E-08	NA	3E-09
4,4'-DDE	51.8	180	ND	1,900	1,900	0.2	17,000	3E-08	9E-08	NA	3E-09
4,4'-DDT	120	46	ND	1,900	1,900	0.2	17,000	6E-08	2E-08	NA	7E-09
Aroclor-1242	ND	ND	1.1	1,600	1,600	0.73	41,000	NA	NA	2E-06	NA
Aroclor-1260	85	ND	ND	320	320	0.0087	2,800	3E-07	NA	NA	3E-08
beta-BHC	ND	32	ND	350	350	0.037	3,200	NA	9E-08	NA	NA
SEMIVOLATILE ORGANIC COMPOUNDS											
Benzo(a)anthracene	ND	130	ND	880	880	0.092	7,800	NA	1E-07	NA	NA
Benzo(a)pyrene	ND	130	ND	88	88	0.0092	780	NA	1E-06	NA	NA
Benzo(b)fluoranthene	ND	160	ND	880	880	0.092	7,800	NA	2E-07	NA	NA
Benzo(k)fluoranthene	ND	140	ND	8,800	8,800	0.92	78,000	NA	2E-08	NA	NA
Benzo(g,h,i)perylene	ND	100	0.54								
Bis(2-ethylhexyl)phthalate	ND	1,100	5	46,000	46,000	4.8	410,000	NA	2E-07	1E-06	NA
Chrysene	ND	160	ND	88,000	88,000	9.2	780,000	NA	2E-09	NA	NA
Dibenzo(a,h)anthracene	ND	ND	0.43	88	88	0.0092	780	NA	NA	5E-05	NA
Indeno(1,2,3-cd)pyrene	ND	100	ND	880	880	0.092	7,800	NA	1E-07	NA	NA
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	21	22	ND	85,000	85,000	4.1	760,000	2E-10	3E-10	NA	3E-11
							Risk Sums by Medium	**2E-06**	**1E-04**	**1E-03**	**3E-07**
							Risk Sums by Use Scenario	**1E-03**			**3E-07**

* All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCBs concentrations are in µg/kg; and all water site data are in µg/L.
D = Not detected.
NA = Not applicable.

TABLE 8-7

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
IR 8
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	454	17,400	2,030	78,000	78,000	37,000	1,000,000	6E-02	2E+00	5E-01	5E-03
Antimony	6	20.7	220	31	31	15	820	2E+00	7E+00	1E+02	7E-02
Arsenic	2.05	43.5	57.3	23	23	11	610	9E-01	2E+01	5E+01	3E-02
Barium	17.1	304	107	5,500	5,500	2,600	140,000	3E-02	6E-01	4E-01	1E-03
Cadmium	20.2	11.4	19.8	39	39	18	1,000	5E+00	3E+00	1E+01	2E-01
Chromium VI	45.2	70.7	37.2	390	390	180	10,000	1E+00	2E+00	2E+00	5E-02
Cobalt	ND	10.1	ND	4,700	4,700	2,200	120,000	NA	2E-02	NA	NA
Copper	53.6	1,100	172	3,100	3,100	1,500	82,000	2E-01	4E+00	1E+00	7E-03
Iron	50.6	27,100	305,000	23,000	23,000	11,000	610,000	2E-02	1E+01	3E+02	8E-04
Manganese	7.6	546	294	390	390	180	10,000	2E-01	1E+01	2E+01	8E-03
Mercury	0.14	1.6	0.43	23	23	11	610	6E-02	7E-01	4E-01	2E-03
Nickel	5.9	248	ND	1,600	1,600	730	41,000	4E-02	2E+00	NA	1E-03
Selenium	1.08	4.8	ND	390	390	180	10,000	3E-02	1E-01	NA	1E-03
Silver	ND	17.7	10.2	390	390	180	10,000	NA	5E-01	6E-01	NA
Thallium	1.51	168	ND	6.3	6.3	2.9	160	2E+00	3E+02	NA	9E-02
Tin	26.9	55.6	94.6	47,000	47,000	22,000	1,000,000	6E-03	1E-02	4E-02	3E-04
Vanadium	2.4	25.7	42.5	550	550	2,600	14,000	4E-02	5E-01	2E-01	2E-03
Zinc	176	2,180	6,230	23,000	23,000	11,000	610,000	8E-02	9E-01	6E+00	3E-03
PESTICIDES/PCBs											
4,4'-DDT	120	46	ND	39,000	39,000	18	1,000,000	3E-02	1E-02	NA	1E-03
Endosulfan I	ND	1.3	ND	470,000	470,000	220	12,000,000	NA	3E-05	NA	NA
SEMIVOLATILE ORGANIC COMPOUNDS											
Anthracene	ND	20	0.11	23,000,000	23,000,000	11,000	610,000,000	NA	9E-06	1E-04	NA
Bis(2-ethylhexyl)phthalate	ND	1100	5	1,600,000	1,600,000	730	41,000,000	NA	7E-03	7E-02	NA
Di-n-butyl phthalate	ND	160	ND	7,800,000	7,800,000	3,700	200,000,000	NA	2E-04	NA	NA
Fluoranthene	ND	210	ND	3,100,000	3,100,000	1,500	82,000,000	NA	7E-04	NA	NA
Pyrene	ND	230	ND	2,300,000	2,300,000	1,100	61,000,000	NA	1E-03	NA	NA
VOLATILE ORGANIC COMPOUNDS											
Acetone	24	72	46	7,800,000	7,800,000	3,700	200,000,000	3E-05	9E-05	1E-01	1E-06
Methylene chloride	21	22	ND	4,700,000	4,700,000	260	120,000,000	5E-05	5E-05	NA	2E-06
Toluene	ND	5	ND	16,000,000	16,000,000	750	410,000,000	NA	3.13E-07	NA	NA
							Hazard Sums by Medium	**9E-01**	**3E+02**	**5E+02**	**4E-02**
							Hazard Sums by Use Scenario	**8E+02**			**4E-02**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

8.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

8.6.2.1 Soils

Aroclor-1260, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, methylene chloride, and metals were detected in one or more of the surface soil samples collected at IR 8. 1,1,2-trichloroethane, acetone, ethylbenzene, carbon disulfide, methylene chloride, xylene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and 4,4'-DDE, and metals were detected in subsurface soil samples collected at IR 8. The occurrence and distribution of chemicals in surface and subsurface soils are presented in Tables 8-8 through 8-11. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in IR 8 soils are also presented in these tables.

The following chemicals were selected as COPCs at IR 8 for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
None Selected	None Selected	Arsenic	None Selected

Inorganic chemicals in surface soils were detected at concentrations less than residential RBC values. Therefore, no inorganic COPCs were selected from surface soils. Likewise, organic chemicals in surface soils were detected at concentrations less than residential RBC values. Therefore, no organic COPCs were selected from surface soils.

Arsenic is selected as the only COPC in subsurface soil. It was detected in three samples at a range of 0.88 mg/kg to 3.9 mg/kg. The maximum concentration of arsenic exceeded RBCs developed for the industrial land use scenario. Organic chemicals detected in subsurface soils each detected at levels less than industrial RBC values. Therefore, no organic COPCs were selected from subsurface soils.

TABLE 8-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT IR 8 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	14/14	120 - 4,250	1,887	1/1	228 - 228	228	228	7,800	228	N	A
Arsenic	6/15	0.63 - 2.7	1.29	1/1	0.84 - 0.84	0.84	0.84	0.43	0.84	N	G
Barium	15/15	4.4 - 17.7	10.51	1/1	5.9 - 5.9	5.9	5.90	550	5.9	N	A
Chromium**	15/15	1.9 - 15.5	6.02	1/1	4.5 - 4.5	4.5	4.50	39	4.5	N	A
Copper	14/15	1.3 - 15.6	5.43	1/1	3.7 - 3.7	3.7	3.70	310	3.7	N	A
Iron	14/14	98.1 - 2,260	1,167	1/1	391 - 391	391	391	2,300	391	N	A
Lead	14/15	0.65 - 48.3	15.66	1/1	26.9 - 26.9	26.9	26.90	400	26.9	N	A
Manganese	14/14	2.6 - 33.7	17.65	1/1	5.7 - 5.7	5.7	5.70	180	5.7	N	A
Mercury	5/15	0.03 - 0.08	0.03	1/1	0.04 - 0.04	0.04	0.04	2.3	0.04	N	A
Vanadium	15/15	0.8 - 8.8	3.97	1/1	1.2 - 1.2	1.2	1.20	55	1.2	N	A
Zinc	12/15	0.63 - 89.1	15.22	1/1	13.7 - 13.7	13.7	13.70	2,300	13.7	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

**As chromium VI

TABLE 8-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE SOILS AT IR 8 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
PESTICIDES/PCBs											
4,4'-DDD	3/14	2 - 233	22.46	2/5	5.7 - 61.5	33.6	15.56	2,700	61.5	N	A
4,4'-DDE	7/14	1.8 - 741	63.23	3/5	0.98 - 51.8	18.53	13.69	1,900	51.8	N	A
4,4'-DDT	7/14	1.8 - 557	46.78	4/5	2.5 - 120	34.88	29.70	1,900	120	N	A
Aroclor-1260	1/17	69 - 69	43.28	2/5	15.6 - 85	50.3	43.46	320	85	N	A
VOLATILE ORGANIC COMPOUNDS											
Methylene chloride	6/12	0.11 - 14	2.80	1/1	6 - 6	6	6	85,000	6	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

TABLE 8-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SUBSURFACE SOILS AT IR 8 (mg/kg)

NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	14/14	120. - 4,250	1,887	1/1	454 - 454	454	454	100,000	454	N	A
Antimony	2/15	0.26 - 0.48	0.39	3/4	2.9 - 6	4.3	3.76	82	6	N	A
Arsenic	6/15	0.63 - 2.7	1.29	3/4	0.88 - 3.9	2.28	1.78	3.8	3.9	Y	C
Barium	15/15	4.4 - 17.7	10.51	4/4	7.7 - 17.1	11.2	11.20	14,000	17.1	N	A
Beryllium	2/15	0.13 - 0.15	0.05	1/4	0.14 - 0.14	0.14	0.08	1.3	0.14	N	A
Cadmium	4/15	0.11 - 0.45	0.15	1/4	20.2 - 20.2	20.2	5.29	100	20.2	N	A
Chromium**	15/15	1.9 - 15.5	6.02	4/4	5.3 - 45.2	16.36	16.36	1,000	45.2	N	A
Copper	14/15	1.3 - 15.6	5.43	4/4	1.9 - 53.6	17.88	17.88	8,200	53.6	N	A
Cyanide	0/15	Not detected	–	1/1	16 - 16	16	16	4,100	16	N	A
Iron	14/14	98.1 - 2,260	1,167	1/1	506 - 506	506	506	61,000	506	N	A
Lead	14/15	0.65 - 48.3	15.66	4/4	6.2 - 168	62.48	62.48	400	168	N	A
Manganese	14/14	2.6 - 33.7	17.65	1/1	7.6 - 7.6	7.6	7.60	4,700	7.6	N	A
Mercury	5/15	0.03 - 0.08	0.03	4/4	0.03 - 0.14	0.07	0.07	61	0.14	N	A
Nickel	11/15	0.63 - 4.1	1.67	1/4	5.9 - 5.9	5.9	2.42	4,100	5.9	N	A
Selenium	5/15	0.46 - 1.8	0.65	1/4	1.1 - 1.1	1.1	0.68	1,000	1	N	A
Thallium	0/15	Not detected	–	1/4	1.5 - 1.5	1.5	0.57	16	1.51	N	A
Tin	2/5	0.78 - 2.1	1.94	2/4	18.5 - ,	22.7	12.31	100,000	26.9	N	A
Vanadium	15/15	0.8 - 8.8	3.97	4/4	1.4 - 2.4	1.9	1.90	1,400	2.4	N	A
Zinc	12/15	0.63 - 89.1	15.22	4/4	6.3 - 176	70.51	70.51	61,000	176	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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 industrial exposure, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As chromium VI

TABLE 8-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SUBSURFACE SOILS AT IR 8 (µg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBS											
4,4'-DDE	7/14	1.8 - 741	63.23	1/4	4 - 4	4	7.69	17,000	4	N	A
Dieldrin	0/14	Not detected	–	1/4	17.3 - 17.3	17.3	7.81	360	17.3	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
1,2-dichlorobenzene	0/14	Not detected	–	1/4	4.6 - 4.6	4.6	119.08	18,000,000	4.55	N	A
1,4-dichlorobenzene	0/14	Not detected	–	1/4	62.5 - 62.5	62.5	133.83	240,000	62.5	N	A
VOLATILE ORGANIC COMPOUNDS											
1,1,2-trichloroethane	0/12	Not detected	–	1/4	0.15 - 0.15	0.15	0.96	100,000	0.15	N	A
Acetone	1/12	1 - 1	3.67	1/1	24 - 24	24	24	20,000,000	24	N	A
Carbon disulfide	0/12	Not detected	–	1/1	5 - 5	5	5	20,000,000	5	N	A
Ethylbenzene	1/15	0.31 - 0.31	1.58	1/4	2.8 - 2.8	2.8	2.18	20,000,000	2.8	N	A
Methylene chloride	6/12	0.11 - 14	2.80	1/4	21 - 21	21	11.81	760,000	21	N	A
Xylenes, total	1/15	2.1 - 2.1	3.73	1/4	8.8 - 8.8	8.8	3.36	100,000,000	8.8	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

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 industrial exposure, incidental soil ingestion, with non-cancer risk adjusted to 0.1 hazard index.

*A - Not COPC (Max<RBC)

8.6.2.2 Sediment and Surface Water

Several VOCs, phthalates, PAHs, PCBs, pesticides, and metals were detected in one or more of the sediment samples collected at IR 8. Acetone, anthracene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, Aroclor-1242, bis(2-ethylhexyl)phthalate, and metals were detected in surface-water samples collected at IR 8. The occurrence and distribution of chemicals in sediment and surface water are presented in Tables 8-12 through 8-15. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in IR 8 sediment and surface water are also presented in these tables. The following chemicals were selected as COPCs for IR 8 sediment and surface water:

SEDIMENT		SURFACE WATER	
Inorganics	Organics	Inorganics	Organics
Aluminum	Benzo(a)anthracene	Antimony	Aroclor-1242
Antimony	Benzo(a)pyrene	Arsenic	Bis(2-ethylhexyl)phthalate
Arsenic	Benzo(b)fluoranthene	Cadmium	Dibenzo(a,h)anthracene
Cadmium	Benzo(k)fluoranthene	Lead*	Acetone**
Chromium	Chrysene	Aluminum**	Benzo(g,h,i)perylene*
Copper	Indeno(1,2,3-cd)pyrene	Barium**	
Iron	delta-BHC*	Iron**	
Lead*	Benzo(g,h,i)perylene*	Manganese**	
Manganese	Phenanthrene*	Tin**	
Nickel		Vanadium**	
Thallium		Zinc**	

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No WQSs (for consumption of water and organisms) are listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Maximum and representative concentrations of metals selected as COPCs exceeded RBCs for residential soil exposure. Carcinogenic PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene, were selected as COPCs in sediment at IR 8. They were each detected in five out of 13 sediment samples. The maximum and representative concentrations of these PAHs were detected at concentrations exceeding residential soil RBCs. Soil RBCs are used because RBCs protective of human health for sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health. Delta-BHC, benzo(g,h,i)perylene, and phenanthrene will be evaluated qualitatively in the uncertainty section because they lack quantitative toxicity values.

TABLE 8-12

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SEDIMENT AT IR 8 (mg/kg)

NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	12/12	97.7 - 3,350	1,332	14/14	159 - 17,400	2,147	2,147	7,800	6,700	Y	C
Antimony	0/13	Not detected	–	5/13	5 - 20.7	12.06	6.32	3.1	11	Y	C
Arsenic	8/12	1.5 - 7	2.63	22/22	1 - 43.5	7.74	7.74	0.43	13.3	Y	C
Barium	13/13	5 - 15.2	9.27	13/22	4 - 304	42.09	26.53	550	37.9	N	A
Cadmium	3/13	0.06 - 0.9	0.22	6/15	0.21 - 11.4	3.21	1.55	3.9	2.91	Y	C
Chromium**	8/13	2.1 - 11.7	5.01	22/22	2.3 - 70.7	13.80	13.80	39	22.7	Y	C
Cobalt	2/13	0.12 - 0.56	0.47	9/18	0.37 - 10.1	4.24	3.02	470	5.48	N	A
Copper	13/13	0.76 - 34.6	8.88	21/21	1.5 - 1,100	129	129	310	611	Y	C
Iron	12/12	109 - 3,640	1,199	3/4	646 - 27,100	10,602	7,952	2,300	27,100	Y	C
Lead	12/13	5.5 - 56.5	17.97	22/22	4.9 - 1,680	164	164	400	370	Y	C
Manganese	12/12	4 - 38.6	15.39	14/14	4.7 - 546	148	148	180	546	Y	C
Mercury	4/13	0.04 - 0.07	0.05	15/22	0.04 - 1.6	0.2	0.14	2.3	0.268	N	A
Nickel	10/13	0.7 - 5.5	2.15	14/22	1.1 - 248	30.33	19.98	160	42	Y	C
Selenium	2/13	0.24 - 0.59	0.68	1/13	4.8 - 4.8	4.8	0.78	39	1.26	N	A
Silver	1/13	0.5 - 0.5	0.27	3/13	0.63 - 17.7	6.91	1.93	39	3.34	N	A
Thallium	0/13	Not detected	–	2/12	46.7 - 168	107.35	18.18	0.63	168	Y	C
Tin	1/2	0.99 - 0.99	2.85	2/9	12.8 - 55.6	34.70	9.83	4,700	30.2	N	A
Vanadium	13/13	1.6 - 11.7	5.08	17/20	1.9 - 25.7	7.86	6.85	55	12.6	N	A
Zinc	8/13	3.5 - 140	25.74	20/20	5.2 - 2,180	367	367	2,300	2,180	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Sediment RBCs are adapted using residential soil RBC.

An RBC for lead based on cancer risk or hazard index is not available. The 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As chromium VI

TABLE 8-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SEDIMENT AT IR 8 (µg/kg)

NAS KEY WEST

PAGE 1 OF 2

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBs											
2,4-D	1/10	24.7 - 24.7	39.15	6/10	11 - 58.8	25.19	17.86	78,000	33.7	N	A
4,4'-DDD	1/12	3.9 - 3.9	13.03	3/23	9 - 100	40.57	15.28	2,700	31	N	A
4,4'-DDE	5/12	2.2 - 149	19.85	5/23	4 - 180	46.44	19.15	1,900	61.6	N	A
4,4'-DDT	1/12	3.7 - 3.7	13.02	6/23	8 - 46	24.62	15.91	1,900	32.8	N	A
alpha-BHC	3/11	1.1 - 1.5	7.11	1/23	30 - 30	30	6.22	100	14	N	A
Aroclor-1254	0/9	Not detected	–	1/15	26.1 - 26.1	26.1	72.50	320	26	N	A
beta-BHC	0/9	Not detected	–	1/23	32 - 32	32	6.65	350	13	N	A
delta-BHC	2/12	2.8 - 15.7	7.35	1/23	48 - 48	48	7.70	–	15.2	Y	F
Endosulfan I	3/12	1.2 - 2.7	6.70	1/23	1.3 - 1.3	1.3	6.43	47,000	1.3	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Anthracene	0/13	Not detected	–	1/13	20 - 20	20	134.31	2,300,000	20	N	A
Benzo(a)anthracene	0/13	Not detected	–	5/13	15 - 130	71.4	116.77	880	130	Y	E
Benzo(a)pyrene	0/13	Not detected	–	5/13	41 - 130	83	122.08	88	130	Y	B
Benzo(b)fluoranthene	1/13	489 - 489	966.92	5/13	21 - 160	85.2	122.50	880	160	Y	E
Benzo(g,h,i)perylene	0/13	Not detected	–	4/13	36 - 100	68.75	125.08	–	100	Y	EF
Benzo(k)fluoranthene	0/13	Not detected	–	5/13	9.8 - 140	60.56	113.14	8,800	140	Y	E
Bis(2-ethylhexyl)phthalate	1/6	4,500 - 4,500	1992.17	5/5	290 - 1,100	640	640.00	46,000	1,100	N	A
Chrysene	1/13	417 - 417	961.38	5/13	16 - 160	84.4	121.77	88,000	160	Y	E
Di-n-butylphthalate	0/6	Not detected	–	1/5	160 - 160	160	316.00	780,000	160	N	A
Fluoranthene	1/13	690 - 690	982.38	7/13	26 - 210	111.14	148.54	310,000	210	N	A
Fluorene	0/13	Not detected	–	5/13	110 - 320	180	223.46	310,000	320	N	A
Indeno(1,2,3-cd)pyrene	0/13	Not detected	–	5/13	17 - 100	56	110.85	880	100	Y	E
Naphthalene	0/13	Not detected	–	5/13	45 - 90	60.6	157.62	310,000	90	N	A
Phenanthrene	0/13	Not detected	–	7/13	24 - 150	88	140.50	–	150	Y	F
Pyrene	1/13	509 - 509	968.46	7/13	28 - 230	99.71	142.04	230,000	230	N	A

TABLE 8-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SEDIMENT AT IR 8 (µg/kg)

NAS KEY WEST

PAGE 2 OF 2

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
VOLATILE ORGANIC COMPOUNDS											
Acetone	3/6	4 - 120	30.90	2/5	5 - 72	38.5	19.20	780,000	16.6	N	A
Methylene chloride	2/6	5 - 20	7.50	4/13	7 - 22	12.5	12.51	85,000	16.6	N	A
Toluene	2/13	3.5 - 16.9	4.49	1/13	5 - 5	5	2.62	1,600,000	3.32	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Sediment RBCs are adapted using residential soil RBC.

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

*A - Not COPC (Max<RBC)

B - COPC (Max>RBC, organics)

E - COPC - (same family)

F - COPC (eval. qual.)

TABLE 8-14

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE WATER AT IR 8 (µg/L)

NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Aluminum	2/12	25 - 148	24.97	1/2	2,030 - 2,030	2,030	1,025	–	2,030	Y	H
Antimony	4/12	3.5 - 205	33.71	9/10	197 - 220	211.67	192	14	220	Y	C
Arsenic	3/13	2.6 - 5.2	3.97	1/10	57.3 - 57.3	57.3	11.43	0.018	57.3	Y	C
Barium	11/13	4.7 - 16.3	6.93	10/10	4.6 - 107	15.36	15.36	–	29.2	Y	H
Cadmium	0/13	Not detected	–	1/10	19.8 - 19.8	19.8	4.23	16	6.51	Y	C
Chromium**	1/13	16.4 - 16.4	2.62	1/10	37.2 - 37.2	37.2	8.22	170	12.5	N	A
Copper	1/13	2 - 2	2.26	1/10	172 - 172	172	21.70	1,300	46.5	N	A
Iron	5/12	8.5 - 170	24.7	2/2	10.5 - 305,000	152,505	152,505	–	305,000	Y	H
Lead	0/12	Not detected	–	2/10	26.4 - 155	90.7	29.74	50	82.2	Y	C
Manganese	2/12	3.2 - 12.3	2	1/2	294 - 294	294	147.50	–	294	Y	H
Mercury	6/13	0.29 - 4.2	0.52	3/10	0.2 - 0.43	0.28	0.15	0.14	0.219	N	G
Silver	0/13	Not detected	–	1/10	10.2 - 10.2	10.2	3.27	105	4.37	N	A
Tin	0/4	Not detected	–	3/9	48 - 94.6	71.35	33.78	–	72.5	Y	H
Vanadium	2/13	2 - 2.8	1.99	1/10	42.5 - 42.5	42.5	8.75	–	13.7	Y	H
Zinc	5/13	1.4 - 39.6	7.19	10/10	5.8 - 6,230	632.06	632.06	–	6,230	Y	H

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg)

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

H - COPC (lacks an RBC, but has a quantitative toxicity)

**As chromium VI

TABLE 8-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN SURFACE WATER AT IR 8 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
PESTICIDES/PCBs											
Aroclor-1242	0/13	Not detected	–	1/2	1.1 - 1.1	1.1	0.68	0.0000444	1.1	Y	B
SEMIVOLATILE ORGANIC COMPOUNDS											
Anthracene	0/13	Not detected	–	1/10	0.11 - 0.11	0.11	1.54	9,600	0.11	N	A
Benzo(g,h,i)perylene	0/13	Not detected	–	1/10	0.54 - 0.54	0.54	1.62	–	0.54	Y	EF
Bis(2-ethylhexyl)phthalate	1/9	8 - 8	5.39	1/2	5 - 5	5	5.00	1.8	5	Y	B
Dibenzo(a,h)anthracene	0/13	Not detected	–	1/10	0.43 - 0.43	0.43	1.57	0.0028	0.43	Y	B
VOLATILE ORGANIC COMPOUNDS											
Acetone	2/9	4 - 12	4.33	1/2	46 - 46	46	25.50	–	46	Y	H

Notes:

Because most organics are not naturally occurring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

*A - Not COPC (Max<RBC)
B - COPC (Max>RBC, organics)
E - COPC - (same family)
F - COPC (eval. qual.)
H - COPC (lacks an RBC, but has a quantitative toxicity)

WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure basis for developing an applicable WQS. Thus, the use of WQS as RBCs to select surface-water COPCs is conservative regarding protection of human health.

Antimony, arsenic, cadmium, and lead were selected as COPCs for surface water. Antimony was detected in 9 out of 10 samples at a range of 197 µg/L to 220 µg/L. All concentrations of antimony exceeded the WQS. Arsenic and cadmium were each detected in one sample that exceeded WQS. Lead does not have a listed quantitative toxicity value; therefore, it will be evaluated qualitatively in the uncertainty section. Aroclor-1242, bis(2-ethylhexyl)phthalate, and dibenzo(a,h)anthracene were also selected as COPCs for surface water. These organics were each detected in one sample that exceeded WQS. Aluminum, barium, iron, manganese, tin, vanadium, zinc, and acetone were also selected as COPCs for surface water at IR 8. These chemicals did not have listed WQS values, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

8.6.2.3 Shellfish Tissue

Several pesticides and several metals were detected in one or more of the lobster and stone crab tissue samples collected at IR 8. The occurrence and distribution of chemicals in lobster tissue is presented in Tables 8-16 through 8-17. The occurrence and distribution of chemicals in crab tissue is presented in Table 8-18 and 8-19. Summary statistics and COPC selection results for chemicals detected in IR 8 lobster and crab tissue samples are also presented in these tables. The following chemicals were selected as COPCs for IR 8 lobster and crab tissue:

LOBSTER TISSUE		CRAB TISSUE	
Inorganics	Organics	Inorganics	Organics
None Selected	Chlorobenzilate	Copper	Aldrin
	delta-BHC*	Lead*	Chlorobenzilate

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section.

TABLE 8-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN LOBSTER TISSUE AT IR 8 (mg/kg) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
Arsenic	19/19	4.7 - 20.7	13.43	4/4	10.9 - 16.9	14.55	14.55	0.0021	N	G
Copper	19/19	14.2 - 37.1	26.18	4/4	25 - 56.4	38.90	38.90	5.4	N	G
Lead	3/19	0.58 - 0.78	0.26	1/4	0.42 0.42	0.42	0.23	–	N	A
Manganese	5/19	1.3 - 1.7	0.65	3/4	0.33 - 1.8	0.97	0.88	3.1	N	A
Vanadium	0/19	Not detected	–	1/4	0.57 0.57	0.57	0.31	0.95	N	A
Zinc	19/19	12.5 - 25.8	20.51	4/4	18.9 - 21.4	21.4	21.40	41	N	A

Notes:
Metals are selected as COPCs if average values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 8-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN LOBSTER TISSUE AT IR 8 (µg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection					
PESTICIDES/PCBs										
4,4'-DDD	4/19	0.72 - 0.86	1.48	2/4	0.18 - 0.61	0.4	1.02	13	N	A
delta-BHC	0/19	Not detected	–	1/4	0.04 - 0.04	0.04	0.66	–	Y	F
gamma-BHC (lindane)	3/19	0.03 - 0.14	0.73	1/4	0.15 - 0.15	0.15	0.68	2.4	N	A
Chlorobenzilate	0/19	Not detected	–	2/4	15 - 23	19	13.75	12	Y	B
Dieldrin	1/19	0.56 - 0.56	1.59	1/4	0.57 - 0.57	0.57	1.38	0.2	N	G
Endosulfan II	8/19	0.12 - 0.67	1.08	1/4	0.84 - 0.84	0.84	1.45	810	N	A
Endrin	9/19	0.06 - 0.56	0.98	3/4	0.21 - 0.37	0.27	0.62	41	N	A
Endrin aldehyde	5/19	0.65 - 3.1	1.54	3/4	0.59 - 2.9	1.6	1.61	41	N	A
Heptachlor	10/19	0.07 - 0.33	0.50	2/4	0.13 - 0.26	0.2	0.52	0.7	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
B - COPC (Avg>RBC, organics)
F - COPC (eval. qual.)
G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 8-18

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN CRAB TISSUE AT IR 8 (mg/kg) NAS KEY WEST

Chemical	Background			Site			Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average			
Arsenic	10/10	4.7 - 20.7	13.43	1/1	19.3 - 19.3	19.3	0.0021	N	G
Copper	10/10	5.5 - 60.5	26.65	1/1	69.8 - 69.8	69.8	5.4	Y	C
Lead	3/19	0.58 - 0.78	0.26	1/1	1.7 - 1.7	1.7	–	Y	F
Manganese	9/10	0.36 - 2.3	1.12	1/1	2.8 - 2.8	2.8	3.1	N	A
Mercury	7/10	0.04 - 0.17	0.08	1/1	0.11 - 0.11	0.11	0.041	N	G
Vanadium	1/10	0.61 - 0.61	0.32	1/1	0.68 - 0.68	0.68	0.95	N	A
Zinc	10/10	9 - 58	43.85	1/1	93.8 - 93.8	93.8	41	N	A

Notes:

Metals are selected as COPCs if average values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)

C - COPC (Avg>RBC & Avg>2XBkgdAvg, inorganics)

F - COPC (eval. qual.)

G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 8-19

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN CRAB TISSUE AT IR 8 (µg/kg) NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection		Average			
PESTICIDES/PCBs										
4,4'-DDE	3/10	0.37 - 1.9	1.43	1/1	1.1	- 1.1	1.1	9.3	N	A
4,4'-DDT	2/10	0.48 - 0.71	1.44	1/1	3.2	- 3.2	3.2	9.3	N	A
Aldrin	7/10	0.13 - 3.4	0.75	1/1	0.41	- 0.41	0.41	0.19	Y	B
Chlorobenzilate	7/10	4.4 - 140	31.03	1/1	86	- 86	86	12	Y	B
Endosulfan I	1/10	0.4 - 0.4	0.8	1/1	0.85	- 0.85	0.85	810	N	A
Endosulfan II	3/10	0.14 - 2.6	1.48	1/1	0.65	- 0.65	0.65	810	N	A
Endrin	7/10	0.31 - 2.7	1.1	1/1	0.41	- 0.41	0.41	41	N	A
Endrin aldehyde	9/10	0.34 - 2.8	1.62	1/1	2.5	- 2.5	2.5	41	N	A
Methoxychlor	2/10	5 - 11	8.4	1/1	4.2	- 4.2	4.2	6800	N	A

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)

B - COPC (Avg>RBC, organics)

Chlorobenzilate was selected as a COPC for lobster tissue at IR 8. It was detected in two out of four samples at a range of 15 µg/kg to 23 µg/kg. Maximum and average concentrations for chlorobenzilate exceeded its fish RBC. Chemicals that lack toxicity criteria (lead and delta-BHC) will be evaluated qualitatively in the uncertainty section.

Copper, aldrin, and chlorobenzilate were each selected as COPCs for crab tissue at IR 8. Copper, aldrin and chlorobenzilate were each detected in one sample at concentrations of 69.8 mg/kg, 0.41 µg/kg, and 86 µg/kg, respectively. Maximum and average concentrations for these COPCs exceeded respective fish RBCs. Chemicals that lack toxicity criteria (i.e. lead) will be evaluated qualitatively in the uncertainty section.

8.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at IR 8 are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

8.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at IR 8 are presented in Section 8.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

8.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under an RME and a CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if an HI

(noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in three parts:

- Carcinogenic risks
- Noncarcinogenic risks
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

8.6.5.1 Carcinogenic Risks

Table 8-20 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risks for the current trespasser adult (1E-05), current trespasser adolescent (1E-05), and hypothetical future resident (1E-04) are within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds FDEP's target risk of 1E-06. The ingestion and dermal exposure routes contribute the most to the cumulative carcinogenic risk for the adult trespasser and the future resident. The dermal exposure route is associated with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. Additionally, incidental ingestion of surface water also contributes to the carcinogenic risk. The principal COPC contributing to this cancer risk is arsenic in sediment and surface water. The estimated carcinogenic risks to all other receptors are less than the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 8.6.8.

Table 8-21 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The estimated carcinogenic risks for the current trespasser adult (1E-06) and hypothetical future resident (1E-05) are within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds FDEP's target risk of 1E-06. The ingestion and dermal contact with sediment and surface water contributes the most to the cumulative carcinogenic risk for the future resident. The estimated carcinogenic risks for all other receptors are below the EPA target risk range. Chemical-specific risks for COPCs are presented in Section 8.6.8.

Table 8-20 lists the estimated cumulative RME carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk due to shellfish ingestion for the hypothetical

TABLE 8-20

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE IR 8*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	5E-08	NA
Dermal Contact	NA	NA	NA	NA	9E-08	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	1E-15	NA
Subtotal	NA	NA	NA	NA	1E-07	NA
Sediment						
Incidental Ingestion	1E-05	5E-07	7E-07	NA	NA	NA
Dermal Contact	3E-05	5E-06	4E-06	NA	NA	NA
Subtotal	4E-05	5E-06	5E-06	NA	NA	NA
Surface Water						
Incidental Ingestion	3E-05	3E-06	4E-06	NA	NA	NA
Dermal Contact	1E-05	2E-06	2E-06	NA	NA	NA
Subtotal	5E-05	5E-06	5E-06	NA	NA	NA
Shellfish* **						
Ingestion	1E-05	NA	NA	NA	NA	NA
Subtotal	1E-05	NA	NA	NA	NA	NA
TOTAL	1E-04	1E-05	1E-05	NA	1E-07	NA
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	7E-03	NA
Dermal Contact	NA	NA	NA	NA	1E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	2E-02	NA
Sediment						
Incidental Ingestion	8E+00	2E-01	5E-01	NA	NA	NA
Dermal Contact	6E-01	10E-02	2E-01	NA	NA	NA
Subtotal	9E+00	3E-01	6E-01	NA	NA	NA
Surface Water						
Incidental Ingestion	4E+00	2E-01	5E-01	NA	NA	NA
Dermal Contact	3E+00	1E-01	2E-01	NA	NA	NA
Subtotal	7E+00	3E-01	7E-01	NA	NA	NA
Shellfish* **						
Ingestion	1E-01	NA	NA	NA	NA	NA
Subtotal	1E-01	NA	NA	NA	NA	NA
TOTAL	2E+01	7E-01	1E+00	**	2E-02	**

* = Chemical-Specific Risks are presented in Section 8.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
*** = Adult Resident Only.
NA = Not Applicable; pathway is not applicable for the respective media.

TABLE 8-21

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE IR 8*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	3E-09	NA
Dermal Contact	NA	NA	NA	NA	5E-09	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	4E-16	NA
Subtotal	NA	NA	NA	NA	7E-09	NA
Sediment						
Incidental Ingestion	2E-06	5E-08	3E-08	NA	NA	NA
Dermal Contact	1E-06	2E-07	8E-08	NA	NA	NA
Subtotal	3E-06	2E-07	1E-07	NA	NA	NA
Surface Water						
Incidental Ingestion	5E-06	5E-07	3E-07	NA	NA	NA
Dermal Contact	5E-06	3E-07	1E-07	NA	NA	NA
Subtotal	1E-05	8E-07	5E-07	NA	NA	NA
Shellfish* **						
Ingestion	4E-07	NA	NA	NA	NA	NA
Subtotal	4E-07	NA	NA	NA	NA	NA
TOTAL	1E-05	1E-06	6E-07	NA	7E-09	NA
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	9E-04	NA
Dermal Contact	NA	NA	NA	NA	1E-03	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	2E-03	NA
Sediment						
Incidental Ingestion	4E+00	5E-02	1E-01	NA	NA	NA
Dermal Contact	6E-02	10E-03	2E-02	NA	NA	NA
Subtotal	4E+00	6E-02	1E-01	NA	NA	NA
Surface Water						
Incidental Ingestion	2E+00	1E-01	2E-01	NA	NA	NA
Dermal Contact	2E+00	6E-02	1E-01	NA	NA	NA
Subtotal	4E+00	2E-01	3E-01	NA	NA	NA
Shellfish* **						
Ingestion	1E-02	NA	NA	NA	NA	NA
Subtotal	1E-02	NA	NA	NA	NA	NA
TOTAL	8E+00	2E-01	5E-01	**	2E-03	**

* = Chemical-Specific Risks are presented in Section 8.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
*** = Adult Resident Only.
NA = Not Applicable; pathway is not applicable for the respective media.

future adult resident (1.12E-05) is within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds the 1E-06 FDEP target risk. Chlorobenzilate is the only contributer to the cumulative carcinogenic risk. Table 8-21 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk due to shellfish ingestion for the hypothetical future adult resident is below the EPA "target risk range" of 1E-04 to 1E-06 and the FDEP target risk of 1E-06. Chemical-specific risks for COPCs are presented in Section 8.6.8.

8.6.5.2 Noncarcinogenic Risks

Table 8-20 lists the estimated cumulative RME noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, excavation workers, and occupational workers. The cumulative HI for the current adolescent trespasser and hypothetical future resident exceed 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The ingestion and dermal exposure routes associated with sediment and surface water contribute the most to the cumulative carcinogenic risk for the future resident. The dermal exposure route is also associate with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPCs contributing to the noncarcinogenic risks are arsenic, antimony, iron, and thallium in sediment and arsenic, antimony, and iron in surface water. The target organs for the COPCs are as follows: antimony (heart), arsenic (skin), iron (pancreas and liver) and thallium (liver). The HIs for arsenic, antimony, and iron (via exposure to sediment and surface water) are greater than 1.0. The HI for thallium (via exposure to sediment) is greater than 1.0. The HIs for the current adolescent trespasser do not exceed 1.0 based on the same target organ. The HIs for all other receptors at IR 8 are less than 1.0. Chemical-specific risks for COPCs are presented in Section 8.6.8.

Table 8-21 lists the estimated cumulative CTE noncarcinogenic risks for future residents, trespasser adults and adolescents, maintenance workers, and excavation workers, and occupational workers. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. The ingestion and dermal exposure routes in sediment and surface water contribute the most to the cumulative noncarcinogenic risk for the future resident. The HIs for antimony and iron (via exposure to sediment and surface water) are greater than 1.0. The HI for thallium (via exposure to sediment) is greater than 1.0. The HI for arsenic (via exposure to sediment and surface water) is less than 1.0. The HIs for all other receptors at IR 8 are less than or equal to 1.0. Chemical-specific risks for COPCs are presented in Section 8.6.8.

Table 8-20 lists the estimated cumulative RME noncarcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The cumulative HI due to shellfish ingestion for the hypothetical future resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Table 8-21 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario The cumulative HI due to shellfish ingestion for the hypothetical future resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Chemical-specific risks for COPCs are presented in Section 8.6.8.

8.6.5.3 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the IR 8 versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 8-22 and 8-23 for inorganics and organics, respectively. The results of this preliminary comparison for IR 8 are presented in this section.

The maximum values of antimony, arsenic, cadmium, copper, lead, mercury, methylene chloride, heptachlor, and bis(2-ethylhexyl)phthalate exceeded both their respective MCL and RBC values. Most of metals that exceeded both MCLs and tap water RBCs were detected in 50 percent or more of the samples analyzed with the exception of cadmium. A majority of the detections of these metals were above tap water RBCs. Generally the higher range of detections of these metals were above MCLs. Heptachlor was detected in one sample exceeding MCLs and tap water RBCs. Bis(2-ethylhexyl)phthalate was detected in five samples with the maximum value exceeding MCLs and tap water RBCs. Methylene chloride was detected in 11 out of 32 samples with the maximum value exceeding MCLs and tap water RBCs. Aluminum, barium, beryllium, cyanide, iron, manganese, silver, thallium, vanadium, and zinc concentrations exceeded tap water RBCs, however, this is not uncommon for unfiltered groundwater. 1,4-dichlorobenzene, 1,1-dichloroethene, benzene, bromodichloromethane, bromoform, chloroform, and dibromochloromethane concentrations also exceeded tap water RBCs.

TABLE 8-22

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs INORGANICS IN GROUNDWATER AT IR 8 (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of All Values	Maximum Contaminant Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	0/10	Not detected	–	9/19	148 - 72,000	16,212	7,716.21	–	NA	3,700	Y
Antimony	0/12	Not detected	–	26/42	4.1 - 236	132.43	95.95	6	Y	1.5	Y
Arsenic	3/13	4.1 - 11.9	4.54	18/42	2.7 - 104	21.94	13.20	50	Y	0.045	Y
Barium	10/13	6.4 - 19.45	10.20	37/37	5.9 - 333	85.42	85.42	2,000	N	260	Y
Beryllium	0/13	Not detected	–	5/42	1 - 1.5	1.22	1.03	4	N	0.016	Y
Cadmium	0/13	Not detected	–	6/42	11.4 - 26.4	17.07	4.33	5	Y	1.8	Y
Chromium*	3/13	0.71 - 13	2.51	11/42	12.3 - 96	33.51	12.71	100	N	3,700	N
Cobalt	0/13	Not detected	–	1/37	2.2 - 2.2	2.2	7.60	–	NA	220	N
Copper	1/13	3.15 - 3.15	2.45	26/42	10.4 - 1,780	170.84	106.95	1,300**	Y	150	Y
Cyanide	2/8	2.4 - 5.525	1.47	1/13	140 - 140	140	71.92	200	N	73	Y
Iron	2/10	76.9 - 97.4	41.72	9/19	167 - 57,200	17,114	8,120.19	–	NA	1,100	Y
Lead	1/12	2.5 - 2.5	1.39	19/42	15.7 - 1,870	253	118	15***	Y	15	Y
Manganese	7/10	2.2 - 10.3	3.78	8/19	35.9 - 422.5	168	77.61	–	NA	84	Y
Mercury	4/13	0.13 - 0.24	0.10	28/42	0.13 - 620	31.35	20.92	2	Y	1.1	Y
Nickel	0/13	Not detected	–	3/42	22.4 - 27.2	24.07	9.70	100	N	73	N
Silver	1/13	3.3 - 3.3	1.37	3/42	6.1 - 21	11.67	6.67	–	NA	18	Y
Thallium	1/13	4.925 - 4.925	2.24	3/42	4 - 11.6	6.62	9.52	–	NA	2.9	Y
Tin	0/3	Not detected	–	6/19	50.9 - 150	97.13	40.94	–	NA	2,200	N
Vanadium	4/13	3.4 - 3.9	2.62	9/37	10.5 - 46.9	27.44	9.38	–	NA	26	Y
Zinc	3/13	3.425 - 15.3	2.82	25/42	9.9 - 2,630	405	242	–	NA	1,100	Y

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

**Copper Action Level

***Lead Action Level

TABLE 8-23

OCCURRENCE, DISTRIBUTION, AND COMPARISON WITH MCLs AND RBCs
ORGANICS IN GROUNDWATER AT IR 8 (µg/L)
NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Background Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Averag of All Values	Maximum Contaminant Level	Maximum Exceeds MCL?	Tap Water Risk-Based Concentration	Maximum Exceeds RBC?
PESTICIDES/PCBs											
2,4,5-TP (silvex)	0/9	Not detected	–	1/10	0.26 - 0.26	0.26	0.07	–	NA	290	N
2,4-D	0/9	Not detected	–	1/10	0.48 - 0.48	0.48	0.09	70	N	61	N
alpha-BHC	0/10	Not detected	–	1/42	0.17 - 0.17	0.17	0.06	–	NA	0.011	Y
Heptachlor	0/10	Not detected	–	1/42	0.62 - 0.62	0.62	0.06	0.4	Y	0.0023	Y
SEMIVOLATILE ORGANIC COMPOUNDS											
1,4-dichlorobenzene	0/7	Not detected	–	4/32	2 - 36	12.65	3.29	75	N	0.44	Y
Bis(2-ethylhexyl)phthalate	0/7	Not detected	–	5/14	3 - 16.5	6.9	4.11	6	Y	4.8	Y
Diethylphthalate	0/7	Not detected	–	2/14	1.4 - 3	2.2	3.74	–	NA	2,900	N
Fluorene	0/7	Not detected	–	1/32	0.82 - 0.82	0.82	1.91	–	NA	150	N
Naphthalene	1/7	2 - 2	4.48	1/32	2.5 - 2.5	2.5	1.67	–	NA	150	N
Pyrene	0/7	Not detected	–	2/32	0.35 - 0.6	0.48	1.58	–	NA	110	N
VOLATILE ORGANIC COMPOUNDS											
1,1-dichloroethene	0/4	Not detected	–	1/32	2 - 2	2	1.21	7	N	0.044	Y
Acetone	1/4	5 - 5	5	1/9	2 - 2	2	4.67	–	NA	370	N
Benzene	0/4	Not detected	–	1/32	1.8 - 1.8	1.8	1.38	5	N	0.36	Y
Bromodichloromethane	0/4	Not detected	–	1/32	3.5 - 3.5	3.5	1.16	80	N	0.17	Y
Bromoform	0/4	Not detected	–	1/32	3.9 - 3.9	3.9	1.45	80	N	2.4	Y
Carbon disulfide	0/4	Not detected	–	5/9	3 - 7	4.3	3.50	–	NA	100	N
Chlorobenzene	0/4	Not detected	–	3/32	17 - 71	50.33	5.89	–	NA	3.9	Y
Chloroform	0/4	Not detected	–	1/32	1.6 - 1.6	1.6	0.96	80	N	0.15	Y
Dibromochloromethane	0/4	Not detected	–	1/32	7.2 - 7.2	7.2	1.24	80	N	0.13	Y
Ethylbenzene	0/4	Not detected	–	2/32	1.2 - 1.3	1.25	1.39	700	N	130	N
Methylene chloride	2/4	1 - 1	1.75	11/32	1 - 6	2.58	5.34	5	Y	4.1	Y
Toluene	0/4	Not detected	–	1/32	3.2 - 3.2	3.2	1.43	1,000	N	75	N
Xylene (total)	0/4	Not detected	–	1/32	2.6 - 2.6	2.6	1.13	10,000	N	1,200	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.

8.6.6 Uncertainties for IR 8

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of IR 8 risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and hazard index (via surface water and sediment) for the future residential receptors. The uncertainty associated with the dermal exposure route may overestimate the risk at IR 8.

- Arsenic is a major contributor to the cumulative carcinogenic risks in sediment and surface water. The carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Since arsenic is a major contributor to the risk, risks may be overstated.

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at IR 8 (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

- Lead was determined to be a COPC in sediment and surface water at IR 8. Lead exposure to sediment and surface water is not estimated under the IEUBK Lead Model for the baseline human health risk assessment at IR 8. This probably underestimates the risks to potential receptors exposed to lead in sediment and surface water, especially to residential children. Exposure to lead in sediment and surface water and by residential children is lower than exposure to lead in surface soil at IR 8. It is generally desirable to avoid contact with lead for all potential receptors, especially for young children.

- Three chemicals in sediment [delta-BHC, benzo(g,h,i)perylene, and phenanthrene] did not have a listed toxicity value for use in the quantitative risk assessment; therefore, no risks were estimated for exposure to these chemicals. These chemicals were detected at low frequencies and at levels that were comparable to other pesticides and PAHs in sediment. These uncertainties could possibly underestimate the carcinogenic and noncarcinogenic risk at IR 8, but without additional toxicity information, this remains unknown.

- One chemical in lobster tissue (delta-BHC) did not have a listed toxicity value for use in the quantitative risk assessment; therefore, no risks were estimated for exposure to delta-BHC. Delta-BHC was detected at similar levels to other pesticides detected in lobster tissue. Most of these pesticides were not selected as COPCs. These uncertainty could possibly underestimate the carcinogenic and noncarcinogenic risk at IR 8, but without additional toxicity information, this remains unknown.

8.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for IR 8.

8.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment, a subset of chemicals, called COCs, was selected for the evaluation of RGOs. At IR 8, COCs were included in the RGO evaluation only if the COC's contribution to risk exceeds a cancer risk level of 1E-06 or a hazard quotient of 0.1. The COCs selected at IR 8 are as follows:

- Sediment
  - Antimony
  - Arsenic
  - Iron
  - Thallium

Antimony, arsenic, iron, and thallium were selected as COCs in soil because their contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor).

- Surface Water
  - Antimony
  - Arsenic
  - Iron

Antimony, arsenic, and iron were selected as COCs in surface water because their contribution to the noncarcinogenic risk is greater than 0.1 (future residential receptor).

8.6.7.2 Remedial Goal Options

Table 8-24 lists RGOs for COCs in surface water based on WQS (for consumption of water and organisms). RGOs are not listed for sediment because generic levels for sediment exposure have not been established. The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 8-25 (sediment - future resident) and Table 8-26 (surface water - future resident). These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

8.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 8-27 and 8-28. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium

- Representative concentrations for each COPC in each applicable medium

- Estimated individual and total carcinogenic and noncarcinogenic risks arranged by receptor and land use

TABLE 8-24

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE WATER AT IR 8
NAS KEY WEST

COC	Human Health Criteria Water+Organism Consumption (µg/L)
Antimony	14
Arsenic	0.018
Iron	-

TABLE 8-25

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SEDIMENT AT IR 8
NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Antimony	-	-	-	10.5	105	314
Arsenic	-	-	-	3.2	32	97
Iron	-	-	-	7,800	78,000	230,000
Thallium	-	-	-	2.1	21	62.7

TABLE 8-26

REMEDIAL GOAL OPTIONS DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE WATER AT IR 8
NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Antimony	-	-	-	10.1	101	303
Arsenic	-	-	-	7.6	76	227
Iron	-	-	-	7,600	76,000	230,000

TABLE 8-27

RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
PAGE 1 OF 12

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	6,700	NA	NA	NA	NA	2.4E-02	1.2E-03	NA	2.6E-02
Antimony	4.00E-04	8.00E-05	-	-	-	-	11	NA	NA	NA	NA	1.0E-01	4.8E-03	NA	1.1E-01
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13.3	8.9E-06	3.4E-05	NA	4.3E-05	1.6E-01	2.5E-01	NA	4.1E-01
Cadmium	1.00E-03	2.00E-04	-	-	-	-	2.91	NA	NA	NA	NA	1.1E-02	5.1E-03	NA	1.6E-02
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	22.7	NA	NA	NA	NA	1.7E-02	7.9E-04	NA	1.7E-02
Copper	4.00E-02	8.00E-03	-	-	-	-	611	NA	NA	NA	NA	5.6E-02	2.7E-03	NA	5.8E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	27,100	NA	NA	NA	NA	3.3E-01	1.6E-02	NA	3.5E-01
Manganese	1.40E-01	2.80E-02	-	-	-	-	546	NA	NA	NA	NA	1.4E-02	6.8E-04	NA	1.5E-02
Nickel	2.00E-02	4.00E-03	-	-	-	-	42	NA	NA	NA	NA	7.7E-03	3.7E-04	NA	8.0E-03
Thallium	8.00E-05	1.60E-05	-	-	-	-	168	NA	NA	NA	NA	7.7E+00	3.7E-01	NA	8.0E+00
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	130	4.2E-08	NA	NA	4.2E-08	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	130	4.2E-07	NA	NA	4.2E-07	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	160	5.2E-08	NA	NA	5.2E-08	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	140	4.6E-09	NA	NA	4.6E-09	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	160	5.2E-10	NA	NA	5.2E-10	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	100	3.3E-08	NA	NA	3.3E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	9.5E-06	3.4E-05	NA	4.4E-05	8.4E+00	6.5E-01	NA	9.0E+00
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	2,030	NA	NA	NA	NA	4.8E-03	3.2E-03	NA	8.1E-03
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	1.3E+00	8.8E-01	NA	2.2E+00
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	57.3	3.2E-05	1.2E-05	NA	4.4E-05	4.5E-01	3.0E-01	NA	7.6E-01
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	29.2	NA	NA	NA	NA	9.9E-04	6.6E-04	NA	1.7E-03
Cadmium	5.00E-04	1.00E-04	5.71E-05	-	-	6.30E+00	6.51	NA	NA	NA	NA	3.1E-02	2.1E-02	NA	5.2E-02
Iron	3.00E-01	6.00E-02	-	-	-	-	305,000	NA	NA	NA	NA	2.4E+00	1.6E+00	NA	4.0E+00
Lead	-	-	-	-	-	-	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	294	NA	NA	NA	NA	3.0E-02	2.0E-02	NA	5.1E-02
Tin	6.00E-01	1.20E-01	-	-	-	-	72.5	NA	NA	NA	NA	2.9E-04	1.9E-04	NA	4.8E-04

TABLE 8-27

RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Vanadium	7.00E-03	1.40E-03	-	-	-	-	13.7	NA	NA	NA	NA	4.6E-03	3.1E-03	NA	7.8E-03
Zinc	3.00E-01	6.00E-02	-	-	-	-	6,230	NA	NA	NA	NA	4.9E-02	3.3E-02	NA	8.2E-02
Pesticide/PCBs															
Aroclor-1242	-	-	-	2.00E+00	4.00E+00	-	1.1	1.7E-07	NA	NA	1.7E-07	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthalate	2.00E-02	1.00E-02	-	1.40E-02	2.80E-02	-	5	2.6E-08	1.0E-07	NA	1.3E-07	5.9E-04	1.2E-03	NA	1.8E-03
Dibenzo(a,h)anthracene	-	-	-	7.30E+00	1.46E+01	3.10E+00	0.43	1.2E-06	NA	NA	1.2E-06	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	46	NA	NA	NA	NA	1.1E-03	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.4E-05	1.2E-05	NA	4.6E-05	4.3E+00	2.9E+00	NA	7.2E+00
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.01375	1.23E-06	NA	NA	1.23E-06	5.30E-04	NA	NA	5.30E-04
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	-	-	-	-	-	5.4	NA	NA	NA	NA	1.04E-01	NA	NA	1.04E-01
Pesticides/PCBs															
Aldrin	3.00E-05	-	-	1.70E+01	-	-	0.00041	2.30E-06	NA	NA	2.30E-06	1.05E-02	NA	NA	1.05E-02
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.086	7.68E-06	NA	NA	7.68E-06	3.42E-03	NA	NA	3.42E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.1E-05	NA	NA	1.1E-05	1.2E-01	NA	NA	1.2E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	5.5E-05	4.6E-05	NA	1.0E-04	1.3E+01	3.5E+00	NA	1.6E+01

TABLE 8-27

RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser - Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	6,700	NA	NA	NA	NA	6.3E-04	1.8E-04	NA	8.1E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	11	NA	NA	NA	NA	2.6E-03	7.4E-04	NA	3.3E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13.3	5.1E-07	4.7E-06	NA	5.2E-06	4.2E-03	3.8E-02	NA	4.2E-02
Cadmium	1.00E-03	2.00E-04	-	-	-	-	2.91	NA	NA	NA	NA	2.7E-04	7.9E-04	NA	1.1E-03
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	22.7	NA	NA	NA	NA	4.3E-04	1.2E-04	NA	5.5E-04
Copper	4.00E-02	8.00E-03	-	-	-	-	611	NA	NA	NA	NA	1.4E-03	4.1E-04	NA	1.8E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	27,100	NA	NA	NA	NA	8.5E-03	2.4E-03	NA	1.1E-02
Manganese	1.40E-01	2.80E-02	-	-	-	-	546	NA	NA	NA	NA	3.7E-04	1.1E-04	NA	4.7E-04
Nickel	2.00E-02	4.00E-03	-	-	-	-	42	NA	NA	NA	NA	2.0E-04	5.7E-05	NA	2.5E-04
Thallium	8.00E-05	1.60E-05	-	-	-	-	168	NA	NA	NA	NA	2.0E-01	5.7E-02	NA	2.5E-01
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	130	2.4E-09	NA	NA	2.4E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	130	2.4E-08	NA	NA	2.4E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	160	3.0E-09	NA	NA	3.0E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	140	2.6E-10	NA	NA	2.6E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	160	3.0E-11	NA	NA	3.0E-11	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	100	1.9E-09	NA	NA	1.9E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.4E-07	4.7E-06	NA	5.2E-06	2.2E-01	1.0E-01	NA	3.2E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	2,030	NA	NA	NA	NA	2.5E-04	1.4E-04	NA	3.9E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	6.7E-02	3.9E-02	NA	1.1E-01
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	57.3	2.8E-06	1.6E-06	NA	4.5E-06	2.3E-02	1.3E-02	NA	3.7E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	29.2	NA	NA	NA	NA	5.1E-05	2.9E-05	NA	8.0E-05
Cadmium	5.00E-04	1.00E-04	5.71E-05	-	-	6.30E+00	6.51	NA	NA	NA	NA	1.6E-03	9.1E-04	NA	2.5E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	305,000	NA	NA	NA	NA	1.2E-01	7.1E-02	NA	2.0E-01
Lead	-	-	-	-	-	-	82.2	NA	NA	NA	NA	NA	NA	NA	
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	294	NA	NA	NA	NA	1.6E-03	9.0E-04	NA	2.5E-03
Tin	6.00E-01	1.20E-01	-	-	-	-	72.5	NA	NA	NA	NA	1.5E-05	8.5E-06	NA	2.3E-05

TABLE 8-27

RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser - Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Vanadium	7.00E-03	1.40E-03	-	-	-	-	13.7	NA	NA	NA	NA	2.4E-04	1.4E-04	NA	3.8E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	6,230	NA	NA	NA	NA	2.5E-03	1.5E-03	NA	4.0E-03
Pesticide/PCBs															
Aroclor-1242	-	-	-	2.00E+00	4.00E+00	-	1.1	1.5E-08	NA	NA	1.5E-08	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthalate	2.00E-02	1.00E-02	-	1.40E-02	2.80E-02	-	5	2.3E-09	1.4E-08	NA	1.6E-08	3.1E-05	1.8E-04	NA	2.1E-04
Dibenzo(a,h)anthracene	-	-	-	7.30E+00	1.46E+01	3.10E+00	0.43	1.0E-07	NA	NA	1.0E-07	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	46	NA	NA	NA	NA	5.6E-05	NA	NA	5.6E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.0E-06	1.7E-06	NA	4.6E-06	2.2E-01	1.3E-01	NA	3.5E-01
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	-	-	-	-	-	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	-	-	1.70E+01	-	-	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.5E-06	6.3E-06	NA	9.8E-06	4.4E-01	2.3E-01	NA	6.6E-01

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RME -- CHEMICAL SPECIFIC RISKS AT IR 8
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser - Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	6,700	NA	NA	NA	NA	1.4E-03	2.8E-04	NA	1.7E-03
Antimony	4.00E-04	8.00E-05	-	-	-	-	11	NA	NA	NA	NA	5.7E-03	1.2E-03	NA	6.8E-03
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13.3	6.4E-07	4.3E-06	NA	4.9E-06	9.1E-03	6.0E-02	NA	6.9E-02
Cadmium	1.00E-03	2.00E-04	-	-	-	-	2.91	NA	NA	NA	NA	6.0E-04	1.2E-03	NA	1.8E-03
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	22.7	NA	NA	NA	NA	9.3E-04	1.9E-04	NA	1.1E-03
Copper	4.00E-02	8.00E-03	-	-	-	-	611	NA	NA	NA	NA	3.1E-03	6.5E-04	NA	3.8E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	27,100	NA	NA	NA	NA	1.9E-02	3.8E-03	NA	2.2E-02
Manganese	1.40E-01	2.80E-02	-	-	-	-	546	NA	NA	NA	NA	8.0E-04	1.7E-04	NA	9.7E-04
Nickel	2.00E-02	4.00E-03	-	-	-	-	42	NA	NA	NA	NA	4.3E-04	8.9E-05	NA	5.2E-04
Thallium	8.00E-05	1.60E-05	-	-	-	-	168	NA	NA	NA	NA	4.3E-01	8.9E-02	NA	5.2E-01
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	130	3.1E-09	NA	NA	3.1E-09	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	130	3.1E-08	NA	NA	3.1E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	160	3.8E-09	NA	NA	3.8E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	140	3.3E-10	NA	NA	3.3E-10	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	160	3.8E-11	NA	NA	3.8E-11	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	100	2.4E-09	NA	NA	2.4E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	6.8E-07	4.3E-06	NA	4.9E-06	4.7E-01	1.6E-01	NA	6.3E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	2,030	NA	NA	NA	NA	5.4E-04	2.2E-04	NA	7.7E-04
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	1.5E-01	6.1E-02	NA	2.1E-01
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	57.3	3.6E-06	1.5E-06	NA	5.1E-06	5.1E-02	2.1E-02	NA	7.2E-02
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	29.2	NA	NA	NA	NA	1.1E-04	4.6E-05	NA	1.6E-04
Cadmium	5.00E-04	1.00E-04	5.71E-05	-	-	6.30E+00	6.51	NA	NA	NA	NA	3.5E-03	1.4E-03	NA	4.9E-03
Iron	3.00E-01	6.00E-02	-	-	-	-	305,000	NA	NA	NA	NA	2.7E-01	1.1E-01	NA	3.8E-01
Lead	-	-	-	-	-	-	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	294	NA	NA	NA	NA	3.4E-03	1.4E-03	NA	4.8E-03
Tin	6.00E-01	1.20E-01	-	-	-	-	72.5	NA	NA	NA	NA	3.2E-05	1.3E-05	NA	4.6E-05

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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser - Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Vanadium	7.00E-03	1.40E-03	-	-	-	-	13.7	NA	NA	NA	NA	5.2E-04	2.2E-04	NA	7.4E-04
Zinc	3.00E-01	6.00E-02	-	-	-	-	6,230	NA	NA	NA	NA	5.5E-03	2.3E-03	NA	7.8E-03
Pesticide/PCBs															
Aroclor-1242	-	-	-	2.00E+00	4.00E+00	-	1.1	1.8E-08	NA	NA	1.8E-08	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthalate	2.00E-02	1.00E-02	-	1.40E-02	2.80E-02	-	5	2.9E-09	1.3E-08	NA	1.6E-08	6.7E-05	2.9E-04	NA	3.5E-04
Dibenzo(a,h)anthracene	-	-	-	7.30E+00	1.46E+01	3.10E+00	0.43	1.3E-07	NA	NA	1.3E-07	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	46	NA	NA	NA	NA	1.2E-04	NA	NA	1.2E-04
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.8E-06	1.5E-06	NA	5.3E-06	4.8E-01	2.0E-01	NA	6.8E-01
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	-	-	-	-	-	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	-	-	1.70E+01	-	-	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.4E-06	5.8E-06	NA	1.0E-05	9.6E-01	3.6E-01	NA	1.3E+00

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RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	6,700	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	11	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	-	-	-	-	2.91	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	22.7	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	611	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	27,100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	546	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	2.00E-02	4.00E-03	-	-	-	-	42	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	8.00E-05	1.60E-05	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	160	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	140	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	160	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	100	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	2,030	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	57.3	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	29.2	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.00E-04	1.00E-04	5.71E-05	-	-	6.30E+00	6.51	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	305,000	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	294	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	72.5	NA	NA	NA	NA	NA	NA	NA	NA

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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Vanadium	7.00E-03	1.40E-03	-	-	-	-	13.7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	6,230	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1242	-	-	-	2.00E+00	4.00E+00	-	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthalate	2.00E-02	1.00E-02	-	1.40E-02	2.80E-02	-	5	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	-	-	-	7.30E+00	1.46E+01	3.10E+00	0.43	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	46	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	-	-	-	-	-	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	-	-	1.70E+01	-	-	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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RME -- CHEMICAL SPECIFIC RISKS AT IR 8
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.9	4.7E-08	9.0E-08	1.4E-15	1.4E-07	7.3E-03	1.4E-02	NA	2.1E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	4.7E-08	9.0E-08	1.4E-15	1.4E-07	7.3E-03	1.4E-02	NA	2.1E-02
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	6,700	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	11	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	-	-	-	-	2.91	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	22.7	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	611	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	27,100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	546	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	2.00E-02	4.00E-03	-	-	-	-	42	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	8.00E-05	1.60E-05	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	160	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	140	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	160	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	100	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	2,030	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	57.3	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	29.2	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.00E-04	1.00E-04	5.71E-05	-	-	6.30E+00	6.51	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	305,000	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	294	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	72.5	NA	NA	NA	NA	NA	NA	NA	NA

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RME -- CHEMICAL SPECIFIC RISKS AT IR 8
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Vanadium	7.00E-03	1.40E-03	-	-	-	-	13.7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	6,230	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1242	-	-	-	2.00E+00	4.00E+00	-	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthalate	2.00E-02	1.00E-02	-	1.40E-02	2.80E-02	-	5	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	-	-	-	7.30E+00	1.46E+01	3.10E+00	0.43	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	46	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	-	-	-	-	-	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	-	-	1.70E+01	-	-	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.7E-08	9.0E-08	NA	1.4E-07	7.3E-03	1.4E-02	NA	2.1E-02

TABLE 8-27

RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	6,700	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	11	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	-	-	-	-	2.91	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	-	-	-	4.20E+01	22.7	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	-	-	-	-	611	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	27,100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	-	-	-	-	546	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	2.00E-02	4.00E-03	-	-	-	-	42	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	8.00E-05	1.60E-05	-	-	-	-	168	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	-	-	-	7.30E-01	1.46E+00	3.10E-01	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	-	-	-	7.30E+00	1.46E+01	3.10E+00	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	-	-	-	7.30E-01	1.46E+00	3.10E-01	160	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	-	-	-	7.30E-02	1.46E-01	3.10E-02	140	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	-	-	-	7.30E-03	1.46E-02	3.10E-03	160	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	-	-	-	7.30E-01	1.46E+00	3.10E-01	100	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	-	-	-	-	2,030	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	-	-	-	-	220	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	-	1.50E+00	7.50E+00	1.51E+01	57.3	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	-	-	-	29.2	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.00E-04	1.00E-04	5.71E-05	-	-	6.30E+00	6.51	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	-	-	-	-	305,000	NA	NA	NA	NA	NA	NA	NA	NA
Lead	-	-	-	-	-	-	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	-	-	-	294	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	-	-	-	-	72.5	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 8-27

RME -- CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST
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Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Vanadium	7.00E-03	1.40E-03	-	-	-	-	13.7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	-	-	-	-	6,230	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1242	-	-	-	2.00E+00	4.00E+00	-	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthalate	2.00E-02	1.00E-02	-	1.40E-02	2.80E-02	-	5	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	-	-	-	7.30E+00	1.46E+01	3.10E+00	0.43	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	-	-	-	-	46	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	-	-	-	-	-	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	-	-	1.70E+01	-	-	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	-	-	2.70E-01	-	-	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	6,700	NA	NA	NA	NA	1.2E-02	1.2E-04	NA	1.2E-02
Antimony	4.00E-04	8.00E-05	–	–	–	–	11	NA	NA	NA	NA	5.0E-02	4.8E-04	NA	5.1E-02
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	13.3	1.4E-06	1.0E-06	NA	2.5E-06	8.1E-02	2.5E-02	NA	1.1E-01
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.91	NA	NA	NA	NA	5.3E-03	5.0E-04	NA	5.8E-03
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.7	NA	NA	NA	NA	8.3E-03	7.9E-05	NA	8.4E-03
Copper	4.00E-02	8.00E-03	–	–	–	–	611	NA	NA	NA	NA	2.8E-02	2.6E-04	NA	2.8E-02
Iron	3.00E-01	6.00E-02	–	–	–	–	27,100	NA	NA	NA	NA	1.6E-01	1.6E-03	NA	1.7E-01
Manganese	1.40E-01	2.80E-02	–	–	–	–	546	NA	NA	NA	NA	7.1E-03	6.8E-05	NA	7.2E-03
Nickel	2.00E-02	4.00E-03	–	–	–	–	42	NA	NA	NA	NA	3.8E-03	3.6E-05	NA	3.9E-03
Thallium	8.00E-05	1.60E-05	–	–	–	–	168	NA	NA	NA	NA	3.8E+00	3.6E-02	NA	3.9E+00
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	130	6.8E-09	NA	NA	6.8E-09	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	130	6.8E-08	NA	NA	6.8E-08	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	160	8.4E-09	NA	NA	8.4E-09	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	140	7.3E-10	NA	NA	7.3E-10	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	160	8.4E-11	NA	NA	8.4E-11	NA	NA	NA	NA
Indeno(1,2,3-cd)pyren	–	–	–	7.30E-01	1.46E+00	3.10E-01	100	5.2E-09	NA	NA	5.2E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.5E-06	1.0E-06	NA	2.6E-06	4.2E+00	6.4E-02	NA	4.3E+00
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	2,030	NA	NA	NA	NA	2.4E-03	2.1E-03	NA	4.5E-03
Antimony	4.00E-04	8.00E-05	–	–	–	–	220	NA	NA	NA	NA	6.5E-01	5.8E-01	NA	1.2E+00
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	57.3	5.1E-06	4.9E-06	NA	1.0E-05	2.3E-01	2.0E-01	NA	4.3E-01
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	29.2	NA	NA	NA	NA	5.0E-04	4.4E-04	NA	9.3E-04
Cadmium	5.00E-04	1.00E-04	5.71E-05	–	–	6.30E+00	6.51	NA	NA	NA	NA	1.5E-02	1.4E-02	NA	2.9E-02
Iron	3.00E-01	6.00E-02	–	–	–	–	305,000	NA	NA	NA	NA	1.2E+00	1.1E+00	NA	2.3E+00
Lead	–	–	–	–	–	–	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	294	NA	NA	NA	NA	1.5E-02	1.3E-02	NA	2.9E-02

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
Tin	6.00E-01	1.20E-01	–	–	–	–	72.5	NA	NA	NA	NA	1.4E-04	1.3E-04	NA	2.7E-04
Vanadium	7.00E-03	1.40E-03	–	–	–	–	13.7	NA	NA	NA	NA	2.3E-03	2.1E-03	NA	4.4E-03
Zinc	3.00E-01	6.00E-02	–	–	–	–	6,230	NA	NA	NA	NA	2.5E-02	2.2E-02	NA	4.7E-02
Pesticide/PCBs															
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	1.1	2.6E-08	NA	NA	2.6E-08	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthal	2.00E-02	1.00E-02	–	1.40E-02	2.80E-02	–	5	4.2E-09	1.5E-08	NA	1.9E-08	3.0E-04	1.9E-04	NA	4.9E-04
Dibenzo(a,h)anthracen	–	–	–	7.30E+00	1.46E+01	3.10E+00	0.43	1.9E-07	NA	NA	1.9E-07	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	–	–	–	–	46	NA	NA	NA	NA	5.5E-04	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.3E-06	4.9E-06	NA	1.0E-05	2.1E+00	1.9E+00	NA	4.1E+00
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.01375	4.43E-08	NA	NA	4.43E-08	6.38E-05	NA	NA	#######
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	–	–	–	–	–	5.4	NA	NA	NA	NA	1.25E-02	NA	NA	#######
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00041	8.32E-08	NA	NA	8.32E-08	1.27E-03	NA	NA	#######
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.086	2.77E-07	NA	NA	2.77E-07	3.99E-04	NA	NA	#######
Subtotal	NA	NA	NA	NA	NA	NA	NA	4.0E-07	NA	NA	4.0E-07	1.4E-02	NA	NA	1.4E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	7.2E-06	5.9E-06	NA	1.3E-05	6.4E+00	2.0E+00	NA	8.3E+00

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	6,700	NA	NA	NA	NA	1.6E-04	1.8E-05	NA	1.8E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	11	NA	NA	NA	NA	6.5E-04	7.4E-05	NA	7.2E-04
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	13.3	4.7E-08	1.7E-07	NA	2.2E-07	1.0E-03	3.8E-03	NA	4.9E-03
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.91	NA	NA	NA	NA	6.8E-05	7.9E-05	NA	1.5E-04
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.7	NA	NA	NA	NA	1.1E-04	1.2E-05	NA	1.2E-04
Copper	4.00E-02	8.00E-03	–	–	–	–	611	NA	NA	NA	NA	3.6E-04	4.1E-05	NA	4.0E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	27,100	NA	NA	NA	NA	2.1E-03	2.4E-04	NA	2.4E-03
Manganese	1.40E-01	2.80E-02	–	–	–	–	546	NA	NA	NA	NA	9.2E-05	1.1E-05	NA	1.0E-04
Nickel	2.00E-02	4.00E-03	–	–	–	–	42	NA	NA	NA	NA	4.9E-05	5.7E-06	NA	5.5E-05
Thallium	8.00E-05	1.60E-05	–	–	–	–	168	NA	NA	NA	NA	4.9E-02	5.7E-03	NA	5.5E-02
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	130	2.2E-10	NA	NA	2.2E-10	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	130	2.2E-09	NA	NA	2.2E-09	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	160	2.7E-10	NA	NA	2.7E-10	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	140	2.4E-11	NA	NA	2.4E-11	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	160	2.7E-12	NA	NA	2.7E-12	NA	NA	NA	NA
Indeno(1,2,3-cd)pyren	–	–	–	7.30E-01	1.46E+00	3.10E-01	100	1.7E-10	NA	NA	1.7E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.0E-08	1.7E-07	NA	2.2E-07	5.4E-02	1.0E-02	NA	6.4E-02
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	2,030	NA	NA	NA	NA	1.2E-04	7.1E-05	NA	2.0E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	220	NA	NA	NA	NA	3.4E-02	1.9E-02	NA	5.3E-02
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	57.3	5.2E-07	3.0E-07	NA	8.3E-07	1.2E-02	6.7E-03	NA	1.8E-02
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	29.2	NA	NA	NA	NA	2.5E-05	1.5E-05	NA	4.0E-05
Cadmium	5.00E-04	1.00E-04	5.71E-05	–	–	6.30E+00	6.51	NA	NA	NA	NA	7.9E-04	4.6E-04	NA	1.3E-03
Iron	3.00E-01	6.00E-02	–	–	–	–	305,000	NA	NA	NA	NA	6.2E-02	3.6E-02	NA	9.8E-02
Lead	–	–	–	–	–	–	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	294	NA	NA	NA	NA	7.8E-04	4.5E-04	NA	1.2E-03

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
Tin	6.00E-01	1.20E-01	–	–	–	–	72.5	NA	NA	NA	NA	7.4E-06	4.2E-06	NA	1.2E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	13.7	NA	NA	NA	NA	1.2E-04	6.9E-05	NA	1.9E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	6,230	NA	NA	NA	NA	1.3E-03	7.3E-04	NA	2.0E-03
Pesticide/PCBs															
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	1.1	2.7E-09	NA	NA	2.7E-09	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthal	2.00E-02	1.00E-02	–	1.40E-02	2.80E-02	–	5	4.3E-10	2.5E-09	NA	3.0E-09	1.5E-05	9.1E-05	NA	1.1E-04
Dibenzo(a,h)anthracen	–	–	–	7.30E+00	1.46E+01	3.10E+00	0.43	1.9E-08	NA	NA	1.9E-08	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	–	–	–	–	46	NA	NA	NA	NA	2.8E-05	NA	NA	2.8E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.5E-07	3.0E-07	NA	8.5E-07	1.1E-01	6.4E-02	NA	1.7E-01
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	–	–	–	–	–	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	6.0E-07	4.8E-07	NA	1.1E-06	1.6E-01	7.4E-02	NA	2.4E-01

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespresser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	6,700	NA	NA	NA	NA	3.4E-04	2.9E-05	NA	3.7E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	11	NA	NA	NA	NA	1.4E-03	1.2E-04	NA	1.5E-03
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	13.3	2.9E-08	8.0E-08	NA	1.1E-07	2.3E-03	6.2E-03	NA	8.5E-03
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.91	NA	NA	NA	NA	1.5E-04	1.3E-04	NA	2.8E-04
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.7	NA	NA	NA	NA	2.3E-04	2.0E-05	NA	2.5E-04
Copper	4.00E-02	8.00E-03	–	–	–	–	611	NA	NA	NA	NA	7.8E-04	6.7E-05	NA	8.5E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	27,100	NA	NA	NA	NA	4.6E-03	3.9E-04	NA	5.0E-03
Manganese	1.40E-01	2.80E-02	–	–	–	–	546	NA	NA	NA	NA	2.0E-04	1.7E-05	NA	2.2E-04
Nickel	2.00E-02	4.00E-03	–	–	–	–	42	NA	NA	NA	NA	1.1E-04	9.2E-06	NA	1.2E-04
Thallium	8.00E-05	1.60E-05	–	–	–	–	168	NA	NA	NA	NA	1.1E-01	9.2E-03	NA	1.2E-01
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	130	1.4E-10	NA	NA	1.4E-10	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	130	1.4E-09	NA	NA	1.4E-09	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	160	1.7E-10	NA	NA	1.7E-10	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	140	1.5E-11	NA	NA	1.5E-11	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	160	1.7E-12	NA	NA	1.7E-12	NA	NA	NA	NA
Indeno(1,2,3-cd)pyren	–	–	–	7.30E-01	1.46E+00	3.10E-01	100	1.1E-10	NA	NA	1.1E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.1E-08	8.0E-08	NA	1.1E-07	1.2E-01	1.6E-02	NA	1.3E-01
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	2,030	NA	NA	NA	NA	2.7E-04	1.2E-04	NA	3.9E-04
Antimony	4.00E-04	8.00E-05	–	–	–	–	220	NA	NA	NA	NA	7.3E-02	3.1E-02	NA	1.0E-01
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	57.3	3.3E-07	1.4E-07	NA	4.7E-07	2.6E-02	1.1E-02	NA	3.6E-02
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	29.2	NA	NA	NA	NA	5.6E-05	2.4E-05	NA	7.9E-05
Cadmium	5.00E-04	1.00E-04	5.71E-05	–	–	6.30E+00	6.51	NA	NA	NA	NA	1.7E-03	7.4E-04	NA	2.5E-03
Iron	3.00E-01	6.00E-02	–	–	–	–	305,000	NA	NA	NA	NA	1.4E-01	5.8E-02	NA	1.9E-01
Lead	–	–	–	–	–	–	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	294	NA	NA	NA	NA	1.7E-03	7.2E-04	NA	2.4E-03

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespresser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
Tin	6.00E-01	1.20E-01	–	–	–	–	72.5	NA	NA	NA	NA	1.6E-05	6.9E-06	NA	2.3E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	13.7	NA	NA	NA	NA	2.6E-04	1.1E-04	NA	3.7E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	6,230	NA	NA	NA	NA	2.8E-03	1.2E-03	NA	4.0E-03
Pesticide/PCBs															
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	1.1	1.7E-09	NA	NA	1.7E-09	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthal	2.00E-02	1.00E-02	–	1.40E-02	2.80E-02	–	5	2.7E-10	1.2E-09	NA	1.4E-09	3.3E-05	1.5E-04	NA	1.8E-04
Dibenzo(a,h)anthracen	–	–	–	7.30E+00	1.46E+01	3.10E+00	0.43	1.2E-08	NA	NA	1.2E-08	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	–	–	–	–	46	NA	NA	NA	NA	6.1E-05	NA	NA	6.1E-05
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.4E-07	1.4E-07	NA	4.8E-07	2.4E-01	1.0E-01	NA	3.4E-01
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	–	–	–	–	–	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.7E-07	2.2E-07	NA	5.9E-07	3.6E-01	1.2E-01	NA	4.8E-01

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	6,700	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	11	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.91	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.7	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	611	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	27,100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	546	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	2.00E-02	4.00E-03	–	–	–	–	42	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	8.00E-05	1.60E-05	–	–	–	–	168	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	160	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	140	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	160	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyren	–	–	–	7.30E-01	1.46E+00	3.10E-01	100	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	2,030	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	220	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	57.3	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	29.2	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.00E-04	1.00E-04	5.71E-05	–	–	6.30E+00	6.51	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	305,000	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	82.2	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	294	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	72.5	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	13.7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	6,230	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthal	2.00E-02	1.00E-02	–	1.40E-02	2.80E-02	–	5	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracen	–	–	–	7.30E+00	1.46E+01	3.10E+00	0.43	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	–	–	–	–	46	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	–	–	–	–	–	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
PARAMETER	RfD[1]	RfD[1]	RfD[1]	SF[2]	SF[2]	SF[2]	ONCENTRATION	GESTIO	ERMA	HALATIO	TOTAL	GESTIO	DERMAL	HALATIO	TOTAL
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.9	2.9E-09	4.5E-09	3.6E-16	7.4E-09	9.0E-04	1.4E-03	NA	2.3E-03
Subtotal	NA	NA	NA	NA	NA	NA	NA	2.9E-09	4.5E-09	3.6E-16	7.4E-09	9.0E-04	1.4E-03	NA	2.3E-03
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	6,700	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	11	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.91	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.7	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	611	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	27,100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	546	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	2.00E-02	4.00E-03	–	–	–	–	42	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	8.00E-05	1.60E-05	–	–	–	–	168	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	160	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	140	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	160	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyren	–	–	–	7.30E-01	1.46E+00	3.10E-01	100	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	2,030	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	220	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	57.3	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	29.2	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.00E-04	1.00E-04	5.71E-05	–	–	6.30E+00	6.51	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	305,000	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
Lead	–	–	–	–	–	–	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	294	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	72.5	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	13.7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	6,230	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthal	2.00E-02	1.00E-02	–	1.40E-02	2.80E-02	–	5	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracen	–	–	–	7.30E+00	1.46E+01	3.10E+00	0.43	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	–	–	–	–	46	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	–	–	–	–	–	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	2.9E-09	4.5E-09	3.6E-16	7.4E-09	9.0E-04	1.4E-03	NA	2.3E-03

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Occupational Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
SUBSURFACE SOIL															
Inorganics															
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	3.9	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEDIMENT															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	6,700	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	11	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	13.3	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.91	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.7	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	611	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	27,100	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	546	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	2.00E-02	4.00E-03	–	–	–	–	42	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	8.00E-05	1.60E-05	–	–	–	–	168	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Benzo(a)anthracene	–	–	–	7.30E-01	1.46E+00	3.10E-01	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	–	–	–	7.30E+00	1.46E+01	3.10E+00	130	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	–	–	–	7.30E-01	1.46E+00	3.10E-01	160	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	–	–	–	7.30E-02	1.46E-01	3.10E-02	140	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	–	–	–	7.30E-03	1.46E-02	3.10E-03	160	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyren	–	–	–	7.30E-01	1.46E+00	3.10E-01	100	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Aluminum	1.00E+00	2.00E-01	–	–	–	–	2,030	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	4.00E-04	8.00E-05	–	–	–	–	220	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	57.3	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	29.2	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.00E-04	1.00E-04	5.71E-05	–	–	6.30E+00	6.51	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	305,000	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	82.2	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	294	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 8-28

CTE--CHEMICAL SPECIFIC RISKS AT IR 8
NAS KEY WEST

Parameter	Dose-Response Parameters						Occupational Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalatio RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalatio SF[2]		Ingestio	Dermal	Inhalation	Total	Ingestio	Dermal	Inhalation	Total
Tin	6.00E-01	1.20E-01	–	–	–	–	72.5	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	13.7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	6,230	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCBs															
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds															
Bis(2-ethylhexyl)phthal	2.00E-02	1.00E-02	–	1.40E-02	2.80E-02	–	5	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracen	–	–	–	7.30E+00	1.46E+01	3.10E+00	0.43	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds															
Acetone	1.00E-01	8.00E-02	–	–	–	–	46	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- LOBSTER[5]															
Pesticides/PCBs															
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.01375	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Copper	4.00E-02	–	–	–	–	–	5.4	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00041	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

- Cumulative carcinogenic and noncrcinogenic risks for individual receptor pathways

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser, maintenance worker, and occupational worker) and hypothetical future (residents and excavation workers) receptors. COPCs in IR 8 media were not present at sufficient concentrations to cause adverse noncarcinogenic health effects to any current potential receptors or future excavation worker. The cancer risks estimated for the current potential or future receptors were below or within the 1E-04 to 1E-06 target risk range, often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation.

COPCs at IR 8 were present at concentrations indicating that adverse noncarcinogenic health effects might occur under conditions evaluated in this baseline human health risk assessment for the hypothetical future resident. Thallium, antimony, iron, and arsenic are the main contributors to the noncarcinogenic risk.

8.7 ECOLOGICAL RISK ASSESSMENT

This section presents the results of the ecological risk assessment performed at IR 8, including a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

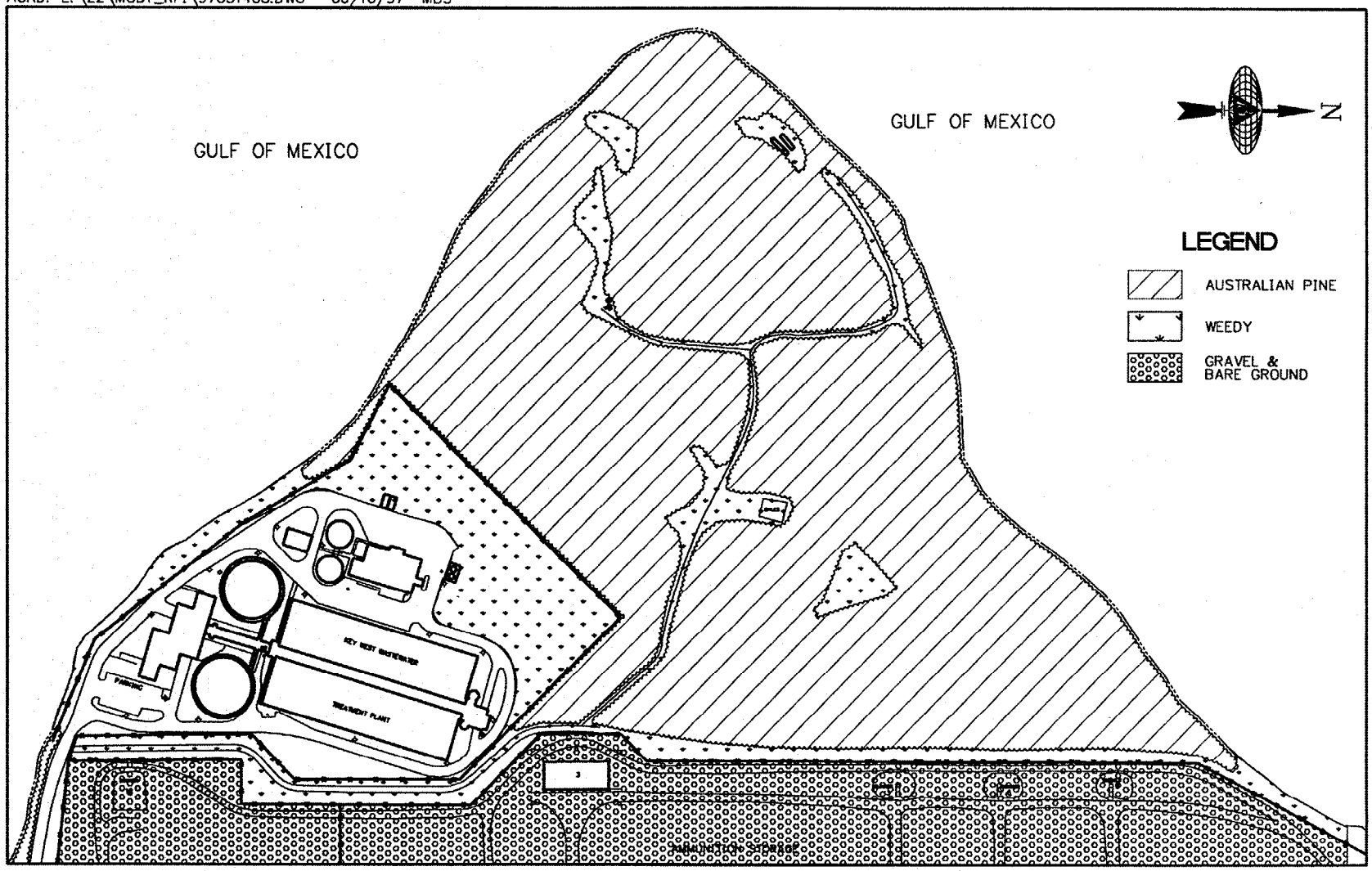
8.7.1 Problem Formulation

This section presents the problem formulation, including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

8.7.1.1 Habitat Types and Ecological Receptors

Section 8.1 (See Figure 8-13) describes the physical setting at IR 8. Vegetation on most of the site is dominated by a closed canopy of Australian pines. Ground cover is sparse beneath the Australian pines. Brazilian pepper and weedy species such as sandbur (*Cenchrus tribuloides*) and *Cyperus* spp. occur in areas where sufficient sunlight can reach the ground. These areas are limited primarily to narrow dirt access roads within the site. There are no mangroves along the rocky shoreline at IR 8; instead, Australian pines extend seaward to the top of a low bluff along the shore. The bluff varies in height from

ACAD: E:\Z2\MOD1_RFI\97051408.DWG 06/10/97 MBS



SITE MANAGER: CB	CHECKED BY: DSF	BROWN & ROOT ENVIRONMENTAL	FIGURE 8-13 HABITATS AT IR 8 NAVAL AIR STATION KEY WEST, FLORIDA
DRAWN BY: TCB/SRM/MBS	DRAWING DATE:		
SURVEYED BY:	SURVEY DATE:		
SCALE: 1"=200'			
CAD DWG. NO.: IR8704685/97051408			

2 to 10 feet and is composed primarily of debris from past waste disposal at the site. There is no surface freshwater at IR 8.

Since most of the site is a monoculture of Australian pines, the site provides poor habitat for terrestrial species. Nevertheless, a few species of reptiles, arboreal birds, and avian raptors utilize the site. Mammals such as raccoons, opossums, and cotton rats probably utilize the site, as well as exotic rodents such as the black rat and house mouse. The lack of shallow water along most of the shoreline precludes extensive foraging at the site by wading piscivorous birds, except within approximately 20 feet of the shore.

Water quality at IR-8 is typical of shallow, near-shore habitats in this part of the Gulf of Mexico. The salinity (35.2 to 36.8 ppt) is within the range of salinities normally observed in open ocean waters (Reid, 1961). DO concentrations were high during sampling conducted in August and September 1996, ranging from 5.32 to 7.41 mg/L (Appendix C, Table C.1-3), sufficient to support even the most sensitive and pollution-intolerant organisms. Turbidity was very low (1 to 2 NTUs) in August and September 1996, indicating extremely high water clarity.

Turtle grass is abundant and is the dominant aquatic vegetation in nearshore waters of IR 8. Aquatic marine life observed here during sampling activities in August and September of 1996 included queen conch, milk conch (*Strombus costatus*), stone crab, spiny spider crab, true tulip (*Fasciolaria tulipa*), spiny lobsters, and several species of fish. Lobster, stone crab, spiny spider crab, true tulip, milk conch, and turtle grass were collected from the nearshore vicinity of the site for tissue analysis.

Ecological receptors listed as threatened, endangered, or of special concern that could potentially be exposed to site related contamination are probably limited to red rat snakes, brown pelicans, ospreys, and wading birds such as the little blue heron, snowy egret, tricolored heron, and reddish egret, all of which are state-listed as SSC. An osprey nest is located at the southern tip of Fleming Key, approximately 1,600-feet southeast of IR 8 (FNAI, 1994). Indigo snakes (state and federally listed as threatened) could potentially inhabit some on-site areas, although habitat for this species is of marginal quality at IR 8. The Lower Keys marsh rabbit is not known to exist on Fleming Key, and habitat preferred by this species does not exist on or near the site. There are no sandy beaches favored as nesting habitat for sea turtles on the Key. There are no known eagle nests on or near Fleming Key, but bald eagles could occasionally forage in nearshore waters.

8.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways at IR 8 is presented in Section 8.5.2.

8.7.1.3 Exposure Routes

Terrestrial animals at IR 8 can be exposed to soil contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation. Aerial deposition could have been a significant exposure route during historical landfill activities. However, as mentioned in Section 8.5.2, aerial deposition is presently minimal. Terrestrial receptors can also come into contact with contaminants in surface water by using it for drinking, although this exposure route generally represents a negligible portion of total exposure for most receptors. In addition, the high salt content of the adjacent waters precludes the use of the water for drinking. Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue.

Volatile constituents could be present in some site soils and soil-bound contaminant airborne suspension could occur at IR 8. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors.

Aquatic and semi-aquatic organisms utilizing the open water adjacent to IR 8 can be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semi-aquatic organisms can also be exposed to constituents in contaminated groundwater that discharges into surface water.

8.7.1.4 Selection of Ecological Chemicals of Potential Concern

Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water and groundwater. Otherwise, analytes selected for evaluation

consisted of all analytes detected during current and previous sampling of surface water, sediment, and surface soil at IR 8. Groundwater analytes selected for evaluation consisted of analytes detected in three groundwater samples collected in 1996 and in seven groundwater samples collected by IT Corporation in 1993. The seven samples from 1993 were used because they were collected from the wells closest to the shoreline, which are most likely to reflect groundwater to surface-water discharge. These consist of samples I8MW-3 through I8MW-9 (Figure 8-5). The three other samples were collected during most recent sampling of wells closest to the shoreline (samples I8KWM-16R, I8MW8-2, and I8MW8-3). Inorganic contaminants in groundwater, surface water, sediment, and surface soil whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

8.7.1.5 Assessment and Measurement Endpoints

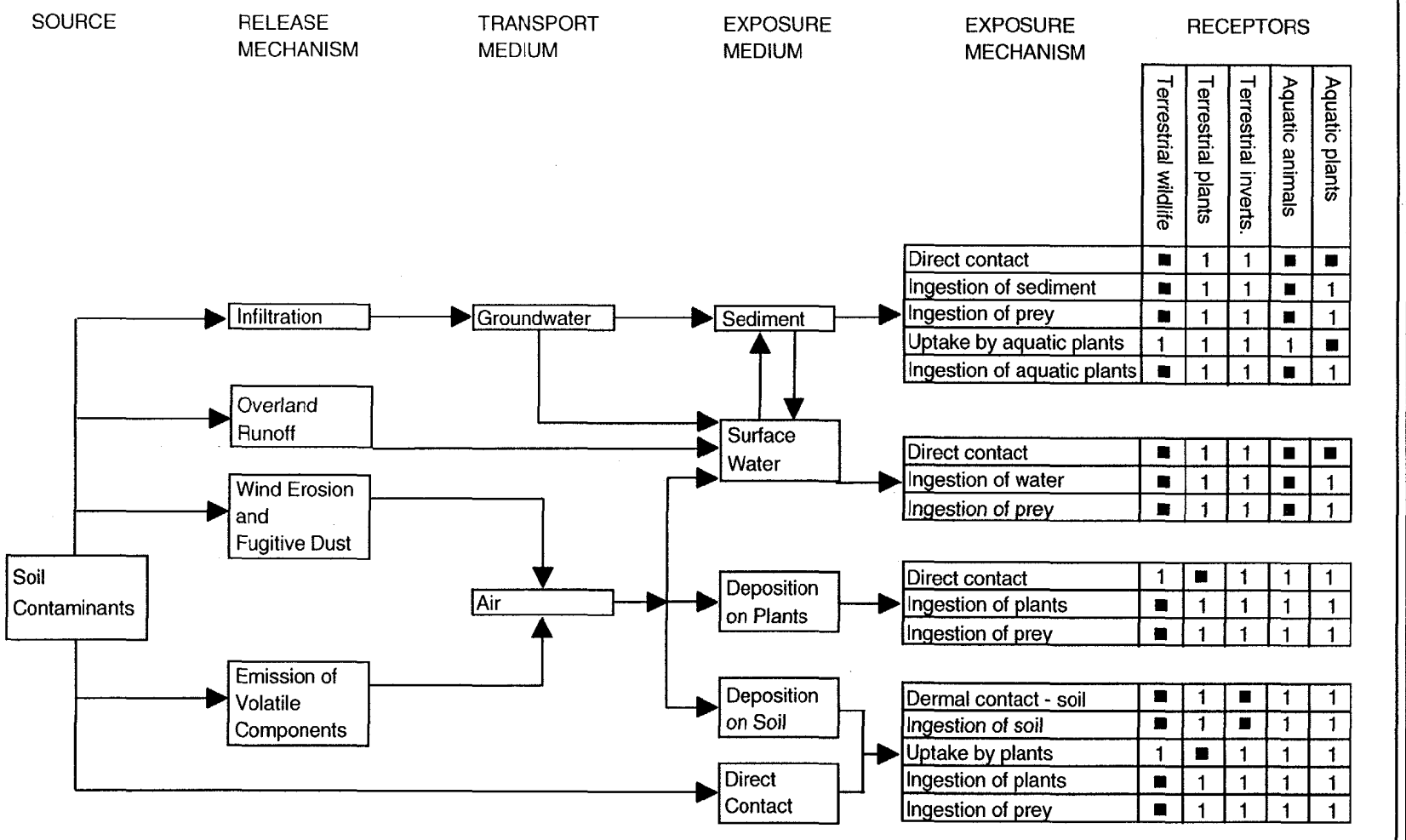
A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3.1.1.5 of Appendix C.

8.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 8-14 shows the conceptual model for IR 8. The figure shows complete exposure routes for wind erosion and volatile emission pathways. Since most of the site is heavily vegetated, the wind erosion and volatile emission pathways are possible only to a small extent.

8.7.2 Ecological Effects Characterization

Ecologically-based thresholds (i.e., concentrations of contaminants in various media protective of ecological receptors) were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at IR 8. Brief descriptions of each COPC are included in Appendix B Part 3. Groundwater contaminant concentrations were compared to surface-water thresholds for saltwater. Terrestrial plant thresholds were



7046-24PC\Mod1/R2-RFI-RI\F8-14.ppt

Figure 8-14. Conceptual Site Model - IR 8, NAS Key West, Fleming Key, Florida

obtained to assess potential risks to plants from soil contaminants. Contaminant intake doses for the cotton rat, raccoon, and kestrel were modeled, and estimated doses were compared to TRVs, which are doses above which potential risks might be present (example doses and TRVs are provided in Appendix B, Part 4). Groundwater, surface-water, sediment, terrestrial plant, and surface soil thresholds, as well as TRVs used in food-chain modeling, are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Lobster, stone crab, spiny spider crab, true tulip conch, milk conch, and turtle grass were collected from the nearshore vicinity of the site for tissue analysis. Tissue samples were analyzed for pesticides, PCBs, and metals. Concentrations of analytes detected in tissues were compared to tissue concentrations collected at background sites. Maximum and mean contaminant concentrations in crab samples were also used to estimate doses to the raccoon.

8.7.3 Exposure Assessment

This section presents the ecological exposure assessment for IR 8 and includes a discussion of exposure point contaminant concentrations and dose calculations.

8.7.3.1 Exposure Point Contaminant Concentrations

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil were used as representative exposure point concentrations for screening against threshold values. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.

8.7.3.2 Dose Calculations

The potential risks to ecological receptors resulting from exposure to IR 8-related contaminants were also evaluated by estimating the total contaminant dose that representative organisms inhabiting the site might receive for each contaminant and comparing those doses to toxicity reference values (TRVs), which are doses above which adverse effects might occur. The cotton rat, raccoon, and kestrel were selected as representative terrestrial receptors for foodchain modeling at IR 8. Modeling of potential risks to piscivorous birds was not conducted due to the absence of shallow surface water at the site. Section 3.3.2.1.2 of Appendix C provides a detailed description of dose calculations and exposure parameters used for the foodchain modeling.

8.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at IR 8.

8.7.4.1 Results

The results of the ecological risk characterization at IR 8 are presented in this section, which includes a discussion of the results from the Phase I and Phase II ecological screening assessments, food-chain modeling for selected receptors, and tissue analyses.

8.7.4.1.1 Phase I

The Phase I ecological risk assessment for IR 8 conducted by IT Corporation (1994) identified antimony, copper, lead, manganese, mercury, thallium, and vanadium as inorganic groundwater COCs. Antimony, copper, silver, and vanadium were identified as inorganic surface-water COCs. Antimony, arsenic, barium, cadmium, copper, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc were inorganic COCs in sediments. The study concluded that the greatest potential risks from inorganics to aquatic organisms is from direct contact with groundwater discharges, surface water, and sediment. The organics 1,4-dichlorobenzene and alpha-BHC were identified as groundwater COCs, and no organic COCs were identified for surface water or sediments. In addition, antimony, arsenic, cadmium, chromium, copper, lead, mercury, silver, thallium, zinc, 1,4-dichlorobenzene, fluorene, 4,4'-DDE, 4,4'-DDT, and Aroclor-1242 were considered to be capable of bioaccumulating sufficiently in fish to pose a potential risk to piscivores. Antimony, barium, cadmium, chromium, tin, and zinc were identified as COCs in soils. Zinc bioaccumulated in vegetation was considered to pose potential risks to terrestrial receptors that forage on plants. The overall conclusion of the assessment was that contaminants in IR 8 media pose potential risks to ecological receptors and that additional ecological investigations to more fully characterize risks were warranted (IT Corporation, 1994).

8.7.4.1.2 Phase II - Ecological Screening Assessment

The inorganics copper, lead, mercury, thallium, tin, and zinc exceeded two times their average background concentrations and threshold values and were retained as COPCs in groundwater (Table 8-29). No organics were detected in IR 8 groundwater. Aluminum, arsenic, copper, iron, manganese, and zinc were detected in maximum concentrations in IR 8 surface water that exceeded two times their average background concentrations and threshold values and were retained as surface-water

TABLE 8-29

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER (µg/L) - IR 8
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	9/10	ND	4.1- 225	4,300	0.05	Eliminated - does not exceed threshold
Arsenic	2/10	4.54	4.4 - 5.4	50	0.11	Eliminated - does not exceed 2 X background
Barium	10/10	10.2	7.7 - 162	10,000	0.02	Eliminated - does not exceed threshold
Copper	3/10	2.45	42.4 - 99.3	2.4	41.38	Retained - exceeds 2 X background and HQ > 1
Lead	4/10	1.39	70.5 - 248	5.6	44.29	Retained - exceeds 2 X background and HQ > 1
Mercury	4/10	0.1	0.22 - 1.5	0.025	60.00	Retained - exceeds 2 X background and HQ > 1
Thallium	3/10	2.24	4 - 11.6	6.3	1.84	Retained - exceeds 2 X background and HQ > 1
Tin	1/10	ND	150	73	2.1	Retained - exceeds 2 X background and HQ > 1
Zinc	6/10	2.82	12.5 - 225	86	2.62	Retained - exceeds 2 X background and HQ > 1

ND = Not detected.

COPCs (Table 8-30). Cadmium, lead, silver, and tin were not detected in background but had maxima in excess of thresholds and were retained as surface-water COPCs. Dibenzo(a,h)anthracene and Aroclor-1242 were the only organics detected in surface water that exceeded their threshold values and were retained as COPCs.

Antimony was not detected in background sediments but its maximum detected concentration in IR 8 sediments exceeded its threshold, and barium exceeded two times its average background concentration and the only threshold available (Table 8-31). Chromium and manganese had maxima in excess of two times their average background concentrations and the most conservative thresholds available and were, therefore, retained as COPCs. However, chromium and manganese did not exceed less conservative thresholds used in the assessment. Cadmium, copper, lead, mercury, nickel, silver, and zinc had maxima that exceeded two times average background and the most and less conservative thresholds. Aluminum, selenium, thallium, tin, and vanadium were conservatively retained as sediment COPCs since their maxima exceeded two times average background, however, no suitable thresholds were available. A multitude of organics were retained as sediment COPCs since their maxima exceeded the only threshold available, exceeded the most conservative threshold, or exceeded both the most and less conservative thresholds used in the assessment. These included several pesticides, several semivolatiles (mainly PAHs), and acetone. Also, 2,4-D was conservatively retained as a sediment COPC since no threshold was available.

No inorganics in IR 8 surface soils had maximum detected concentrations in excess of two times their average background concentrations (Table 8-32). The pesticide 4,4'-DDT was the only organic in IR 8 surface soils that exceeded its threshold and was retained as a COPC. A PCB mixture, Aroclor-1260, was conservatively retained as a surface soil COPC at IR 8, since no suitable threshold was available. In addition, no inorganics were retained as terrestrial plant COPCs since their maxima did not exceed two times average background. Aroclor-1260 was retained as an organic COPC since its maximum detected concentration exceeded its threshold (Table 8-33). Four organics (4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and methylene chloride) were conservatively retained as terrestrial plant COPCs due the absence of threshold values.

8.7.4.1.3 Tissue Analysis

The inorganics arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, vanadium, and zinc were detected in crabs collected near IR 8, as were several organochlorine pesticides and their metabolites (Table 8-34). The inorganics arsenic, copper, lead, manganese, vanadium, and zinc, and

TABLE 8-30

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L) - IR 8
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						
Aluminum	1/2	24.97	2,030	1,500	1.4	Retained - exceeds 2 X background and HQ > 1
Antimony	9/10	33.71	197 - 220	4,300	0.05	Eliminated - does not exceed threshold
Arsenic	1/10	3.97	57.3	50	1.1	Retained - exceeds 2 X background and HQ > 1
Barium	10/10	6.93	4.6 - 107	10,000	0.01	Eliminated - does not exceed threshold
Cadmium	1/10	ND	19.8	9.3	2.1	Retained - HQ > 1
Chromium	1/10	2.62	37.2	50	0.74	Eliminated - does not exceed threshold
Copper	1/10	2.26	172	2.4	71. 7	Retained - exceeds 2 X background and HQ > 1
Iron	2/2	24.70	10.5 - 305,000	300	1,016.7	Retained - exceeds 2 X background and HQ > 1
Lead	2/10	ND	26.4 - 155	5.6	27.7	Retained - HQ > 1
Manganese	1/2	2.00	294	10	29.4	Retained - exceeds 2 X background and HQ > 1
Mercury	3/10	0.52	0.2 - 0.43	0.025	17.2	Eliminated - does not exceed 2 X background
Silver	1/10	ND	10.2	0.05	204	Retained - HQ > 1
Tin	3/9	ND	48 - 94.6	73	1.3	Retained - HQ > 1
Vanadium	1/10	1.99	42.5	10,000	0.004	Eliminated - does not exceed threshold
Zinc	10/10	7.19	5.8 - 6,230	86	72.4	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs						
Aroclor-1242	1/2	ND	1.1	0.03	36.7	Retained - HQ > 1
SEMIVOLATILE ORGANIC COMPOUNDS						
Anthracene	1/10	ND	0.11	300	0.0004	Eliminated - does not exceed threshold
Benzo(g,h,i)perylene	1/10	ND	0.54	300	0.002	Eliminated - does not exceed threshold
Bis(2-ethylhexyl)phthalate	1/2	5.39	5	360	0.01	Eliminated - does not exceed threshold
Dibenzo(a,h)anthracene	1/10	ND	0.43	0.031	13.9	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS						
Acetone	1/2	4.33	46	9,000,000	5.1E-06	Eliminated - does not exceed threshold

ND = Not detected.

TABLE 8-31

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 8
NAS KEY WEST
PAGE 1 OF 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	14/14	1331.89	159 - 17400	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Antimony	5/13	ND	5 - 20.7	12	1.7	Retained - HQ > 1
Arsenic	22/22	2.63	1 - 43.5	7.24/70	6.0/0.6	Retained - exceeds 2 X background and HQ > 1
Barium	13/22	9.27	4 - 304	40	7.6	Retained - exceeds 2 X background and HQ > 1
Cadmium	6/15	0.22	0.21 - 11.4	0.676/9.6	16.9/1.2	Retained - exceeds 2 X background and HQ > 1
Chromium	22/22	5.01	2.3 - 70.7	52.3/160	1.4/0.4	Retained - exceeds 2 X background and HQ > 1
Cobalt	9/18	0.47	0.37 - 10.1	50	0.2	Eliminated - does not exceed threshold
Copper	21/21	8.88	1.5 - 1100	18.7/270	58.8/4.1	Retained - exceeds 2 X background and HQ > 1
Lead	22/22	17.97	4.9 - 1680	30.2/218	55.6/7.7	Retained - exceeds 2 X background and HQ > 1
Manganese	14/14	15.39	4.7 - 546	460/1,110	1.2/0.5	Retained - exceeds 2 X background and HQ > 1
Mercury	15/22	0.05	0.04 - 1.6	0.13/0.71	12.3/2.3	Retained - exceeds 2 X background and HQ > 1
Nickel	14/22	2.15	1.1 - 248	15.9/42.8	15.6/5.8	Retained - exceeds 2 X background and HQ > 1
Selenium	1/13	0.68	4.8	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Silver	3/13	0.27	0.63 - 17.7	0.733/3.7	24.1/4.8	Retained - exceeds 2 X background and HQ > 1
Thallium	2/12	ND	46.7 - 168	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Tin	2/9	2.85	12.8 - 55.6	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	17/20	5.08	1.9 - 25.7	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Zinc	20/20	25.74	5.2 - 2180	124/410	17.6/5.3	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs (µg/kg)						
2,4-D	6/10	39.15	11 - 58.8	NA	-	Retained - no suitable threshold available
4,4'-DDD	3/23	13.03	9 - 100	1.22/7.81	82.0/12.8	Retained - HQ > 1
4,4'-DDE	5/23	19.85	4 - 180	2.07/27	87.0/6.7	Retained - HQ > 1
4,4'-DDT	6/23	13.02	8 - 46	1.19/4.77	38.7/9.6	Retained - HQ > 1
alpha-BHC	1/23	7.11	30	6/100	5.0/0.3	Retained - HQ > 1

TABLE 8-31

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - IR 8
NAS KEY WEST
PAGE 2 of 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemical of Potential Concern (COPC)
PESTICIDES (µ g/kg) (continued)						
Aroclor-1254	1/15	ND	26.1	60/340	0.44	Eliminated - does not exceed threshold
beta-BHC	1/23	ND	32	5	6.4	Retained - HQ > 1
delta-BHC	1/23	7.35	48	3	16	Retained - HQ > 1
Endosulfan I	1/23	6.7	1.3	2.9	0.5	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Anthracene	1/13	ND	20	46.9/245	0.4	Eliminated - does not exceed threshold
Benzo(a)anthracene	5/13	ND	15 - 130	748/1,600	1.7/0.08	Retained - HQ > 1
Benzo(a)pyrene	5/13	ND	41 - 130	88.8/1,600	1.5/0.08	Retained - HQ > 1
Benzo(b)fluoranthene	5/13	966.92	21 - 160	655/1,700	0.2	Eliminated - does not exceed threshold
Benzo(g,h,i)perylene	4/13	ND	36 - 100	655/1,700	0.2	Eliminated - does not exceed threshold
Benzo(k)fluoranthene	5/13	ND	9.8 - 140	655/1,700	0.2	Eliminated - does not exceed threshold
Bis(2-ethylhexyl)phthalate	5/5	1992.17	290 - 1100	182/2,647	6.0/0.4	Retained - HQ > 1
Chrysene	5/13	961.38	16 - 160	108/2,800	1.5/0.06	Retained - HQ > 1
Di-n-butyl phthalate	1/5	ND	160	11,000	0.01	Eliminated - does not exceed threshold
Fluoranthene	7/13	982.38	26 - 210	113/5,100	1.9/0.04	Retained - HQ > 1
Fluorene	5/13	ND	110 - 320	21.2/144	15.1/2.2	Retained - HQ > 1
Indeno(1,2,3-cd)pyrene	5/13	ND	17 - 100	655/9,600	0.2	Eliminated - does not exceed threshold
Naphthalene	5/13	ND	45 - 90	34.6/391	2.6/0.2	Retained - HQ > 1
Phenanthrene	7/13	ND	24 - 150	86.7/1,100	1.7/0.1	Retained - HQ > 1
Pyrene	7/13	968.46	28 - 230	153/2,600	1.5/0.09	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
Acetone	2/5	30.9	5 - 72	64	1.1	Retained - HQ > 1
Methylene chloride	4/13	7.5	7 - 22	427	0.05	Eliminated - does not exceed threshold
Toluene	1/13	4.49	5	670	0.007	Eliminated - does not exceed threshold

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

TABLE 8-32

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - IR 8
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 (mg/kg)						
Aluminum	1/1	1887.29	228	600	0.4	Eliminated - does not exceed 2 X background
Arsenic	1/1	1.29	0.84	60	0.01	Eliminated - does not exceed 2 X background
Barium	1/1	10.51	5.9	440	0.01	Eliminated - does not exceed 2 X background
Chromium	1/1	6.02	4.5	0.4	11.3	Eliminated - does not exceed 2 X background
Copper	1/1	5.43	3.7	50	0.07	Eliminated - does not exceed 2 X background
Lead	1/1	15.66	26.9	500	0.05	Eliminated - does not exceed 2 X background
Manganese	1/1	17.65	5.7	100	0.06	Eliminated - does not exceed 2 X background
Mercury	1/1	0.03	0.04	0.1	0.4	Eliminated - does not exceed 2 X background
Vanadium	1/1	3.97	1.2	20	0.06	Eliminated - does not exceed 2 X background
Zinc	1/1	15.22	13.7	200	0.07	Eliminated - does not exceed 2 X background
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	2/5	22.46	5.7 - 61.5	100	0.6	Eliminated - does not exceed threshold
4,4'-DDE	3/5	63.23	0.98 - 51.8	100	0.5	Eliminated - does not exceed threshold
4,4'-DDT	4/5	46.78	2.5 - 120	100	1.2	Retained - HQ > 1
Aroclor-1260	2/5	43.28	15.6 - 85	NA	-	Retained - no suitable threshold available
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
Methylene chloride	1/1	2.8	6	300	0.02	Eliminated - does not exceed threshold

NA = No suitable ecological threshold value was available.

TABLE 8-33

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - IR 8
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 (mg/kg)						
Aluminum	1/1	1887.29	228.00	50	4.56	Eliminated - does not exceed 2 X background
Arsenic	1/1	1.29	0.84	10	0.08	Eliminated - does not exceed 2 X background
Barium	1/1	10.51	5.90	500	0.01	Eliminated - does not exceed 2 X background
Chromium	1/1	6.02	4.50	1	4.50	Eliminated - does not exceed 2 X background
Copper	1/1	5.43	3.70	100	0.04	Eliminated - does not exceed 2 X background
Lead	1/1	15.66	26.90	50	0.54	Eliminated - does not exceed 2 X background
Manganese	1/1	17.65	5.70	500	0.01	Eliminated - does not exceed 2 X background
Mercury	1/1	0.03	0.04	0.3	0.13	Eliminated - does not exceed 2 X background
Vanadium	1/1	3.97	1.20	2	0.6	Eliminated - does not exceed 2 X background
Zinc	1/1	15.22	13.70	50	0.27	Eliminated - does not exceed 2 X background
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	2/5	22.46	5.7 - 61.5	NA	-	Retained - no suitable threshold available
4,4'-DDE	3/5	63.23	0.98 - 51.8	NA	-	Retained - no suitable threshold available
4,4'-DDT	4/5	46.78	2.5 - 120	NA	-	Retained - no suitable threshold available
Aroclor-1260	2/5	43.28	15.6 - 85	40	2.12	Retained - HQ > 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)						
Methylene chloride	1/1	2.8	6.00	NA	-	Retained - no suitable threshold available

NA = No suitable ecological threshold value was available.

TABLE 8-34

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CRABS FROM IR 8 AND BACKGROUND SITES, NAS KEY WEST
PAGE 1 OF 2

Analytes	IR 8			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Arsenic						
Spiny Spider Crab	4/4	4.10-8.80	6.25	3/4	4.10-7.70	4.69
Stone Crab	1/1	19.30	19.30	10/10	6.70-31.00	20.07
Barium						
Spiny Spider Crab	2/4	1.70	1.20	3/4	2.00-2.50	1.93
Cadmium						
Spiny Spider Crab	4/4	0.54-1.60	0.90	3/4	1.10-2.50	1.44
Chromium						
Spiny Spider Crab	1/4	5.10	1.58	0/4		
Copper						
Spiny Spider Crab	3/4	8.60-18.30	10.69	3/4	6.00-9.50	6.63
Stone Crab	1/1	69.80	69.80	10/10	5.50-60.50	26.25
Lead						
Spiny Spider Crab	3/4	0.53-1.20	0.64	2/4	0.46-0.54	0.34
Stone Crab	1/1	1.70	1.70	3/10	0.37-0.60	0.26
Manganese						
Spiny Spider Crab	4/4	1.60-3.50	2.65	3/4	1.40-3.60	1.91
Stone Crab	1/1	2.80	2.80	9/10	0.36-2.30	1.12
Mercury						
Stone Crab	1/1	0.11	0.11	7/10	0.04-0.17	0.08
Vanadium						
Spiny Spider Crab	3/4	0.93-1.10	0.84	0/4		
Stone Crab	1/1	0.68	0.68	1/10	0.61	0.32
Zinc						
Spiny Spider Crab	4/4	10.50-21.50	15.03	4/4	8.50-12.80	10.78
Stone Crab	1/1	93.80	93.80	10/10	9.00-58.00	43.85
PESTICIDE/PCBS (µg/kg)						
4,4'-DDD						
Spiny Spider Crab	1/4	1.30	1.56	2/4	0.65-1.30	1.31
4,4'-DDE						
Spiny Spider Crab	1/4	1.70	1.66	1/4	0.37	1.33
Stone Crab	1/1	1.10	1.10	3/10	0.37-1.90	1.43
4,4'-DDT						
Spiny Spider Crab	2/4	1.40-3.30	2.00	2/4	0.68-1.60	1.40
Stone Crab	1/1	3.20	3.20	2/10	0.48-0.71	1.44
Aldrin						
Spiny Spider Crab	3/4	0.52-2.20	1.07	2/4	0.59-0.76	0.76
Stone Crab	1/1	0.41	0.41	7/10	0.13-3.40	0.75
alpha-BHC						
Spiny Spider Crab	1/4	1.60	1.04	0/4		

TABLE 8-34

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CRABS FROM IR 8 AND BACKGROUND SITES, NAS KEY WEST
PAGE 2 OF 2

Analytes	IR 8			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
PESTICIDE/PCBS (µg/kg) (continued)						
delta-BHC						
Spiny Spider Crab	2/4	0.47-1.10	0.82	1/4	0.35	0.73
gamma-BHC (lindane)						
Spiny Spider Crab	1/4	0.84	0.85	1/4	0.69	0.81
Chlorobenzilate						
Spiny Spider Crab	3/4	54.00-78.00	48.88	0/4		
Stone Crab	1/1	86.00	86.00	7/10	4.40-140.00	31.03
Dieldrin						
Spiny Spider Crab	3/4	0.50-1.20	1.00	3/4	0.98-1.00	1.16
Endosulfan I						
Stone Crab	1/1	0.85	0.85	1/10	0.40	0.80
Endosulfan II						
Spiny Spider Crab	3/4	4.70-13.00	6.76	3/4	0.27-0.59	0.74
Stone Crab	1/1	0.65	0.65	3/10	0.14-2.60	1.48
Endosulfan sulfate						
Spiny Spider Crab	2/4	1.00-1.40	1.43	0/4		
Endrin						
Spiny Spider Crab	2/4	0.77-0.96	1.26	3/4	0.22-1.60	1.09
Stone Crab	1/1	0.41	0.41	7/10	0.31-2.70	1.11
Endrin aldehyde						
Spiny Spider Crab	4/4	1.00-6.40	3.53	4/4	1.10-2.30	1.85
Stone Crab	1/1	2.50	2.50	9/10	0.34-2.80	1.62
Heptachlor epoxide						
Spiny Spider Crab	4/4	0.49-12.00	5.12	1/4	0.44	0.75
Isodrin						
Spiny Spider Crab	2/4	0.32-0.60	1.06	0/4		
Methoxychlor						
Spiny Spider Crab	2/4	0.86-16.00	7.97	0/4		
Stone Crab	1/1	4.20	4.20	2/10	5.00-11.00	8.40

1 One-half the detection limit used for all non-detected values.

several organochlorine pesticides and their metabolites were detected in lobsters (Table 8-35). The inorganics aluminum, arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc were detected in conchs, as well as a number of organochlorine pesticides and their metabolites (Table 8-36). Since few milk conchs and true tulip conchs were collected from background sites, Table 8-36 also presents contaminant concentrations for all species of conchs collected from background sites. Aluminum, arsenic, lead, manganese, mercury, and zinc were detected in turtle grass, as were several organochlorine pesticides and their metabolites (Table 8-37).

8.7.4.1.4 Foodchain Modeling

Aluminum, arsenic, lead, barium, and zinc were the major contributors to potential risks to the cotton rat for both the maximum and average contaminant concentration exposure scenarios (Tables 8-38 and 8-39). Total HI values were identical for both scenarios (HI = 0.33), primarily since only one surface soil sample was collected for metals analysis. Incidental ingestion of contaminated soil accounted for the majority of contaminant exposure for this small mammal for both exposure scenarios. For the kestrel, 4,4'-DDT, 4,4'-DDE, zinc, 4,4'-DDD, and mercury accounted for the majority of potential risks using maximum contaminant concentrations, and 4,4'-DDT, zinc, 4,4'-DDE, Aroclor-1260, and mercury accounted for the majority of potential risks using mean contaminant concentrations (Tables 8-40 and 8-41). Total HI values for the maximum and mean exposure scenarios were 0.38 and 0.28, respectively. Since ingestion of soil or water were not considered in the model for this receptor, ingestion of contaminated food accounted for 100% of contaminant exposure. HI values for the raccoon at IR 8 were less than one for both the maximum and average exposure concentration scenarios, with total HI values of 0.03 and 0.01, respectively (Tables 8-42 and 8-43).

8.7.4.2 Discussion

HQ values for several inorganics in groundwater were indicative of potential risks, including copper, lead, mercury, thallium, tin, and zinc. Of these, tin was detected in only 1 of 10 groundwater samples. The HQ values for thallium and zinc were indicative of relatively low potential risks, although zinc was grossly elevated relative to background. In addition, only one detection of thallium and two detections of zinc were above threshold values (out of 10 samples). Conversely, the HQ values using the maximum detected concentrations of copper, lead, and mercury were indicative of significant potential risks. Groundwater samples collected near the shore had detections above threshold values for copper, lead, and mercury in 3, 4 and 4 of 10 samples, respectively. Detections of these metals in surface water were spotty, although this is not unusual given the dynamic nature of surface water at the shoreline (i.e., open water and wave

TABLE 8-35

SUMMARY STATISTICS FOR ANALYTES DETECTED IN LOBSTERS FROM IR 8 AND BACKGROUND SITES, NAS KEY WEST

Analytes	IR 8			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Arsenic	4/4	10.90-16.90	14.55	19/19	4.70-20.70	13.43
Copper	4/4	25.00-56.40	38.90	19/19	14.20-37.10	26.18
Lead	1/4	0.42	0.23	3/19	0.58-0.78	0.26
Manganese	3/4	0.33-1.80	0.88	5/19	1.30-1.70	0.65
Vanadium	1/4	0.57	0.31	0/19		
Zinc	4/4	18.90-24.40	21.40	19/19	12.50-25.80	20.51
PESTICIDE/PCBS (µg/kg)						
4,4'-DDD	2/4	0.18-0.61	1.02	4/19	0.72-0.86	1.46
delta-BHC	1/4	0.04	0.65	0/19		
gamma-BHC (lindane)	1/4	0.15	0.68	3/19	0.03-0.14	0.73
Chlorobenzilate	2/4	15.00-23.00	13.75	0/19		
Dieldrin	1/4	0.57	1.38	1/19	0.56	1.59
Endosulfan II	1/4	0.84	1.45	8/19	0.12-0.67	1.08
Endrin	3/4	0.21-0.37	0.62	9/19	0.06-0.56	0.98
Endrin aldehyde	3/4	0.59-2.90	1.61	5/19	0.65-3.10	1.54
Heptachlor	2/4	0.13-0.26	0.52	10/19	0.07-0.33	0.50

1 One-half the detection limit used for all non-detected values.

TABLE 8-36

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CONCHS FROM IR 8 AND BACKGROUND SITES, NAS KEY WEST
PAGE 1 OF 2

Analytes	IR 8			BACKGROUND[1]		
	Frequency of Detection	Range of Detected Values	Average[2]	Frequency of Detection	Range of Detected Values	Average[2]
INORGANICS (mg/kg)						
Aluminum				2/13	1.70-26.60	3.92
Milk Conch	5/16	29.70-152.00	25.91	0/2		
Arsenic				13/13	3.50-137.00	53.26
Milk Conch	16/16	4.10-9.30	5.91	2/2	3.50-5.40	4.45
True Tulip	4/4	25.60-119.00	53.38	4/4	39.70-94.10	66.95
Barium				0/13		
Milk Conch	3/16	1.70-3.80	0.91	0/2		
Cadmium				7/13	0.22-5.90	1.44
Milk Conch	1/16	0.53	0.28	0/2		
True Tulip	2/4	0.84-1.30	0.67	4/4	0.22-5.90	2.36
Chromium				0/13		
Milk Conch	4/16	0.99-2.00	0.67	0/2		
Copper				13/13	9.00-91.10	32.78
Milk Conch	16/16	9.20-305.00	69.29	2/2	10.50-12.80	11.65
True Tulip	4/4	18.10-111.00	62.13	4/4	10.00-91.10	53.63
Lead				3/13	0.35-0.44	0.22
Milk Conch	16/16	0.37-31.20	5.40	0/2		
True Tulip	3/4	0.42-4.80	1.54	3/4	0.35-0.44	0.34
Manganese				10/13	1.60-5.10	2.56
Milk Conch	16/16	14.00-129.00	48.41	2/2	3.00-4.20	3.60
True Tulip	4/4	1.10-1.40	1.33	2/4	1.60-5.10	2.05
Mercury				6/13	0.02-0.14	0.04
Milk Conch	12/16	0.10-0.24	0.14	0/2		
True Tulip	3/4	0.09-0.20	0.11	4/4	0.02-0.14	0.08
Nickel				1/13	0.72	0.33
Milk Conch	5/16	4.60-8.10	2.92	0/2		
Selenium				1/13	2.40	0.65
Milk Conch	1/16	1.20	0.54	0/2		
Silver				5/13	0.40-4.30	0.63
Milk conch	3/16	1.30-2.70	0.55	0/2		
Vanadium				3/13	0.58-98.30	8.06
Milk Conch	16/16	3.00-61.40	16.07	0/2		
Zinc				13/13	12.80-477.00	69.06
Milk Conch	16/16	18.30-668.00	111.16	2/2	12.80	12.80
True Tulip	4/4	15.30-68.60	33.70	4/4	20.20-218.00	74.05
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD				5/13	0.12-0.75	1.36
Milk Conch	15/16	0.77-12.00	3.07	1/2	0.20	0.92
4,4'-DDE				0/13		
Milk Conch	11/16	0.56-3.60	2.26	0/2		
True Tulip	1/4	0.62	1.39	0/4		
4,4'-DDT				4/13	0.11-1.70	1.55
Milk Conch	6/16	0.18-2.80	2.00	0/2		
True Tulip	1/4	0.49	1.36	1/4	0.11	1.27

TABLE 8-36

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CONCHS FROM IR 8 AND BACKGROUND SITES, NAS KEY WEST
PAGE 2 OF 2

Analytes	IR 8			BACKGROUND[1]		
	Frequency of Detection	Range of Detected Values	Average[2]	Frequency of Detection	Range of Detected Values	Average[2]
PESTICIDE/PCBs (µg/kg)(continued)						
Aldrin				4/13	0.09-0.26	0.64
Milk Conch	7/15	0.24-1.30	1.11	0/2		
alpha-BHC				0/13		
Milk Conch	3/15	0.58-0.72	1.15	0/2		
beta-BHC				4/13	0.38-0.98	0.80
Milk Conch	8/15	1.40-4.70	1.92	0/2		
True Tulip	3/4	0.25-2.30	1.07	0/4		
delta-BHC				0/13		
Milk Conch	1/15	0.82	1.13	0/2		
True Tulip	1/4	1.00	0.89	0/4		
gamma-BHC				2/13	0.20-0.25	0.81
Milk Conch	9/16	0.37-2.10	1.09	0/2		
Chlorobenzilate				2/13	11.00-54.00	12.77
Milk Conch	16/16	24.00-820.00	202.13	0/2		
True Tulip	1/4	3.40	7.23	0/4		
Dieldrin				1/13	0.58	1.78
Milk Conch	4/15	1.00-4.90	2.54	0/2		
True Tulip	1/4	0.14	1.27	0/4		
Endosulfan I				3/13	0.16-0.33	0.77
Milk Conch	1/15	0.56	1.17	0/2		
Endosulfan II				5/13	0.16-0.94	1.21
Milk Conch	14/16	0.64-7.50	2.80	1/2	0.18	0.91
True Tulip	2/4	0.34-0.58	1.06	0/4		
Endosulfan sulfate				0/13		
Milk Conch	11/16	0.60-7.80	3.21	0/2		
Endrin				5/13	0.08-0.30	1.24
Milk Conch	16/16	0.90-9.75	4.08	1/2	0.08	0.87
True Tulip	4/4	0.39-1.70	1.04	2/4	0.18-0.30	0.95
Endrin aldehyde				7/13	0.26-2.00	1.28
Milk Conch	14/16	1.30-37.00	13.25	0/2		
True Tulip	4/4	0.89-3.00	1.85	3/4	0.27-2.00	1.46
Heptachlor				2/13	0.14-0.23	0.82
Milk Conch	4/15	0.37-4.50	1.20	0/2		
Heptachlor epoxide				0/13		
Milk Conch	14/15	0.69-4.00	2.39	0/2		
Methoxychlor				3/13	0.89-2.60	7.09
Milk Conch	10/16	3.00-71.00	17.39	0/2		
Isodrin				0/13		
Milk Conch	10/16	0.49-2.40	1.60	0/2		

1 Values for all conchs from background sites are listed in the first row for each analyte; species specific values are listed in the second and third rows for each analyte.
2 One-half the detection limit used for all non-detected values.

TABLE 8-37

SUMMARY STATISTICS FOR ANALYTES DETECTED IN AQUATIC VEGETATION (TURTLE GRASS) FROM IR 8 AND BACKGROUND SITES, NAS KEY WEST

Analytes	IR 8			BACKGROUND		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
Inorganics (mg/kg)						
Aluminum	1/4	31.90	13.25	8/9	12.20-36.50	18.94
Arsenic	2/4	1.80-2.10	1.21	3/9	0.51-1.30	0.73
Lead	4/4	1.10-2.50	1.60	3/9	0.43-0.93	0.38
Manganese	4/4	8.20-11.30	9.77	9/9	3.20-15.90	9.34
Mercury	4/4	0.01-0.02	0.01	2/9	0.01-0.02	0.01
Zinc	4/4	8.70-15.00	10.88	9/9	1.10-14.60	7.34
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD	2/4	0.65-0.94	1.22	2/9	0.21-0.79	1.39
4,4'-DDE	2/4	0.37-0.45	1.03	2/9	0.52-0.70	1.42
delta-BHC	4/4	0.86-1.10	0.94	1/9	0.68	0.83
gamma-BHC (lindane)	3/4	0.05-0.14	0.28	7/9	0.13-0.64	0.46
Chlorobenzilate	2/4	7.70-24.00	12.80	0/9		
Dieldrin	2/4	0.42-0.75	1.12	1/9	0.25	1.49
Endrin aldehyde	1/4	0.44	1.35	5/9	3.30-18.00	6.28
Heptachlor	4/4	0.15-0.36	0.25	0/9		
Heptachlor epoxide	1/4	0.67	0.81	0/9		

1 One-half the detection limit used for all non-detected values.

TABLE 8-38

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - IR 8 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	0.20	75.6
Arsenic	0.03	9.0
Lead	0.02	4.8
Barium	0.01	4.1
Zinc	0.01	2.6
All others	0.06	4.0
Total receptor HI	0.33	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.24	74.2
Food	0.08	25.8

TABLE 8-39

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MEAN CONTAMINANT CONCENTRATION SCENARIO - IR 8 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	0.25	75.7
Arsenic	0.03	9.0
Lead	0.02	4.9
Barium	0.01	4.1
Zinc	0.01	2.6
All others	0.06	3.9
Total receptor HI	0.33	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.24	74.2
Food	0.08	25.8

TABLE 8-40

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - IR 8 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
4,4'-DDT	0.19	49.8
4,4'-DDE	0.08	19.8
Zinc	0.08	19.8
4,4'-DDD	0.02	4.5
Mercury	0.01	2.9
All others	0.00	3.3
Total receptor HI	0.38	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	0.38	100.0

TABLE 8-41

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MEAN CONTAMINANT CONCENTRATION SCENARIO - IR 8 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
4,4'-DDT	0.11	40.8
Zinc	0.07	27.3
4,4'-DDE	0.05	17.3
Aroclor-1260	0.01	4.0
Mercury	0.01	4.0
All others	0.00	6.7
Total receptor HI	0.28	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	0.28	100.0

TABLE 8-42

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - IR 8 NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Alpha-BHC	0.01	43.6
Beta-BHC	0.01	30.7
Heptachlor epoxide	0.00	15.2
4,4'-DDE	0.00	3.2
Mercury	0.00	2.6
All others	0.00	4.6
Total receptor HI	0.03	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.02	66.5
Food	0.01	33.6

TABLE 8-43

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MEAN CONTAMINANT CONCENTRATION SCENARIO - IR 8 NAS KEY WEST

Chemical)	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Alpha-BHC	0.00	48.6
Beta-BHC	0.00	20.4
Heptachlor epoxide	0.00	17.3
Endrin	0.00	4.8
4,4'-DDT	0.00	2.0
All others	0.00	6.9
Total receptor HI	0.01	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.00	42.7
Food	0.01	57.3

action). However, copper, lead, and mercury exceeded both most and less conservative screening values in sediments. They were not elevated in surface soils. Hence, it appears that groundwater to surface-water migration of these metals from subsurface soils and subsequent deposition in sediments may have occurred at the site.

The inorganics aluminum, arsenic, cadmium, copper, iron, lead, manganese, silver, tin, and zinc in surface water had HQ values indicative of potential risks to aquatic receptors. Of these, arsenic, cadmium, copper, and silver were detected in only 1 of 10 samples. Lead was detected in only 2 of 10 samples. Also, the HQ values for aluminum, arsenic, and tin were indicative of relatively low potential risks (all less than 1.4). Iron, manganese, and zinc had elevated HQ values, although analyses of iron and manganese were conducted in only two samples. Iron and manganese are essential nutrients, and the maximum concentration of zinc was the only detection of that metal that exceeded its threshold (Table 8-4). Dibenzo(a,h)anthracene exceeded its threshold value but it was detected in only 1 of 10 surface-water samples. Aroclor-1242 was detected in 1 of 2 surface-water samples at an elevated concentration but was not detected in any other medium at IR 8. Although the maximum detected concentrations of several contaminants in surface water exceeded thresholds, potential risks to aquatic receptors from surface-water contaminants appear to be low. Also, as mentioned above, the dynamic nature of surface-water at the shoreline (i.e., wave action) makes interpretation of surface-water data difficult. Hence, the results of sediment analyses are a better indicator of potential risks to aquatic organisms and migration of contaminants at IR 8.

Several metals in sediments had HQ values indicative of relatively high potential risks to benthic organisms. Of the metals detected in sediments with HQs greater than 1, antimony, chromium, and manganese had relatively low HQ values for maximum detected concentrations (1.7 or less). Three detected concentrations of barium in 22 samples exceeded the only sediment threshold available. Arsenic exceeded the most conservative threshold in 6 of 22 samples, but no detected concentration exceeded the less conservative threshold used in this assessment. Also, only one detection of cadmium, mercury, and silver exceeded the less conservative thresholds used in this ERA. In contrast, several detections of copper, lead, nickel, and zinc exceeded the less conservative thresholds used. Nickel was not detected in groundwater near the shore and was not elevated in subsurface soils; suggesting that IR 8 is not the source of this metal. Yet copper, lead, and zinc, as mentioned above, were significantly elevated in groundwater near the shore. Since these two metals were not elevated in IR 8 surface soils, it appears that groundwater to sediment migration has occurred.

Aluminum, selenium, thallium, tin, and vanadium were conservatively retained as sediment COPCs since their maxima exceeded two times average background but no suitable thresholds were available.

Selenium was detected in only 1 of 13 samples and thallium was detected in only 2 of 12 samples. Selenium was not detected in groundwater or surface soils and was detected in only one subsurface soil sample. Thallium was detected in 3 of 10 groundwater samples, was elevated in only one of those samples, was not detected in surface soils, and was detected in only one subsurface soil sample. Most detections of aluminum were comparable to the average background concentration. Tin was detected in only 2 of 9 sediment samples, but both detections were significantly higher than background. Tin is generally not toxic unless present as organotin (Eisler, 1989). The analyses performed were for total tin, and thus, the determination of the ratio of inorganic to organic tin in these samples is not possible. Organotin compounds are frequently elevated near marinas and other areas where organotin-based antifouling paints are used (Eisler, 1989). The area immediately west of IR 8 (Man of War Harbor) experiences heavy boat usage. As such, tin detected in 2 sediment samples may be due to boating activity. Since tin was detected in only one groundwater sample, was not elevated in subsurface soils, and was detected in only 2 of 9 sediment samples, tin in sediments near IR 8 does not appear to be the result of migration from IR 8 media. Several detections of vanadium were significantly elevated above background, but vanadium is generally not considered to be highly toxic in the environment (Mailman, 1980).

Several pesticides in IR 8 sediments had HQ values indicative of potential risks, including 4,4'-DDT and daughter products, alpha-BHC, beta-BHC, and delta-BHC. However, the BHC isomers were detected in only 1 of 23 samples. The organics 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD all had maxima in excess of the most conservative thresholds used in this ERA, but most detected concentrations of these compounds were below the less conservative thresholds used (Table 8-3). In addition, 4,4'-DDD was detected only in 3 of 23 samples. None of these three compounds were detected in groundwater, and only 4,4'-DDE was detected in subsurface soil (and was not elevated). All three compounds were detected in surface soil but were not significantly elevated (Table 8-2). Thus, it does not appear that IR 8 is the source of these three compounds in sediments. Moreover, these compounds are not bioaccumulating in biota near IR 8, as discussed below.

The PAHs benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, flourene, napthalene, phenanthrene, and pyrene all had HQs greater than 1.0 in sediments. With the exception of fluorene, all of the HQ values using maximum detected concentrations were relatively low (2.6 or less). Flourene was detected at a low concentration in only one groundwater sample, and was not detected in surface or subsurface soils at IR 8. Therefore, the potential risks posed by PAHs in sediments appear to be low, and the presence of PAHs may be the result of heavy boat traffic in nearby waters. Bis(2-ethylhexy)phthalate also had an HQ greater than 1.0, but its maximum detected concentration did not exceed the less conservative threshold and phthalates are ubiquitous environmental contaminants. One VOC, acetone,

had an HQ indicative of low potential risks (HQ = 1.1). However, acetone is a common laboratory contaminant.

No inorganics were COPCs in surface soils at IR 8. One organic, 4,4'-DDT, was present with a maximum detected concentration that exceeded the threshold, but the HQ value was quite low (HQ = 1.2). Aroclor-1260 was conservatively retained as a surface soil COPC since no suitable threshold was available. It was detected in 2 of 5 samples, but the maximum detected concentration was relatively low (85 µg/kg). Moreover, no inorganic COPCs were identified for terrestrial plants. The organics 4,4'-DDT and degradation products and methylene chloride were conservatively retained as plant COPCs since no suitable threshold was available, but plants do not translocate organics appreciably (Will and Suter, 1995b).

Of the inorganics detected in crabs from IR 8, arsenic, barium, cadmium, and mercury were present in average concentrations comparable to or lower than the concentrations detected in crabs collected from background sites in the Key West area (Table 8-34). Chromium was detected in one spiny spider crab at a low level but was not detected in background crabs. The average concentrations of manganese were slightly higher in IR 8 crabs than in background crabs, but the concentration ranges were similar. Vanadium was detected in spiny spider crabs at IR 8 but not in background spiny spider crabs, and was slightly higher in IR 8 stone crabs than in background crabs. As mentioned above, vanadium is not believed to he highly toxic in the environment (Mailman, 1980). However, copper and zinc were considerably higher in IR 8 crabs than in background crabs, as was lead, but to a much lesser extent. These three inorganics were COPCs in surface water and sediments.

Although lead was elevated in IR 8 crabs relative to background crabs collected for this assessment, the highest concentration detected (1.7 mg/kg in the one stone crab sample) was within the range of concentrations detected in other marine species at areas considered to be representative of background, as was the average concentration detected in spiny spider crabs (0.64 mg/kg). Mackay et al. (1972) reported an average lead concentration of 7.8 mg/kg in shrimp (soft parts) from an unpolluted area. An average concentration of 5 mg/kg in sea urchins (soft parts) was reported by Sheppard and Bellamy (1974) in an unpolluted area.

Concentrations of zinc in tissues of aquatic organisms are usually far in excess of those required for normal metabolism (Eisler, 1993). For example, American oysters (*Crassostrea virginica*) may naturally contain up to 4,000 mg/kg in soft parts. Zinc concentrations in marine crustacean tissues are usually less than 75 mg/kg (Eisler, 1993). The average concentration in spiny spider crabs collected near IR 8 was 15.0 mg/kg, which is far less than the 75 mg/kg value. The maximum detected concentration of zinc in the

one stone crab sample collected near IR 8 was 93.8 mg/kg. Although this is higher than the typical maximum concentration in marine crustaceans mentioned above, only one stone crab sample was able to be collected, making interpretation of the stone crab concentration difficult. It should be noted that molting results in a 33-50 percent loss of total zinc in marine crustaceans (Eisler, 1993). The loss of this large a percentage of zinc in crabs may ameliorate potential risks.

Copper was detected in 3 of 4 spiny spider crabs from IR 8 at an average concentration of 10.7 mg/kg and was detected at an average concentration of 6.6 mg/kg from the background locations in this assessment. The concentration in the single stone crab sample (69.8 mg/kg) collected at IR 8 was much higher than the average concentration of 26.3 mg/kg in stone crabs from the background sites. Copper was detected in 10 of 10 background stone crabs and ranged from 5.5 to 60.5 mg/kg. Background concentrations of copper ranging from 8.5 to 25.9 mg/kg have been reported for marine shrimp (*Crangon* spp.) (Jorgensen et al., 1991). Background concentrations of copper in crabs (*Cancer pagurus, Carcinus maenas*) ranging from 6.0 to 43.8 mg/kg have also been reported (Jorgensen et al., 1991). The concentrations of copper in spiny spider crabs (10.7 mg/kg) falls within these ranges. The concentration of copper in the single stone crab from IR 8 is higher than these reported background values, but not considerably higher than the greatest concentration in background stone crabs.

Toxicity data regarding the effects of copper on crustaceans are scarce. Available data for these organisms are limited to aquatic toxicity tests using copper (e.g., surface-water concentrations). Since the interpretation of surface-water concentrations of copper near IR 8 is confounded by the dynamic nature of open surface-water, comparisons of toxic surface-water concentrations to ambient surface-water concentrations cannot be made. However, only a fraction of total copper in aquatic systems is Cu^{+2}, which is the most toxic form (Sorenson, 1991). Saltwater organisms are more tolerant of copper than freshwater organisms, and increased salinity has an ameliorative effect of copper toxicity (Sorenson, 1991). Moreover, elevated levels of copper in tissues of fish are associated with the development of enhanced tolerance to subsequent copper exposure (Dixon and Sprague, 1981). For these reasons, adverse effects from copper may not pose potential risks to crabs. Nonetheless, tissue levels indicative of potential effects on crustaceans are not available, precluding a definitive conclusion regarding the elevated concentrations of copper in crabs at IR 8.

Many of the pesticides detected in IR 8 crabs were present in relatively low concentrations that are similar to the concentrations detected in background crabs. The pesticides 4,4'-DDT, alpha-BHC, chlorobenzilate, endosulfan II, endosulfan sulfate, endrin aldehyde, heptachlor epoxide, isodrin, and methoxychlor were either detected in IR 8 crabs and not in background crabs or were higher in IR 8 crabs than in background crabs. Nonetheless, all of the maximum concentrations of organics in crabs were

relatively low; most were within 1 to 5 µg/kg and no chlorinated compounds exceeded the 100 µg/kg concentration indicative of low potential risk (Gibson and Dillon, 1989). As a result, organics do not appear to be bioaccumulating in crabs.

Arsenic, copper, lead, manganese, vanadium, and zinc were detected in IR 8 lobsters. The average concentrations of arsenic, lead, manganese, and zinc were comparable to the average concentrations in background lobsters collected for this assessment. The average concentration of copper was slightly higher in site-related lobsters than in background lobsters. The significance of elevated concentrations of copper in crustacean tissue is discussed above. Vanadium was detected at a relatively low concentration (0.31 mg/kg) in one lobster sample collected near IR 8 but was not detected in background. Of the organics detected in lobsters, the average concentrations of 4,4'-DDD, lindane, dieldrin, endrin, endrin aldehyde, and heptachor were comparable to background. Delta-BHC and chlorobenzilate were detected in IR 8 lobsters but not in background lobsters, and endosulfan, although detected in only one sample, was slightly higher than in background. Despite these exceptions, no maximum concentration of any organic exceeded the 100 µg/kg concentration indicative of low potential risk (Gibson and Dillon, 1989). Therefore, it does not appear that organics are bioaccumulating in lobsters.

A number of metals were detected in conchs collected near IR 8. Of these, the average concentrations of arsenic, cadmium, mercury, selenium, and silver were comparable to the average concentrations in background conchs. The average concentrations of aluminum (milk conch), copper (milk conch), lead (milk conch and true tulip), manganese (milk conch), nickel (milk conch), vanadium (milk conch), and zinc (milk conch) were all considerably higher in IR 8 conchs than in background conchs (either milk conch, true tulip or both). Of these metals, aluminum is common in environmental media (Goyer, 1986), manganese is an essential nutrient (Goyer, 1986), and vanadium is not believed to be highly toxic in the environment (Mailman, 1980).

Reported background concentrations of lead in oysters (*Crassostrea* spp.), another mollusk, range from 0.2 mg/kg to 4 mg/kg (Jorgensen et al., 1991). Bivalve mollusks in the Chesapeake Bay have body burdens of lead ranging from 0.15 to 6.75 mg/kg, with an average of 1.25 mg/kg (Di Giulio and Scanlon, 1985). Background concentrations of lead in the blue mussel (*Mytilus edulis*) of 0.83 to 50 mg/kg have been reported (Jorgensen et al., 1991). Background concentrations of lead in gastropods range from 0.16 to 10.5 mg/kg (Jorgensen et al., 1991). The average concentrations of lead in IR 8 conchs, 5.4 mg/kg for milk conchs and 1.54 mg/kg for true tulip fall within these ranges. Concentrations of zinc in tissues of aquatic organisms are usually far in excess of those required for normal metabolism (Eisler, 1993), and American oysters may naturally contain up to 4,000 mg/kg of zinc in soft parts, as mentioned earlier. Reported background concentrations of zinc in oysters range from 21 to 5625 mg/kg (Jorgensen

et al., 1991). Background concentrations of zinc in snails (*Littorina littorea*) ranging from 29.3 to 54.0 mg/kg have been reported (Jorgensen et al., 1991). The average concentration of zinc in true tulip conchs near IR 8 was less than the average concentration in background conchs collected for this assessment. The average concentration of zinc in milk conchs was higher than in background milk conchs from this assessment, but generally falls within the reported background concentrations mentioned above.

Background concentrations of nickel ranging from 0.2 to 1.29 and from 0.93 to 3.75 have been reported for oysters and blue mussels, respectively (Jorgensen et al., 1991). Background concentrations of nickel in gastropods ranging from 0.09 to 12.3 mg/kg have been reported (Jorgensen et al., 1991). Although the average concentration of nickel in IR 8 conchs (2.92 mg/kg) exceeded the average in site-specific background conchs, it generally falls within the range of background from other areas, and nickel was not detected in most conchs from IR 8. Copper was considerably higher in milk conchs from IR 8 than in background conchs collected for this assessment. Reported background concentrations of copper in the blue mussel range from 0.73 to 6.0 mg/kg and from 3.7 to 1,025 mg/kg in oysters (Jorgensen et al., 1991). Concentrations of copper in true tulip conchs from IR 8 were similar to concentrations in the same species from background sites. Concentrations of copper in milk conchs from IR 8 were considerably higher than in background milk conchs, but only two background milk conch samples were available for comparison. Although copper concentrations in milk conchs ranged up to 305 mg/kg, the average value was not grossly higher than background values. The significance of copper in the tissue of marine organisms was discussed earlier.

Of these four generally ecotoxic metals (copper, lead, nickel, and zinc) that were elevated in conchs relative to background conchs collected for this assessment, copper, lead, and zinc were surface-water COPCs. Copper, lead, nickel, and zinc were sediment COPCs. Copper, lead, and zinc were significantly elevated in groundwater (and were COPCs). Most of the metals that were elevated in conchs relative to site-specific background were not considerably elevated in surface or subsurface soil. Therefore, groundwater discharge of copper, lead, and zinc appears to be the primary migration pathway.

The organics 4,4'-DDD, 4,4'-DDE, aldrin, alpha-BHC, beta-BHC, delta-BHC, chlorobenzilate, dieldrin, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, methoxychlor, and isodrin were present in IR 8 conchs (milk conch, true tulip, or both) in concentrations slightly higher than in background conchs or were detected in IR 8 conchs and not in background conchs. However, none of the maximum detected concentrations of any organics in IR 8 conchs exceeded the 100-µg/kg threshold mentioned above (Gibson and Dillon, 1989), with the exception of chlorobenzilate in milk conchs. Chlorobenzilate was detected in all milk conchs and in 1 of 4 true tulip collected near IR 8. It was

not detected in background conchs, and analyses for chlorobenzilate were not conducted in surface water, sediment, surface soil, or groundwater. Aquatic toxicity data for this pesticide were not available, but no ecological problems caused by this organic appear to have been reported in the literature. The average concentration of chlorobenzilate (202 µg/kg) was approximately twice the 100-µg/kg threshold for low probability of effects of chlorinated organics on aquatic organisms (Gibson and Dillon, 1989). This concentration is on the lower end of the range of body burdens considered to be of medium concern (100 to 1,000 µg/kg) for potential sublethal effects (Gibson and Dillon, 1989). Chlorobenzilate was detected but was not elevated in lobsters, crabs, true tulip, and turtle grass collected from IR 8. Therefore, on the whole, chlorobenzilate does not appear to pose significant risks to IR 8 aquatic biota. Average concentrations of the other organics detected in IR 8 conchs were similar to those in background conchs. Thus, organics do not appear to be bioaccumulating in conchs, with the exception of chlorobenzilate.

Aluminum, arsenic, lead, manganese, mercury, and zinc were detected in turtle grass collected near IR 8. Aluminum, manganese, and mercury were present in average concentrations comparable to background. The average concentrations of arsenic, lead, and zinc were only slightly higher in IR 8 turtle grass than in background turtle grass. The concentrations of most organics in IR 8 turtle grass were comparable to background concentrations. Chlorobenzilate, heptachlor, and heptachlor epoxide were detected in IR 8 turtle grass but not in background. Yet, the maximum detected concentrations of all organics in turtle grass were relatively low; all maximums were approximately 1 µg/kg or less, with the exception of chlorobenzilate, which had a maximum of 24 µg/kg. Hence, it does not appear that contaminants are significantly accumulating in aquatic vegetation.

HI values for the two terrestrial mammals (the cotton rat and raccoon) evaluated in the foodchain modeling were below 1.0 for both the maximum and average exposure concentration scenarios. Also, the HI values for the maximum and average scenarios were less than 1.0 for the avian carnivore evaluated in this study, the kestrel. Thus, potential risks to terrestrial receptors such as small mammals and raptors from surface soil-related contaminants appear to be insignificant. Similarly, the potential risks to the raccoon from contaminants in crabs collected near IR 8 appear to be insignificant.

8.7.4.3 Ecological Risk Summary

IR 8 is a 45-acre inactive landfill located on Fleming Key. The landfilled area is a small peninsula on the western side of the key, with Man of War Harbor and the Gulf of Mexico located immediately adjacent to the peninsula. The former landfill is covered by a thick monoculture of Australian pine, which provides extensive but poor habitat for terrestrial receptors. The shoreline and nearshore areas provide excellent aquatic habitat for a variety of marine organisms.

The Phase I ERA conducted by IT Corporation (1994) identified several metals in groundwater as COCs, as well as a number of inorganic COCs in surface water and sediment. The study concluded that the greatest risks to aquatic organisms was from direct contact with groundwater discharges, surface water, and sediment. Only a few organics were identified as groundwater COCs, and no surface-water or sediment organic COCs were identified. Some metals and organics were considered to be capable of sufficiently bioaccumulating in fish to pose risks to piscivores. A few metals were identified as soil COCs, and zinc bioaccumulated in vegetation was considered to pose risks to herbivores. The Phase I study concluded that contaminants in IR 8 media posed potential risks to ecological receptors and that additional ecological investigations to more fully characterize risks were warranted.

In this Phase II ERA, copper, lead, and zinc in groundwater appear to pose the most significant risks to aquatic receptors via groundwater discharge and subsequent deposition in sediments at the shoreline. Copper and lead were also groundwater COCs in the Phase I assessment. Contaminants detected in surface water do not appear to pose significant potential risks to aquatic receptors, but this is not surprising given the open and dynamic nature of surface water near IR 8. Copper, lead, and zinc appear to pose the most significant potential risks in sediments and, as mentioned above, may be migrating to the shoreline via groundwater. Copper and lead were COCs also in the Phase I assessment. Slightly elevated concentrations of several organics, primarily organochlorine pesticides and PAHs, exceeded sediment thresholds, but either HQ values were low, frequencies of detection were low, or the contaminants did not appear to originate from IR 8 soils or groundwater. Potential risks to soil invertebrates and terrestrial plants were also low.

Copper, lead, and zinc were elevated in IR 8 crabs relative to background crabs collected for this assessment, and these three metals were COPCs in surface water and sediments. In lobsters, only copper was slightly elevated relative to background lobsters. Several metals were elevated in conchs from IR 8 relative to background conchs. Of these inorganics, copper, lead, and zinc appear to have originated from IR 8, mainly from groundwater discharge. However, most concentrations of these inorganic contaminants in IR 8 biota do not appear to be significantly elevated in comparison to concentrations of these metals reported in the literature for similar organisms from other background areas. Inorganics do not appear to be accumulating in turtle grass collected from IR 8. Organics do not appear to be bioaccumulating in any biota collected for this study, with the exception of nominal accumulation of chlorobenzilate in milk conchs.

The results of the foodchain modeling indicate that potential risks to terrestrial mammals from IR 8-related contaminants are insignificant. In addition, potential risks to the kestrel were also insignificant. Since

these receptors include a representative mammalian carnivore, mammalian herbivore, and avian carnivore, potential risks to other similar species are most likely low.

The results of the modeling, in concert with the aquatic investigations discussed above, indicate that potential ecological risks at IR 8 are primarily confined to risks to benthic organisms from copper, lead, and zinc in sediments. Therefore, these three metals are sediment COCs. Groundwater discharge of copper, lead, and zinc appears to be the dominant migration pathway. However, the bioavailability and toxicity of IR 8 sediment contaminants to benthos is not known. As a result, sediment toxicity testing is recommended at IR 8 to evaluate whether elevated concentrations of copper, lead, and zinc are potentially impacting benthic organisms near the site.

8.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of investigation at IR 8 were to identify the existing nature and extent of contamination (after interim remedial action) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

IR 8 is a 45-acre inactive landfill located on the southern portion of Fleming Key. The western edge of the site is bordered by the Gulf of Mexico. In February 1997, BEI began the installation of a "Shoreline Protection System" at IR 8 to reduce the shoreline erosion and exposure of debris at IR 8. Metals and pesticides are the most widespread contaminants detected at the site. VOCs are present in sediment and groundwater. SVOCs are also present in sediment, surface water, and groundwater. PCBs, to a limited extent, are also present in sediment and surface water.

The human health risk for current receptors caused by the contaminants at IR 8 exceeds the FDEP target risk (1E-06) in several scenarios, are within or below the EPA target risk range of 1.0E-04 to 1.0E-06 for cancer-causing chemicals and are at or below the 1.0 hazard index for noncancer chemicals. In addition, contaminants are present at concentrations indicating that adverse noncarcinogenic health effects might occur for the hypothetical future resident exposure scenario. Antimony, arsenic, iron, and thallium were the main contributors to the noncarcinogenic risk. The cancer risk to the future resident is within the 1.0E-04 to 1.0E-06 range and exceeds FDEP's 1E-06 target risk.

The ecological risk assessment at IR 8 indicates that potential ecological risks to benthic organisms are present from elevated concentrations of copper, lead, and zinc in sediments. Groundwater discharge of these metals appears to be the dominant migration pathway. However, the bioavailability and toxicity of IR 8 sediment contaminants to benthos is not known.

An FS is recommended for IR 8. The FS should include the performance of toxicity tests to determine whether the concentration of chemicals detected in sediments are actually toxic to benthic organisms. The results of the toxicity tests should be used with the existing data to support the evaluation of remedial alternatives in the FS.

9.0 AREA OF CONCERN SITE B (AOC B)

This chapter describes the site-specific evaluation of data for AOC B (Big Coppitt Key Abandoned Civilian Disposal Area). It discusses all investigations conducted at the site, RFI/RI rationale, site geology and hydrogeology, nature and extent of contamination, contaminant fate and transport, baseline human health risk assessment, and ecological risk assessment. Section 9.8 presents a summary and conclusions with recommendations for AOC B.

9.1 UNIT DESCRIPTION

Big Coppitt Key Abandoned Civilian Disposal Area (AOC B) is located on Big Coppitt Key to the east of Boca Chica Key (Figure 9-1). The site encompasses approximately 10 acres, of which approximately 1.6 acres is occupied by a dead-end canal. At the southeastern end is the former disposal area. A mangrove swamp extends to the east, west and south of the former disposal area. The canal and a large cleared area is located north of the former disposal area. The ground elevations at the site vary from sea level up to approximately 2 feet above sea level. All runoff from precipitation appears to drain directly into the canal and into the mangrove wetlands.

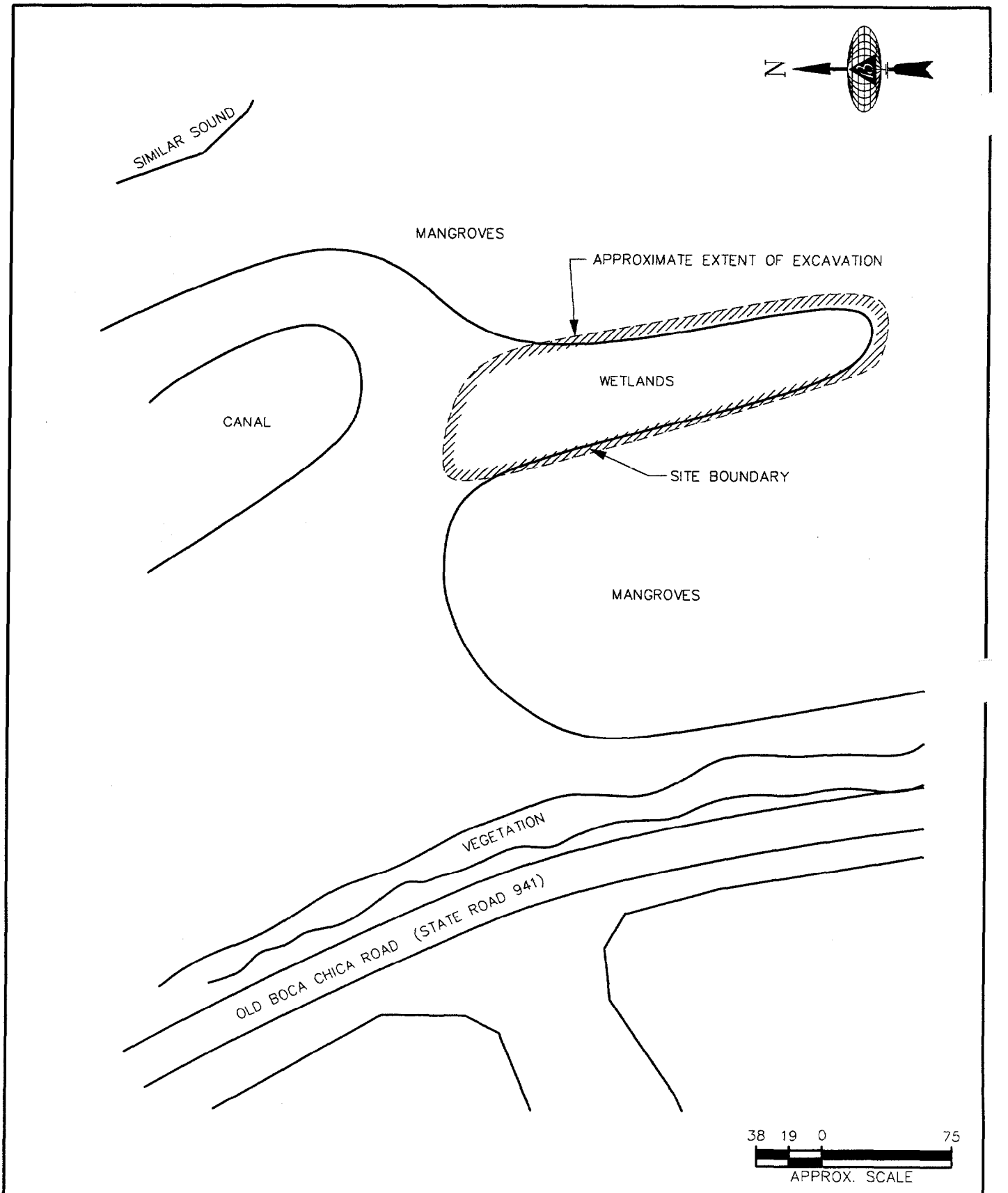
The site was formerly used by civilians for disposal of discarded car/truck body and frame parts. The exact date and method of debris placement is not known. The Navy purchased this property to comply with the Federal Aviation Agency requirements for an Aircraft Compatibility Usage Installation Zone.

9.2 INVESTIGATION HISTORY

Several investigations have been performed at AOC B since 1993 to identify, confirm, or delineate contamination. The previous investigations are summarized in Section 9.2.1. The investigation rationale and scope of this Supplemental RFI/RI are presented in Section 9.2.2.

9.2.1 Previous Investigations

Samples of groundwater, soils, surface water, and sediments were collected and analyzed by IT Corporation during the RFI/RI conducted in 1993. Analytical results indicated metal concentrations above background in all media, and PCB compounds were detected in the surface water. The Final RFI/RI



SITE MANAGER: RCD	CHECKED BY: CB	Brown & Root Environmental	FIGURE 9-1
DRAWN BY: CLG	DRAWING DATE: 4/21/97		**SITE LOCATION MAP AOC B**
SURVEYED BY: TCB	SURVEY DATE: 9/24/96		NAVAL AIR STATION KEY WEST, FLORIDA
SCALE: AS SHOWN			
CAD DWG. NO.: 7046AOC91	PROJ. NO.: HK7046		

Report recommended an IRA to remove waste from the site or prevent further contact between the waste and surface water and sediment, install groundwater monitoring wells, survey the area for potable water wells, perform a receptor survey to determine impacts to aquatic organisms, collect additional sediment samples, and conduct a baseline human health risk assessment based on data to be collected after the IRA.

In 1996, BEI conducted an IRA to excavate and dispose of contaminated soils at AOC B. The action removed 993 cubic yards of soil for offsite treatment and disposal. BEI subsequently performed confirmation sampling to verify that the IRA goals had been met (BEI, 1997).

9.2.2 Current Investigations

This section presents a brief discussion of the rationale for conducting the Supplemental RFI/RI activities at AOC B and the scope of those field activities performed from August to October 1996. In addition to the results from the Supplemental RFI/RI, sediment data was obtained from the confirmation sampling conducted after the IRA. Deviations from the Supplemental RFI/RI Sampling and Analysis Plan are addressed in Appendix D. Figures 9-2 through 9-5 show the location of all soil, sediment, surface-water, groundwater, and biota samples obtained during this investigation, as well as those from previous investigations.

9.2.2.1 Investigation Rationale

Additional sampling of sediment, surface water and groundwater was conducted at AOC B to provide more information upon which appropriate risk assessments can be based. Resampling of sediments and surface water at the original RFI/RI field program locations was performed to confirm the presence or absence of contamination indicated in earlier findings. Three permanent monitoring wells were installed to evaluate the groundwater to surface-water migration of contaminants at the site.

9.2.2.2 Scope of Current Field Investigation

Supplemental field activities at AOC B included the collection of sediment, surface-water, and groundwater samples to confirm previously-detected levels of contamination.

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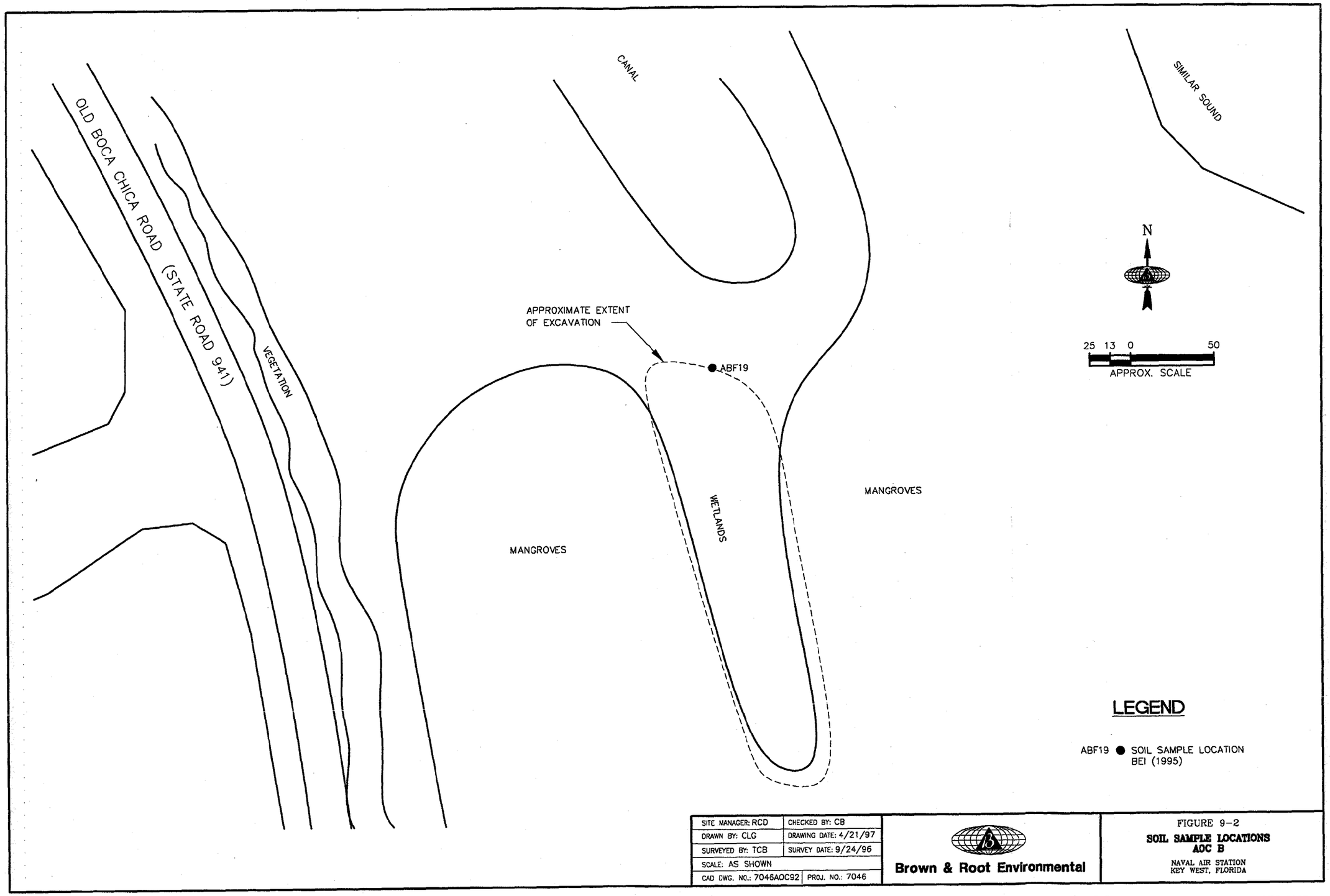

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CAD DWG. NO.: 7046AOC92	PROJ. NO.: 7046

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FIGURE 9-2
SOIL SAMPLE LOCATIONS AOC B
NAVAL AIR STATION
KEY WEST, FLORIDA

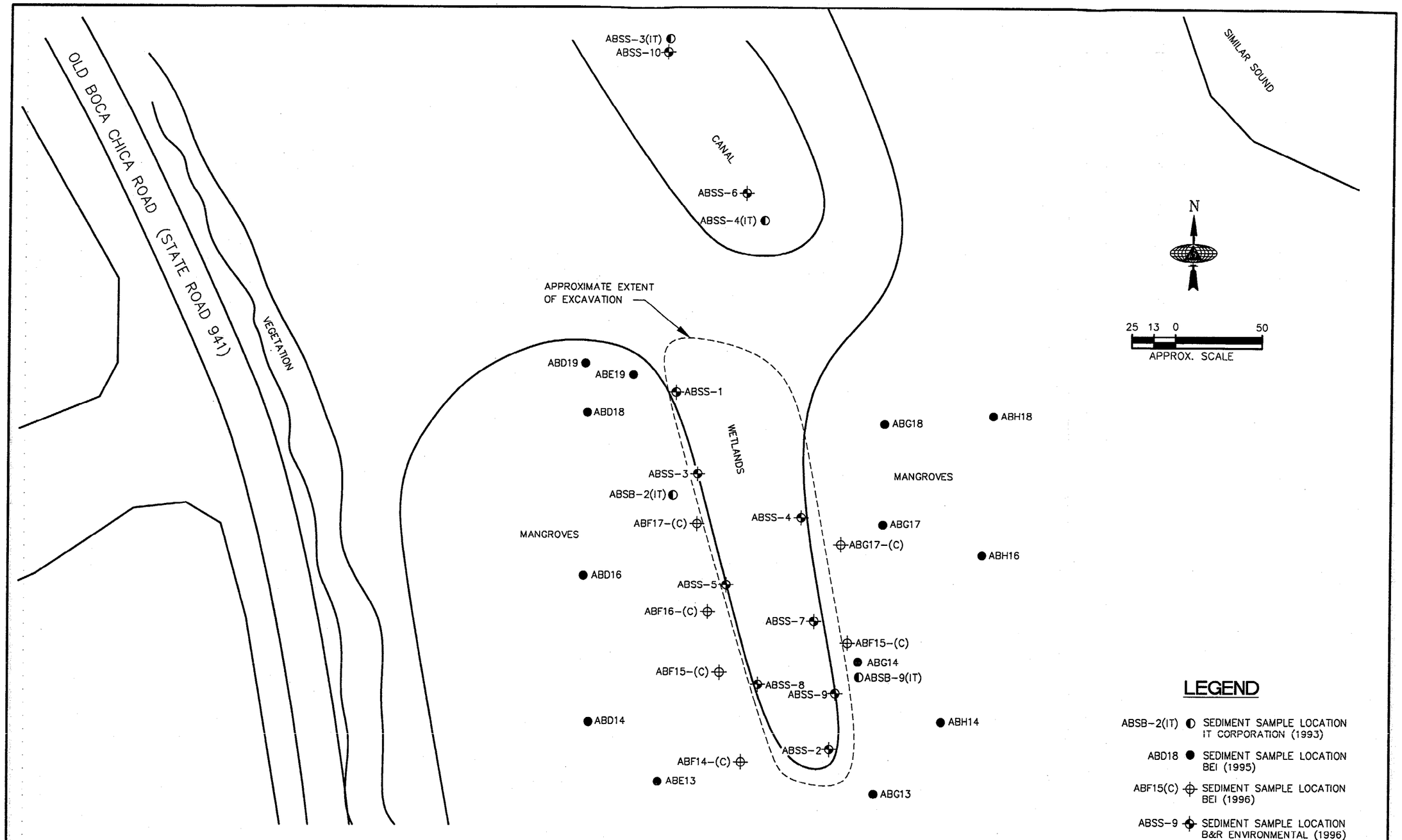

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FIGURE 9-3
SEDIMENT SAMPLE LOCATIONS AOC B
NAVAL AIR STATION KEY WEST, FLORIDA

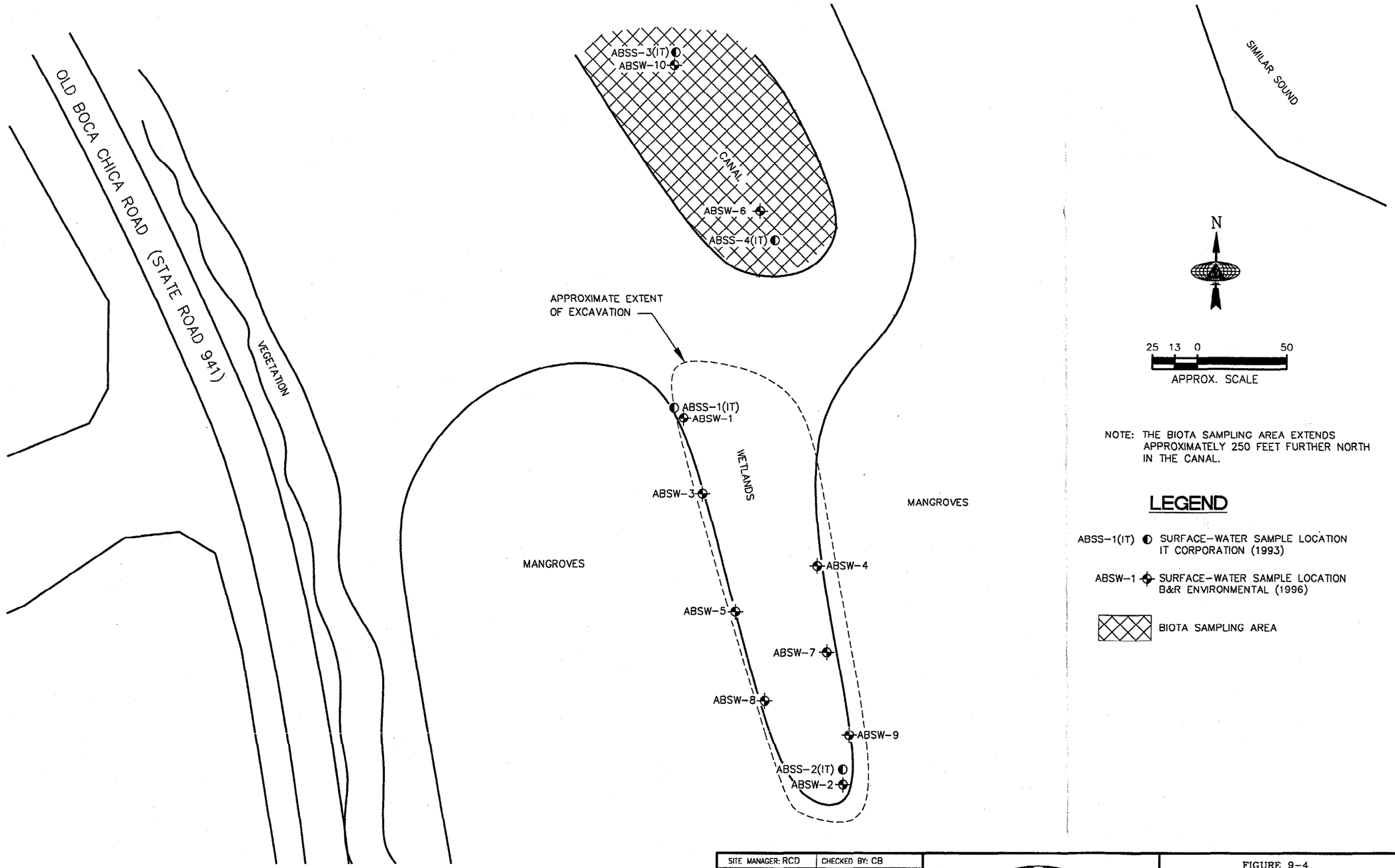

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FIGURE 9-4
SURFACE-WATER AND BIOTA SAMPLING LOCATIONS
AOC B
NAVAL AIR STATION
KEY WEST, FLORIDA

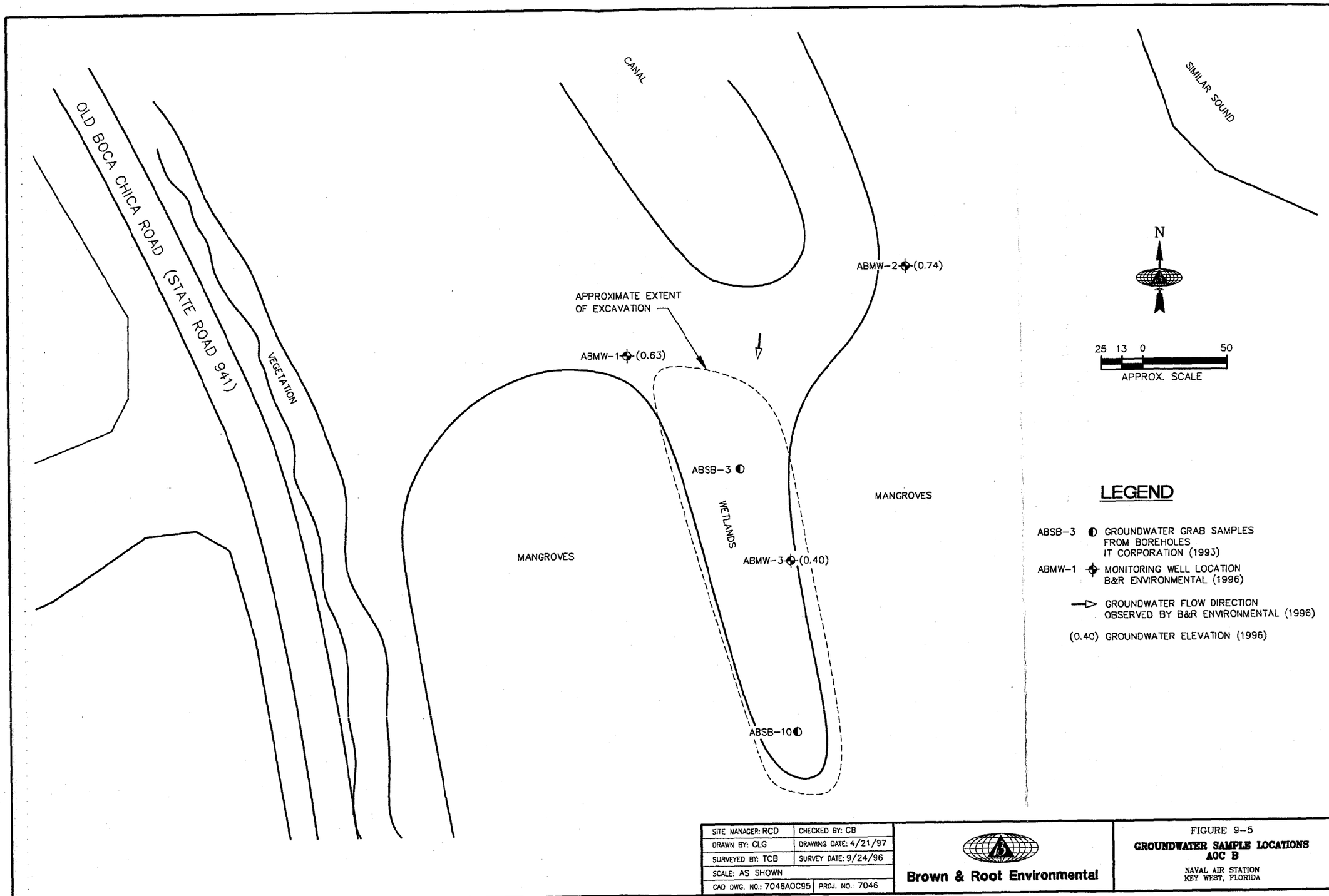

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FIGURE 9-5
GROUNDWATER SAMPLE LOCATIONS AOC B
NAVAL AIR STATION
KEY WEST, FLORIDA

9.2.2.2.1 Surface Soil

No surface soil sampling was conducted during this investigation as per the ABB Workplan and Sampling and Analysis Plan (ABB, 1995).

9.2.2.2.2 Surface Water and Sediment

Resampling of sediments and surface water at previous sample locations was performed to confirm the presence of pesticides, PCBs, herbicides, metals, and cyanide at AOC B. All AOC B sediment and surface-water samples were analyzed for the following parameters:

- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

9.2.2.2.3 Groundwater

Installation of monitoring wells and sampling of groundwater from the permanent monitoring wells was performed to evaluate the presence of VOCs, SVOCs, pesticides, PCBs, herbicides, metals, and cyanide. The focus of the groundwater sampling was on reducing the levels of turbidity that may have attributed to elevated concentrations of metals. Therefore, low-flow pumping methods were used to control the levels of turbidity. All AOC B groundwater samples were analyzed for the following parameters:

- EPA Methods 602 and 610 [VOCs and SVOCs]
- Appendix IX herbicides
- Appendix IX pesticides
- Appendix IX PCBs
- TAL metals
- Cyanide

9.3 PHYSICAL CHARACTERISTICS

Information concerning the regional geology, hydrogeology, and ecology at Key West, Florida is included in Section 1.4 (Base Environmental Setting) of this document. Applicable site specific physical characteristics are discussed below.

9.3.1 Hydrogeology

Three wells were installed at AOC B during the Supplemental RFI/RI (ABMW-1 through ABMW-3). The well construction logs are presented in Appendix E. The depth to groundwater at the site is approximately 0.6 to 1 foot bls. The groundwater elevations during this monitoring event vary from 0.40 feet to 0.74 feet above msl. Groundwater flow is south towards the wetlands area with a gradient of 0.002 foot/foot. The groundwater flow direction is indicated on Figure 9-5.

9.3.2 Soils

Big Coppitt Key soils/sediment consist of soft, greenish black to dark brown, organic peat-like material, lime mud, and small rock and shell fragments. Geotechnical data collected during the preliminary RI detected a relatively high total organic content of 6,100 mg/kg.

9.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination were investigated by analyzing samples from surface soil, sediment, surface water, and groundwater in the vicinity of the canal and wetlands area at AOC B. No subsurface soil samples were collected at AOC B. Since mangrove swamp encompasses much of the site, most solid samples collected at AOC B were classified as sediment. The results of the analyses were compared with nature and extent screening values that were selected from a variety of sources including background levels as determined in the Comprehensive Background Report (Appendix F) and ARARs and SALs from various state and Federal agencies and research institutions. The selection of screening values is discussed in Appendix C, Section 3.0, and all potential screening values are listed, by media, in Tables C.3-1 through C.3-4.

This section focuses primarily on chemicals that exceeded the screening values. The tables which accompany the text provide results for all detections, with the exceedances shaded for easy identification. Figures in this section that illustrate chemical concentrations only reflect the exceedances. Appendix H

contains the entire data set used for site characterization and assessment. Appendix I contains the analytical results for samples obtained during the August through October 1996 Supplemental RFI/RI.

9.4.1 Surface Soil

Data from one sampling effort, the 1995 BEI Delineation Study, was considered in the analysis of surface soil contamination at AOC B. Only a single surface soil sample was collected at AOC B. Since mangrove swamp encompasses much of the site, most solid samples collected at AOC B were classified as sediment. Chemicals that were detected in the surface soil sample are listed in Table 9-1. The only analytes tested for in this surface soil sample were metals. Figure 9-6 shows the occurrence of analytes that exceeded screening values and indicated possible contamination.

Screening values were obtained from a variety of sources including ORNL BTVs, EPA Region III BTAG Screening Levels, Proposed RCRA ALs, FDEP Residential Soil Cleanup Goals, FDEP Industrial Soil Cleanup Goals, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-1 contains all values considered, as well as those actually selected for the nature and extent screening of surface soil samples.

9.4.1.1 Volatile Organic Compounds

VOCs were not tested in the single surface soil sample collected at AOC B.

9.4.1.2 Semivolatile Organic Compounds

SVOCs were not tested in the single surface soil sample collected at AOC B.

9.4.1.3 Pesticides

Pesticides were not tested in the single surface soil sample collected at AOC B.

9.4.1.4 Polychlorinated Biphenyls

PCBs were not tested in the single surface soil sample collected at AOC B.

TABLE 9-1

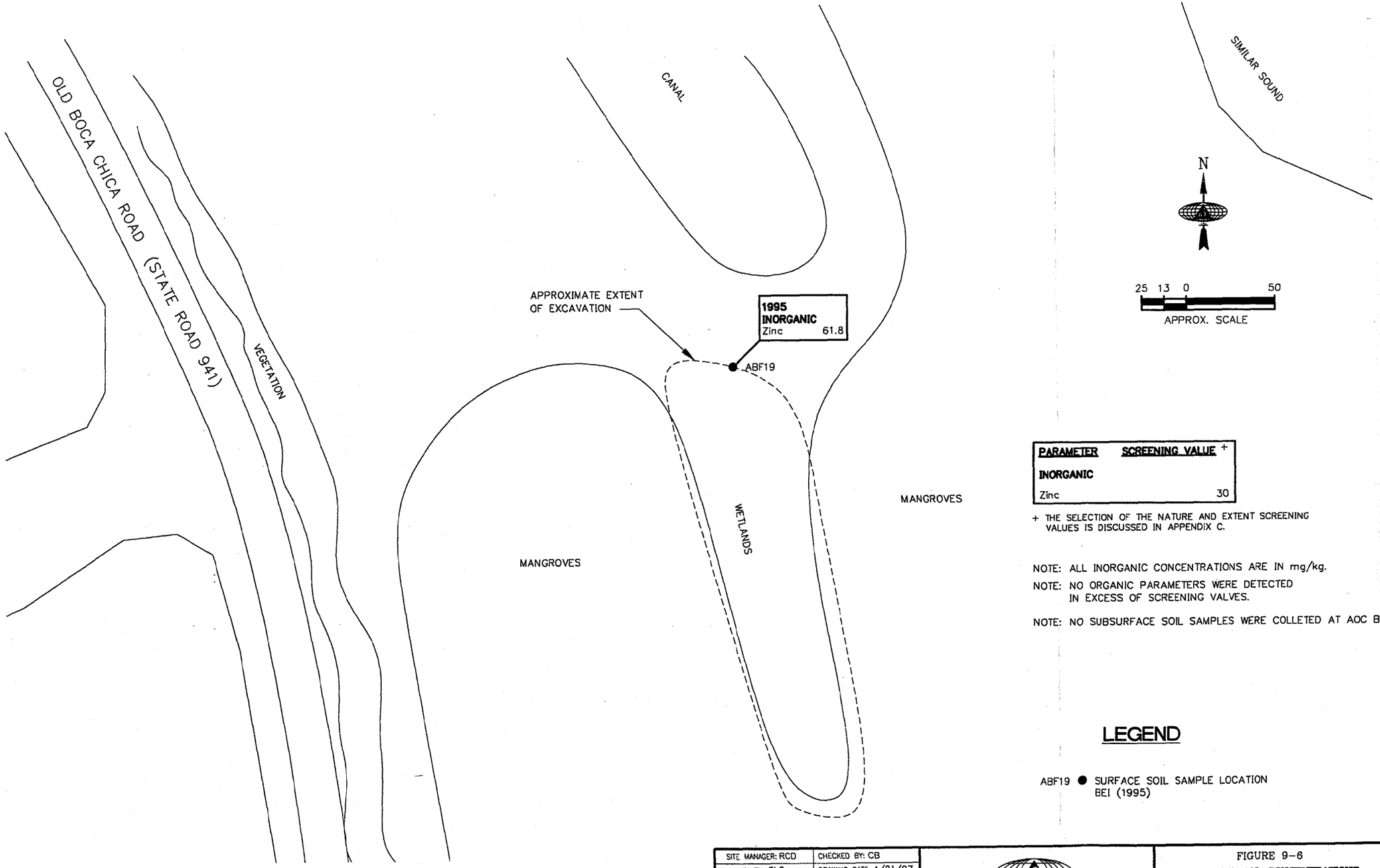
CHEMICALS DETECTED IN SURFACE SOIL AT AOC B
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (mg/kg)				
ABF19	BEI(D) 1995	Aluminum	677	
ABF19	BEI(D) 1995	Arsenic	0.727	B_1
ABF19	BEI(D) 1995	Barium	16.8	
ABF19	BEI(D) 1995	Chromium	4.12	B_1
ABF19	BEI(D) 1995	Cobalt	1.32	B_1
ABF19	BEI(D) 1995	Copper	11.9	
ABF19	BEI(D) 1995	Iron	2,000	
ABF19	BEI(D) 1995	Manganese	11.7	
ABF19	BEI(D) 1995	Nickel	2.18	B_1
ABF19	BEI(D) 1995	Zinc	61.8	

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

1 Data Sources:
BEI(D) 1995 - Delineation Study (BEI, 1995) conducted in 1995 by BEI.

2 Qualifier (Qual.) Codes:
B_1 - Value greater than instrument detection limit, but less than contract required quantitation limit.



PARAMETER	SCREENING VALUE +
INORGANIC	
Zinc	30

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: NO ORGANIC PARAMETERS WERE DETECTED IN EXCESS OF SCREENING VALVES.

NOTE: NO SUBSURFACE SOIL SAMPLES WERE COLLETED AT AOC B.

LEGEND

ABF19 ● SURFACE SOIL SAMPLE LOCATION BEI (1995)

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SURVEYED BY: TCB	SURVEY DATE: 9/24/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046AOC96	PROJ. NO.: 7046

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FIGURE 9-6
SOIL CHEMICAL CONCENTRATIONS AOC B
NAVAL AIR STATION KEY WEST, FLORIDA

AIAIE437

9.4.1.5 Inorganics

A single inorganic, zinc, was detected in excess of its 30 mg/kg screening value at ABF19. Other metals detected included aluminum, arsenic, barium, chromium, cobalt, copper, manganese, and nickel.

9.4.2 Sediment

Data from a number of sampling efforts including the 1993 IT Corporation RFI/RI, 1995 BEI Delineation Study, the 1996 BEI Confirmation Investigation, and this Supplemental RFI/RI were considered in the analysis of sediment contamination at AOC B. Chemicals that were detected in sediment samples are listed in Table 9-2. This table lists analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Sediment samples were collected along the perimeter of the IRA excavation area, as well as in the canal. BEI 1995 and 1996 samples were tested for metals only. IT Corporation 1993 samples were tested for metals, SVOCs, VOCs, and PCBs, but not pesticides. B&R Environmental samples were tested for metals, pesticides, and PCBs. Figures 9-7 through 9-8 show the occurrence of analytes that exceeded screening values and indicated possible sediment contamination. Samples were collected at various depths in sediment, from the surface to a depth of one foot. Since subsurface depths were shallow, surface and subsurface sediment samples will be discussed together in this section.

Screening values were obtained from a variety of sources including FDEP SQAGs, EPA Region IV Screening Values, EPA SQCs for Marine and Freshwater Sediments, ER-L Criteria, ER-M Criteria, Proposed RCRA ALs, EPA Region III BTAG Screening Levels, Residential Soil RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-2 contains all values considered, as well as those actually selected for the nature and extent screening of sediment samples..

9.4.2.1 Volatile Organic Compounds

No VOCs were detected in sediment samples collected by IT Corporation in 1993 at AOC B. VOCs were not tested in sediment collected during the other investigations at AOC B.

9.4.2.2 Semivolatile Organic Compounds

A single SVOC, phenanthrene, was detected at AOC B at a concentration below its screening value. Only samples collected by IT Corporation in 1993 were tested for SVOCs.

TABLE 9-2

CHEMICALS DETECTED IN SEDIMENT AT AOC B
NAS KEY WEST
PAGE 1 OF 8

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
INORGANICS (mg/kg)					
ABD18	0	BEI(D) 1995	Aluminum	5,470	
ABG17	1	BEI(D) 1995	Aluminum	5,320	
ABH14	1	BEI(D) 1995	Aluminum	5,000	
ABE13	0	BEI(D) 1995	Aluminum	4,830	
ABD19	0	BEI(D) 1995	Aluminum	4,750	
ABG15(C)	0	BEI(C) 1995-96	Aluminum	4,230	
ABG13	1	BEI(D) 1995	Aluminum	4,040	
ABD16	0	BEI(D) 1995	Aluminum	3,980	
ABF15(C)	0	BEI(C) 1995-96	Aluminum	3,920	
ABF12	0	BEI(D) 1995	Aluminum	3,760	
ABH16	1	BEI(D) 1995	Aluminum	3,760	
ABG13	0	BEI(D) 1995	Aluminum	3,725	
ABH16	0	BEI(D) 1995	Aluminum	3,670	
ABG14	1	BEI(D) 1995	Aluminum	3,590	
ABH18	1	BEI(D) 1995	Aluminum	3,500	
ABH18	0	BEI(D) 1995	Aluminum	3,380	
ABF17(C)	0	BEI(C) 1995-96	Aluminum	3,340	
ABE19	0	BEI(D) 1995	Aluminum	3,250	
ABG17(C)	0	BEI(C) 1995-96	Aluminum	3,235	
ABD14	0	BEI(D) 1995	Aluminum	3,220	
ABSS-8	0	B&RE 1996	Aluminum	3,050	
ABF12	1	BEI(D) 1995	Aluminum	3,030	
ABSS-1	0	B&RE 1996	Aluminum	2,990	
ABF16(C)	0	BEI(C) 1995-96	Aluminum	2,880	
ABH14	0	BEI(D) 1995	Aluminum	2,840	
ABF14(C)	0	BEI(C) 1995-96	Aluminum	2,770	
ABSS-5	0	B&RE 1996	Aluminum	2,540	
ABD14	1	BEI(D) 1995	Aluminum	2,470	
ABSS-2	0	B&RE 1996	Aluminum	2,450	
ABSS-7	0	B&RE 1996	Aluminum	2,260	
ABSS-3	0	B&RE 1996	Aluminum	2,250	
ABSS-9	0	B&RE 1996	Aluminum	2,120	
ABE13	1	BEI(D) 1995	Aluminum	2,060	
ABSS-4	0	B&RE 1996	Aluminum	1,670	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABSS-10	0	B&RE 1996	Aluminum	1,520	
ABG18	1	BEI(D) 1995	Aluminum	1,350	
ABG18	0	BEI(D) 1995	Aluminum	1,300	
ABSS-6	0	B&RE 1996	Aluminum	1,090	
ABG15(C)	0	BEI(C) 1995-96	Antimony	11.2	
ABF14(C)	0	BEI(C) 1995-96	Antimony	3.1	
ABF17(C)	0	BEI(C) 1995-96	Antimony	2.5	
ABF15(C)	0	BEI(C) 1995-96	Antimony	1.2	
ABF16(C)	0	BEI(C) 1995-96	Antimony	0.71	B_1
ABG17(C)	0	BEI(C) 1995-96	Antimony	0.5	B_1
ABSB-9(IT)	0	IT 1993	Arsenic	27.1	
ABG15(C)	0	BEI(C) 1995-96	Arsenic	22.9	
ABE13	0	BEI(D) 1995	Arsenic	10.2	
ABSS-5	0	B&RE 1996	Arsenic	10.1	
ABF17(C)	0	BEI(C) 1995-96	Arsenic	10.1	
ABD14	1	BEI(D) 1995	Arsenic	8.1	
ABD19	0	BEI(D) 1995	Arsenic	7.68	
ABF16(C)	0	BEI(C) 1995-96	Arsenic	7.6	
ABF15(C)	0	BEI(C) 1995-96	Arsenic	6.6	
ABSB-2(IT)	0	IT 1993	Arsenic	6.4	
ABF12	0	BEI(D) 1995	Arsenic	6.3	
ABSS-2	0	B&RE 1996	Arsenic	5.6	
ABD14	0	BEI(D) 1995	Arsenic	5.44	
ABD16	0	BEI(D) 1995	Arsenic	5.05	
ABG13	0	BEI(D) 1995	Arsenic	4.9	
ABF14(C)	0	BEI(C) 1995-96	Arsenic	4.8	
ABSS-8	0	B&RE 1996	Arsenic	4.7	
ABSS-4(IT)	0	IT 1993	Arsenic	4.5	B_1
ABSS-6	0	B&RE 1996	Arsenic	3.3	
ABSS-10	0	B&RE 1996	Arsenic	3.2	
ABH14	1	BEI(D) 1995	Arsenic	3.11	
ABSS-1	0	B&RE 1996	Arsenic	3.1	
ABH16	0	BEI(D) 1995	Arsenic	2.96	
ABSS-4	0	B&RE 1996	Arsenic	2.6	
ABD18	0	BEI(D) 1995	Arsenic	2.59	

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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABG13	1	BEI(D) 1995	Arsenic	2.5	J
ABG17(C)	0	BEI(C) 1995-96	Arsenic	2.5	
ABSS-9	0	B&RE 1996	Arsenic	2.4	
ABE13	1	BEI(D) 1995	Arsenic	2.34	J
ABH16	1	BEI(D) 1995	Arsenic	2.31	J
ABSS-7	0	B&RE 1996	Arsenic	2.1	
ABG17	1	BEI(D) 1995	Arsenic	2	J
ABSS-3	0	B&RE 1996	Arsenic	2	
ABF12	1	BEI(D) 1995	Arsenic	1.95	J
ABE19	0	BEI(D) 1995	Arsenic	1.53	J
ABH18	0	BEI(D) 1995	Arsenic	1.43	
ABG14	1	BEI(D) 1995	Arsenic	1.36	J
ABH14	0	BEI(D) 1995	Arsenic	1.33	J
ABH18	1	BEI(D) 1995	Arsenic	1.32	
ABSS-3(IT)	0.5	IT 1993	Arsenic	1.1	B_1
ABG18	1	BEI(D) 1995	Arsenic	0.857	B_1
ABG18	0	BEI(D) 1995	Arsenic	0.856	B_1
ABF17(C)	0	BEI(C) 1995-96	Barium	213	
ABG15(C)	0	BEI(C) 1995-96	Barium	131	
ABSS-5	0	B&RE 1996	Barium	58.3	
ABSB-2(IT)	0	IT 1993	Barium	44.9	
ABD19	0	BEI(D) 1995	Barium	32.4	
ABF14(C)	0	BEI(C) 1995-96	Barium	25.9	
ABSB-9(IT)	0	IT 1993	Barium	24.7	B_1
ABF16(C)	0	BEI(C) 1995-96	Barium	22.9	
ABSS-1	0	B&RE 1996	Barium	21	
ABF15(C)	0	BEI(C) 1995-96	Barium	19.7	
ABSS-2	0	B&RE 1996	Barium	19.6	
ABSS-9	0	B&RE 1996	Barium	19.3	
ABSS-8	0	B&RE 1996	Barium	17.6	
ABSS-4	0	B&RE 1996	Barium	17.1	
ABSS-7	0	B&RE 1996	Barium	16.1	
ABSS-3	0	B&RE 1996	Barium	15.1	
ABG17	1	BEI(D) 1995	Barium	13.8	
ABG17(C)	0	BEI(C) 1995-96	Barium	13.5	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABSS-6	0	B&RE 1996	Barium	12.6	
ABD18	0	BEI(D) 1995	Barium	11.6	J
ABD16	0	BEI(D) 1995	Barium	11.6	J
ABG13	1	BEI(D) 1995	Barium	11.3	J
ABH18	0	BEI(D) 1995	Barium	11.1	B_1
ABF12	1	BEI(D) 1995	Barium	10.8	J
ABH18	1	BEI(D) 1995	Barium	10.5	B_1
ABD14	1	BEI(D) 1995	Barium	10.5	J
ABG14	1	BEI(D) 1995	Barium	10.1	J
ABE19	0	BEI(D) 1995	Barium	10.1	J
ABG18	1	BEI(D) 1995	Barium	9.94	
ABH16	0	BEI(D) 1995	Barium	9.89	J
ABH16	1	BEI(D) 1995	Barium	9.88	J
ABH14	1	BEI(D) 1995	Barium	9.66	J
ABE13	0	BEI(D) 1995	Barium	9.43	
ABG13	0	BEI(D) 1995	Barium	9.2	J
ABE13	1	BEI(D) 1995	Barium	9.19	J
ABG18	0	BEI(D) 1995	Barium	9.13	
ABSS-10	0	B&RE 1996	Barium	9.1	
ABF12	0	BEI(D) 1995	Barium	8.75	
ABH14	0	BEI(D) 1995	Barium	8.61	J
ABD14	0	BEI(D) 1995	Barium	7.41	J
ABSS-4(IT)	0	IT 1993	Barium	7	B_1
ABSS-3(IT)	0.5	IT 1993	Barium	5.4	B_1
ABSB-9(IT)	0	IT 1993	Beryllium	1.5	B_1
ABG15(C)	0	BEI(C) 1995-96	Beryllium	0.13	B_1
ABF14(C)	0	BEI(C) 1995-96	Beryllium	0.09	B_1
ABF17(C)	0	BEI(C) 1995-96	Beryllium	0.08	B_1
ABG17(C)	0	BEI(C) 1995-96	Beryllium	0.08	B_1
ABF15(C)	0	BEI(C) 1995-96	Beryllium	0.07	B_1
ABF16(C)	0	BEI(C) 1995-96	Beryllium	0.07	B_1
ABSB-9(IT)	0	IT 1993	Cadmium	15.6	
ABSB-2(IT)	0	IT 1993	Cadmium	9	
ABG15(C)	0	BEI(C) 1995-96	Cadmium	6.8	
ABF16(C)	0	BEI(C) 1995-96	Cadmium	3.6	

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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABSS-5	0	B&RE 1996	Cadmium	3.3	
ABF17(C)	0	BEI(C) 1995-96	Cadmium	3.3	
ABE13	0	BEI(D) 1995	Cadmium	1.91	J
ABSS-2	0	B&RE 1996	Cadmium	1.9	J
ABF15(C)	0	BEI(C) 1995-96	Cadmium	1.5	
ABD14	0	BEI(D) 1995	Cadmium	1.19	J
ABG17(C)	0	BEI(C) 1995-96	Cadmium	0.91	
ABF14(C)	0	BEI(C) 1995-96	Cadmium	0.74	
ABSS-6	0	B&RE 1996	Cadmium	0.58	
ABSS-5	0	B&RE 1996	Chromium	141	
ABG15(C)	0	BEI(C) 1995-96	Chromium	121	
ABF17(C)	0	BEI(C) 1995-96	Chromium	79.6	
ABF14(C)	0	BEI(C) 1995-96	Chromium	56.9	
ABD19	0	BEI(D) 1995	Chromium	35.4	
ABF16(C)	0	BEI(C) 1995-96	Chromium	21.9	
ABSS-2	0	B&RE 1996	Chromium	19.7	
ABF15(C)	0	BEI(C) 1995-96	Chromium	18.6	
ABSS-8	0	B&RE 1996	Chromium	18.4	
ABSB-9(IT)	0	IT 1993	Chromium	17.8	
ABG17(C)	0	BEI(C) 1995-96	Chromium	17.4	
ABE13	0	BEI(D) 1995	Chromium	13	
ABSS-1	0	B&RE 1996	Chromium	12.3	
ABG17	1	BEI(D) 1995	Chromium	11.7	J
ABSB-2(IT)	0	IT 1993	Chromium	11.5	
ABF12	0	BEI(D) 1995	Chromium	11.2	
ABSS-9	0	B&RE 1996	Chromium	11	
ABSS-4(IT)	0	IT 1993	Chromium	10.5	
ABSS-7	0	B&RE 1996	Chromium	10.1	
ABH18	0	BEI(D) 1995	Chromium	9.79	B_1
ABD14	0	BEI(D) 1995	Chromium	9.7	
ABD18	0	BEI(D) 1995	Chromium	9.57	J
ABH14	1	BEI(D) 1995	Chromium	9.45	J
ABD16	0	BEI(D) 1995	Chromium	9.33	J
ABSS-3	0	B&RE 1996	Chromium	9.1	
ABH18	1	BEI(D) 1995	Chromium	8.94	B_1

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABSS-4	0	B&RE 1996	Chromium	8.4	
ABG14	1	BEI(D) 1995	Chromium	8.34	J
ABG13	0	BEI(D) 1995	Chromium	8	J
ABSS-6	0	B&RE 1996	Chromium	7.1	
ABH16	1	BEI(D) 1995	Chromium	6.81	J
ABSS-10	0	B&RE 1996	Chromium	6.7	
ABH14	0	BEI(D) 1995	Chromium	6.62	J
ABSS-3(IT)	0.5	IT 1993	Chromium	6.5	
ABG13	1	BEI(D) 1995	Chromium	6.3	J
ABE13	1	BEI(D) 1995	Chromium	5.7	J
ABH16	0	BEI(D) 1995	Chromium	4.84	J
ABE19	0	BEI(D) 1995	Chromium	4.69	J
ABF12	1	BEI(D) 1995	Chromium	3.85	J
ABG18	1	BEI(D) 1995	Chromium	3.76	B_1
ABG18	0	BEI(D) 1995	Chromium	3.25	B_1
ABG15(C)	0	BEI(C) 1995-96	Cobalt	9.7	
ABF15(C)	0	BEI(C) 1995-96	Cobalt	7.8	
ABD16	0	BEI(D) 1995	Cobalt	7.34	
ABG18	0	BEI(D) 1995	Cobalt	4.54	B_1
ABG13	0	BEI(D) 1995	Cobalt	4.4	J
ABSS-2	0	B&RE 1996	Cobalt	4.4	
ABH14	1	BEI(D) 1995	Cobalt	4.06	J
ABD18	0	BEI(D) 1995	Cobalt	4.06	J
ABD19	0	BEI(D) 1995	Cobalt	3.57	B_1
ABG14	1	BEI(D) 1995	Cobalt	3.5	J
ABF16(C)	0	BEI(C) 1995-96	Cobalt	3.4	
ABH18	0	BEI(D) 1995	Cobalt	3.26	B_1
ABG17	1	BEI(D) 1995	Cobalt	3.17	J
ABF17(C)	0	BEI(C) 1995-96	Cobalt	3.1	
ABE13	1	BEI(D) 1995	Cobalt	3.04	J
ABG13	1	BEI(D) 1995	Cobalt	3	J
ABH18	1	BEI(D) 1995	Cobalt	2.93	B_1
ABSS-5	0	B&RE 1996	Cobalt	2.9	
ABH16	0	BEI(D) 1995	Cobalt	2.74	J
ABH14	0	BEI(D) 1995	Cobalt	2.71	J

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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABF12	0	BEI(D) 1995	Cobalt	2.45	J
ABE19	0	BEI(D) 1995	Cobalt	2.43	J
ABE13	0	BEI(D) 1995	Cobalt	2.39	J
ABF12	1	BEI(D) 1995	Cobalt	2.06	J
ABH16	1	BEI(D) 1995	Cobalt	2.02	J
ABG18	1	BEI(D) 1995	Cobalt	1.9	B_1
ABD14	0	BEI(D) 1995	Cobalt	1.74	J
ABF14(C)	0	BEI(C) 1995-96	Cobalt	1.1	B_1
ABSS-8	0	B&RE 1996	Cobalt	1.1	
ABG17(C)	0	BEI(C) 1995-96	Cobalt	0.92	B_1
ABSS-9	0	B&RE 1996	Cobalt	0.64	
ABSS-7	0	B&RE 1996	Cobalt	0.6	
ABSS-1	0	B&RE 1996	Cobalt	0.59	
ABSS-4	0	B&RE 1996	Cobalt	0.49	
ABSS-3	0	B&RE 1996	Cobalt	0.43	
ABG15(C)	0	BEI(C) 1995-96	Copper	420	
ABF15(C)	0	BEI(C) 1995-96	Copper	415	
ABF17(C)	0	BEI(C) 1995-96	Copper	107	
ABSB-9(IT)	0	IT 1993	Copper	84.6	
ABSS-5	0	B&RE 1996	Copper	80.2	
ABSB-2(IT)	0	IT 1993	Copper	76.3	
ABSS-2	0	B&RE 1996	Copper	60.3	
ABF16(C)	0	BEI(C) 1995-96	Copper	49.2	
ABSS-1	0	B&RE 1996	Copper	46.7	
ABSS-8	0	B&RE 1996	Copper	44.8	
ABF14(C)	0	BEI(C) 1995-96	Copper	40.5	
ABSS-4	0	B&RE 1996	Copper	35.6	
ABSS-6	0	B&RE 1996	Copper	33.8	
ABSS-4(IT)	0	IT 1993	Copper	31.9	
ABSS-10	0	B&RE 1996	Copper	30.3	
ABD19	0	BEI(D) 1995	Copper	25.9	
ABG17(C)	0	BEI(C) 1995-96	Copper	25.8	
ABSS-9	0	B&RE 1996	Copper	23.1	
ABSS-7	0	B&RE 1996	Copper	17.8	
ABSS-3(IT)	0	IT 1993	Copper	17.4	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABE13	0	BEI(D) 1995	Copper	16.1	
ABSS-3	0	B&RE 1996	Copper	15.1	
ABD14	0	BEI(D) 1995	Copper	11.4	
ABH18	0	BEI(D) 1995	Copper	3.86	B_1
ABD18	0	BEI(D) 1995	Copper	3.21	J
ABH18	1	BEI(D) 1995	Copper	2.55	B_1
ABF12	0	BEI(D) 1995	Copper	2.08	J
ABG18	1	BEI(D) 1995	Copper	1.99	B_1
ABG15(C)	0	BEI(C) 1995-96	Iron	116,000	
ABF16(C)	0	BEI(C) 1995-96	Iron	50,300	
ABF17(C)	0	BEI(C) 1995-96	Iron	49,400	
ABSS-5	0	B&RE 1996	Iron	40,000	
ABSS-2	0	B&RE 1996	Iron	38,600	
ABF15(C)	0	BEI(C) 1995-96	Iron	18,900	
ABF14(C)	0	BEI(C) 1995-96	Iron	16,800	
ABD19	0	BEI(D) 1995	Iron	12,700	
ABSS-8	0	B&RE 1996	Iron	9,140	
ABG17(C)	0	BEI(C) 1995-96	Iron	7,905	
ABSS-9	0	B&RE 1996	Iron	6,320	
ABSS-6	0	B&RE 1996	Iron	6,080	
ABSS-10	0	B&RE 1996	Iron	5,760	
ABSS-7	0	B&RE 1996	Iron	5,240	
ABSS-1	0	B&RE 1996	Iron	4,745	
ABSS-4	0	B&RE 1996	Iron	4,570	
ABE13	0	BEI(D) 1995	Iron	3,350	
ABSS-3	0	B&RE 1996	Iron	3,250	
ABG17	1	BEI(D) 1995	Iron	3,230	
ABD14	0	BEI(D) 1995	Iron	2,730	
ABD14	1	BEI(D) 1995	Iron	2,610	
ABG13	1	BEI(D) 1995	Iron	2,590	
ABD18	0	BEI(D) 1995	Iron	2,420	
ABH14	1	BEI(D) 1995	Iron	2,420	
ABG14	1	BEI(D) 1995	Iron	2,070	
ABH16	1	BEI(D) 1995	Iron	1,830	
ABH18	0	BEI(D) 1995	Iron	1,810	

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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABD16	0	BEI(D) 1995	Iron	1,800	
ABG13	0	BEI(D) 1995	Iron	1,780	
ABH16	0	BEI(D) 1995	Iron	1,710	
ABH18	1	BEI(D) 1995	Iron	1,680	
ABE19	0	BEI(D) 1995	Iron	1,620	
ABF12	0	BEI(D) 1995	Iron	1,540	
ABF12	1	BEI(D) 1995	Iron	1,490	
ABG18	0	BEI(D) 1995	Iron	1,310	*
ABH14	0	BEI(D) 1995	Iron	1,200	
ABE13	1	BEI(D) 1995	Iron	1,120	
ABG18	1	BEI(D) 1995	Iron	824	
ABG15(C)	0	BEI(C) 1995-96	Lead	302	
ABSB-9(IT)	0	IT 1993	Lead	237	
ABF14(C)	0	BEI(C) 1995-96	Lead	165	
ABSB-2(IT)	0	IT 1993	Lead	84.7	
ABSS-5	0	B&RE 1996	Lead	47.8	
ABD19	0	BEI(D) 1995	Lead	44.7	
ABSS-8	0	B&RE 1996	Lead	43	
ABSS-2	0	B&RE 1996	Lead	39.5	
ABF17(C)	0	BEI(C) 1995-96	Lead	37.9	
ABF15(C)	0	BEI(C) 1995-96	Lead	33.8	
ABSS-9	0	B&RE 1996	Lead	30.2	
ABSS-7	0	B&RE 1996	Lead	26.1	
ABSS-4	0	B&RE 1996	Lead	24.7	
ABSS-1	0	B&RE 1996	Lead	24.5	
ABSS-6	0	B&RE 1996	Lead	24.4	
ABSS-4(IT)	0	IT 1993	Lead	22	
ABSS-3	0	B&RE 1996	Lead	20.9	
ABSS-10	0	B&RE 1996	Lead	20.4	
ABF16(C)	0	BEI(C) 1995-96	Lead	12.4	
ABG17(C)	0	BEI(C) 1995-96	Lead	11.3	
ABSS-3(IT)	0.5	IT 1993	Lead	7.7	
ABG15(C)	0	BEI(C) 1995-96	Manganese	388	
ABF17(C)	0	BEI(C) 1995-96	Manganese	168	
ABSS-2	0	B&RE 1996	Manganese	154	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABF16(C)	0	BEI(C) 1995-96	Manganese	129	B
ABSS-5	0	B&RE 1996	Manganese	90.9	
ABF15(C)	0	BEI(C) 1995-96	Manganese	69.7	
ABF14(C)	0	BEI(C) 1995-96	Manganese	65	
ABSS-10	0	B&RE 1996	Manganese	59	
ABD19	0	BEI(D) 1995	Manganese	55.7	
ABSS-8	0	B&RE 1996	Manganese	54.2	
ABSS-6	0	B&RE 1996	Manganese	47.3	
ABG17(C)	0	BEI(C) 1995-96	Manganese	46.1	
ABSS-9	0	B&RE 1996	Manganese	43.3	
ABSS-1	0	B&RE 1996	Manganese	42.5	
ABSS-7	0	B&RE 1996	Manganese	39.1	
ABSS-4	0	B&RE 1996	Manganese	36.7	
ABSS-3	0	B&RE 1996	Manganese	31.5	
ABG17	1	BEI(D) 1995	Manganese	28.4	
ABD18	0	BEI(D) 1995	Manganese	25.8	
ABH14	1	BEI(D) 1995	Manganese	25.7	
ABG13	1	BEI(D) 1995	Manganese	24.1	
ABG14	1	BEI(D) 1995	Manganese	22.5	
ABH18	1	BEI(D) 1995	Manganese	22.3	
ABH18	0	BEI(D) 1995	Manganese	22.3	
ABH16	1	BEI(D) 1995	Manganese	21.2	
ABD14	1	BEI(D) 1995	Manganese	20.2	
ABH16	0	BEI(D) 1995	Manganese	19	
ABF12	1	BEI(D) 1995	Manganese	18.4	
ABD16	0	BEI(D) 1995	Manganese	18.4	
ABG18	1	BEI(D) 1995	Manganese	16.9	
ABH14	0	BEI(D) 1995	Manganese	16.5	
ABG13	0	BEI(D) 1995	Manganese	16.1	
ABE19	0	BEI(D) 1995	Manganese	15.5	
ABE13	1	BEI(D) 1995	Manganese	13.9	
ABG18	0	BEI(D) 1995	Manganese	11.4	
ABE13	0	BEI(D) 1995	Manganese	11.4	
ABD14	0	BEI(D) 1995	Manganese	11.2	
ABF12	0	BEI(D) 1995	Manganese	8.75	

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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABG15(C)	0	BEI(C) 1995-96	Mercury	1.2	
ABSB-9(IT)	0	IT 1993	Mercury	0.22	
ABF14(C)	0	BEI(C) 1995-96	Mercury	0.11	
ABF17(C)	0	BEI(C) 1995-96	Mercury	0.09	
ABSS-4	0	B&RE 1996	Mercury	0.07	
ABSS-5	0	B&RE 1996	Mercury	0.06	
ABSS-3	0	B&RE 1996	Mercury	0.05	
ABSS-7	0	B&RE 1996	Mercury	0.05	
ABF16(C)	0	BEI(C) 1995-96	Mercury	0.04	
ABF15(C)	0	BEI(C) 1995-96	Mercury	0.04	B_1
ABSS-1	0	B&RE 1996	Mercury	0.04	
ABSS-8	0	B&RE 1996	Mercury	0.03	
ABSS-9	0	B&RE 1996	Mercury	0.03	
ABSS-2	0	B&RE 1996	Mercury	0.03	
ABG17(C)	0	BEI(C) 1995-96	Mercury	0.02	B_1
ABG15(C)	0	BEI(C) 1995-96	Nickel	151	
ABF16(C)	0	BEI(C) 1995-96	Nickel	123	
ABF17(C)	0	BEI(C) 1995-96	Nickel	57.7	
ABD19	0	BEI(D) 1995	Nickel	38.1	
ABF15(C)	0	BEI(C) 1995-96	Nickel	37.6	
ABSS-2	0	B&RE 1996	Nickel	24.5	
ABF14(C)	0	BEI(C) 1995-96	Nickel	23.6	
ABSS-5	0	B&RE 1996	Nickel	22.5	
ABSB-2(IT)	0	IT 1993	Nickel	16.2	
ABSB-9(IT)	0	IT 1993	Nickel	15.3	B_1
ABSS-8	0	B&RE 1996	Nickel	13.6	
ABE13	0	BEI(D) 1995	Nickel	13.1	
ABG17(C)	0	BEI(C) 1995-96	Nickel	10.8	
ABSS-1	0	B&RE 1996	Nickel	9.9	
ABSS-9	0	B&RE 1996	Nickel	7.6	
ABH18	1	BEI(D) 1995	Nickel	6.9	B_1
ABSS-7	0	B&RE 1996	Nickel	6.8	
ABG13	0	BEI(D) 1995	Nickel	5.9	J
ABD14	0	BEI(D) 1995	Nickel	5.87	J
ABD18	0	BEI(D) 1995	Nickel	5.83	J

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABH18	0	BEI(D) 1995	Nickel	5.45	B_1
ABH16	1	BEI(D) 1995	Nickel	5.21	J
ABF12	0	BEI(D) 1995	Nickel	5.08	J
ABG17	1	BEI(D) 1995	Nickel	5.04	J
ABSS-6	0	B&RE 1996	Nickel	5	
ABSS-4	0	B&RE 1996	Nickel	5	
ABG13	1	BEI(D) 1995	Nickel	4.9	J
ABH14	1	BEI(D) 1995	Nickel	4.81	J
ABSS-3	0	B&RE 1996	Nickel	3.9	
ABSS-10	0	B&RE 1996	Nickel	3.6	
ABG18	1	BEI(D) 1995	Nickel	2.64	B_1
ABSS-8	0	B&RE 1996	Selenium	1.3	
ABSS-5	0	B&RE 1996	Selenium	1.2	
ABSS-3	0	B&RE 1996	Selenium	0.9	
ABSS-9	0	B&RE 1996	Selenium	0.7	
ABSS-4	0	B&RE 1996	Selenium	0.6	
ABSS-1	0	B&RE 1996	Selenium	0.53	J
ABSS-5	0	B&RE 1996	Silver	0.7	
ABSS-7	0	B&RE 1996	Silver	0.46	
ABSB-2(IT)	0	IT 1993	Tin	12.2	B_1
ABE13	0	BEI(D) 1995	Vanadium	40.5	
ABG15(C)	0	BEI(C) 1995-96	Vanadium	19.4	
ABSB-9(IT)	0	IT 1993	Vanadium	17.5	B_1
ABF12	0	BEI(D) 1995	Vanadium	14.5	
ABD14	0	BEI(D) 1995	Vanadium	11.6	
ABF14(C)	0	BEI(C) 1995-96	Vanadium	9.3	
ABSS-5	0	B&RE 1996	Vanadium	9.2	
ABSS-8	0	B&RE 1996	Vanadium	9	
ABF15(C)	0	BEI(C) 1995-96	Vanadium	8.9	
ABF16(C)	0	BEI(C) 1995-96	Vanadium	8.9	
ABF17(C)	0	BEI(C) 1995-96	Vanadium	8.1	
ABG17(C)	0	BEI(C) 1995-96	Vanadium	7.9	
ABSS-2	0	B&RE 1996	Vanadium	7.3	
ABSS-1	0	B&RE 1996	Vanadium	7.2	
ABSS-9	0	B&RE 1996	Vanadium	6.6	

TABLE 9-2

CHEMICALS DETECTED IN SEDIMENT AT AOC B
NAS KEY WEST
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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABSS-3	0	B&RE 1996	Vanadium	5.8	
ABSS-7	0	B&RE 1996	Vanadium	5.7	
ABSS-4	0	B&RE 1996	Vanadium	5.6	J
ABSS-6	0	B&RE 1996	Vanadium	5.4	
ABSS-10	0	B&RE 1996	Vanadium	4.9	
ABSS-3(IT)	0.5	IT 1993	Vanadium	2.4	B_1
ABG13	0	BEI(D) 1995	Vanadium	1.4	J
ABG15(C)	0	BEI(C) 1995-96	Zinc	3,680	
ABSB-9(IT)	0	IT 1993	Zinc	2,590	
ABF18(C)	0	BEI(C) 1995-96	Zinc	2,380	
ABF17(C)	0	BEI(C) 1995-96	Zinc	2,280	
ABSB-2(IT)	0	IT 1993	Zinc	1,260	
ABF15(C)	0	BEI(C) 1995-96	Zinc	1,140	
ABSS-5	0	B&RE 1996	Zinc	683	
ABD14	0	BEI(D) 1995	Zinc	480	
ABD19	0	BEI(D) 1995	Zinc	450	
ABSS-2	0	B&RE 1996	Zinc	447	
ABE13	0	BEI(D) 1995	Zinc	442	
ABSS-8	0	B&RE 1996	Zinc	306	
ABF14(C)	0	BEI(C) 1995-96	Zinc	258	
ABSS-10	0	B&RE 1996	Zinc	258	
ABG17(C)	0	BEI(C) 1995-96	Zinc	225.5	
ABSS-6	0	B&RE 1996	Zinc	224	
ABSS-3(IT)	0.5	IT 1993	Zinc	146	
ABSS-4(IT)	0	IT 1993	Zinc	145	
ABSS-9	0	B&RE 1996	Zinc	142	
ABSS-4	0	B&RE 1996	Zinc	139	
ABSS-7	0	B&RE 1996	Zinc	130	
ABSS-1	0	B&RE 1996	Zinc	100.1	
ABD14	1	BEI(D) 1995	Zinc	90.1	
ABG13	0	BEI(D) 1995	Zinc	73.9	
ABH16	0	BEI(D) 1995	Zinc	72.1	
ABSS-3	0	B&RE 1996	Zinc	59.9	
ABD18	0	BEI(D) 1995	Zinc	54.1	
ABD16	0	BEI(D) 1995	Zinc	41	

Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABG17	1	BEI(D) 1995	Zinc	31.7	
ABG14	1	BEI(D) 1995	Zinc	29.8	
ABH18	0	BEI(D) 1995	Zinc	26.1	
ABE19	0	BEI(D) 1995	Zinc	24.1	
ABH18	1	BEI(D) 1995	Zinc	22.5	
ABF12	0	BEI(D) 1995	Zinc	19.8	
ABH16	1	BEI(D) 1995	Zinc	8.03	J
ABE13	1	BEI(D) 1995	Zinc	7.21	J
ABH14	0	BEI(D) 1995	Zinc	6.43	J
ABG18	0	BEI(D) 1995	Zinc	5.63	B_1
ABG18	1	BEI(D) 1995	Zinc	4.08	B_1
ABG13	1	BEI(D) 1995	Zinc	3.6	J
ABH14	1	BEI(D) 1995	Zinc	3.04	J
ABF12	1	BEI(D) 1995	Zinc	2.19	J
PESTICIDES/PCBs (µg/kg)					
ABSS-10	0	B&RE 1996	2,4,5-TP (silvex)	5.2	
ABSS-4	0	B&RE 1996	4,4'-DDD	12.6	J
ABSS-8	0	B&RE 1996	4,4'-DDD	6.1	J
ABSS-5	0	B&RE 1996	4,4'-DDD	3.1	
ABSS-3	0	B&RE 1996	4,4'-DDD	3.1	
ABSS-9	0	B&RE 1996	4,4'-DDD	2.7	
ABSS-7	0	B&RE 1996	4,4'-DDD	2.6	J
ABSS-1	0	B&RE 1996	4,4'-DDD	2.3	J
ABSS-2	0	B&RE 1996	4,4'-DDD	2.2	J
ABSS-4	0	B&RE 1996	4,4'-DDE	15.7	J
ABSS-8	0	B&RE 1996	4,4'-DDE	4.8	J
ABSS-2	0	B&RE 1996	4,4'-DDE	4.4	
ABSS-5	0	B&RE 1996	4,4'-DDE	4.1	J
ABSS-7	0	B&RE 1996	4,4'-DDE	3.7	J
ABSS-3	0	B&RE 1996	4,4'-DDE	3.4	J
ABSS-9	0	B&RE 1996	4,4'-DDE	3	J
ABSS-10	0	B&RE 1996	4,4'-DDE	2.4	J
ABSS-1	0	B&RE 1996	4,4'-DDE	2.1	J
ABSS-6	0	B&RE 1996	4,4'-DDE	1.7	J
ABSS-8	0	B&RE 1996	4,4'-DDT	6.4	J

TABLE 9-2

CHEMICALS DETECTED IN SEDIMENT AT AOC B
NAS KEY WEST
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Location	Depth[1]	Source[2]	Parameter	Result	Qual.[3]
ABSS-2	0	B&RE 1996	4,4'-DDT	6.3	
ABSS-5	0	B&RE 1996	4,4'-DDT	5.5	J
ABSS-7	0	B&RE 1996	4,4'-DDT	4.1	J
ABSS-3	0	B&RE 1996	4,4'-DDT	3.9	
ABSS-1	0	B&RE 1996	4,4'-DDT	3.6	J
ABSS-9	0	B&RE 1996	4,4'-DDT	3.3	J
ABSS-10	0	B&RE 1996	4,4'-DDT	3.2	J
ABSS-4	0	B&RE 1996	Aroclor-1254	470	J
ABSS-4	0	B&RE 1996	Aroclor-1260	402	
ABSS-3	0	B&RE 1996	Aroclor-1260	19	J
ABSS-9	0	B&RE 1996	Aroclor-1260	17	J
ABSS-4	0	B&RE 1996	Dieldrin	28.8	J
ABSS-7	0	B&RE 1996	Dieldrin	2.5	J
ABSS-9	0	B&RE 1996	Dieldrin	2.3	J
ABSS-6	0	B&RE 1996	Dieldrin	2.2	J
ABSS-4	0	B&RE 1996	Endosulfan I	19.5	
ABSS-3	0	B&RE 1996	Endosulfan I	6.2	J
ABSS-2	0	B&RE 1996	Endosulfan I	4.9	J
ABSS-8	0	B&RE 1996	Endosulfan I	4.6	
ABSS-9	0	B&RE 1996	Endosulfan I	4.6	J
ABSS-7	0	B&RE 1996	Endosulfan I	3.5	J
ABSS-1	0	B&RE 1996	Endosulfan I	3.1	J
ABSS-5	0	B&RE 1996	Endosulfan I	2.4	
ABSS-9	0	B&RE 1996	Endosulfan sulfate	1.9	J
ABSS-4	0	B&RE 1996	Endrin	32.5	
ABSS-2	0	B&RE 1996	Endrin	1.7	J
ABSS-3	0	B&RE 1996	Endrin	1.5	J
ABSS-7	0	B&RE 1996	Endrin	1.4	J
ABSS-5	0	B&RE 1996	Endrin	1.4	J
ABSS-2	0	B&RE 1996	gamma-BHC (lindane)	8.7	J
ABSS-8	0	B&RE 1996	gamma-BHC (lindane)	1.9	
ABSS-10	0	B&RE 1996	gamma-BHC (lindane)	1.6	J
ABSS-5	0	B&RE 1996	gamma-BHC (lindane)	1.6	
ABSS-1	0	B&RE 1996	gamma-BHC (lindane)	1.2	J
ABSS-4	0	B&RE 1996	Heptachlor	6.9	J
ABSS-3	0	B&RE 1996	Heptachlor	1.3	
ABSS-8	0	B&RE 1996	Heptachlor	1.1	J
ABSS-9	0	B&RE 1996	Heptachlor	1	J
ABSS-1	0	B&RE 1996	Heptachlor	0.85	
ABSS-3	0	B&RE 1996	Heptachlor epoxide	3	
ABSS-8	0	B&RE 1996	Heptachlor epoxide	1.8	J
ABSS-9	0	B&RE 1996	Heptachlor epoxide	1.7	J
ABSS-7	0	B&RE 1996	Heptachlor epoxide	1.7	
ABSS-5	0	B&RE 1996	Heptachlor epoxide	1.3	J
ABSS-1	0	B&RE 1996	Heptachlor epoxide	0.85	J
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
ABSB-2(IT)	0	IT 1993	Phenanthrene	55	

Shading indicates a concentration in excess of the screening values (see Table C.3-2).

1 Depths are in feet and represent top of sampling interval.

2 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
BEI(D) 1995 - Delineation Study (BEI, 1995) conducted in 1995 by BEI
BEI(C) 1995-96 - Confirmation Study (BEI, 1997) conducted in 1995 and 1996 by BEI
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

3 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.
* - Qualifier definition not available.

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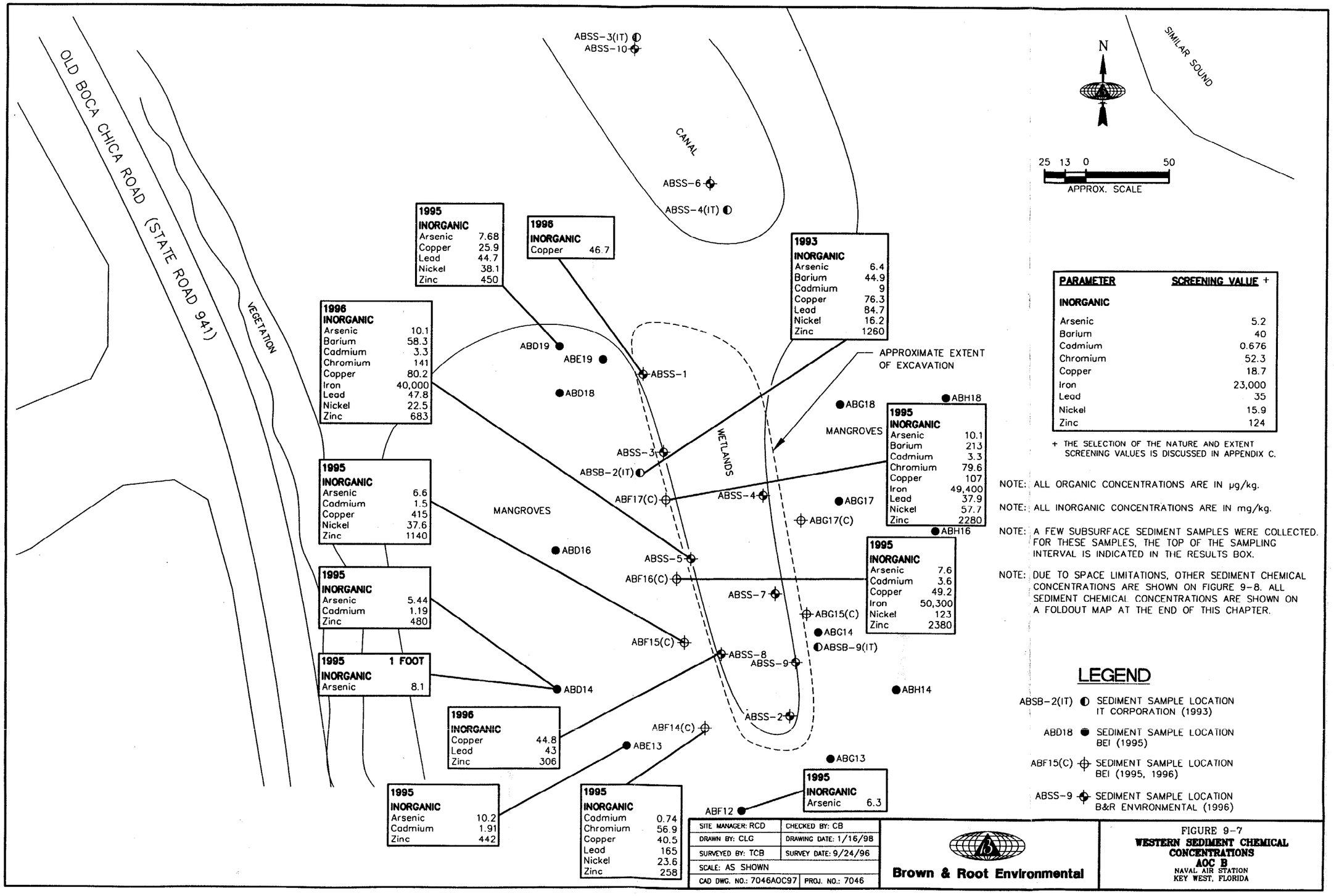
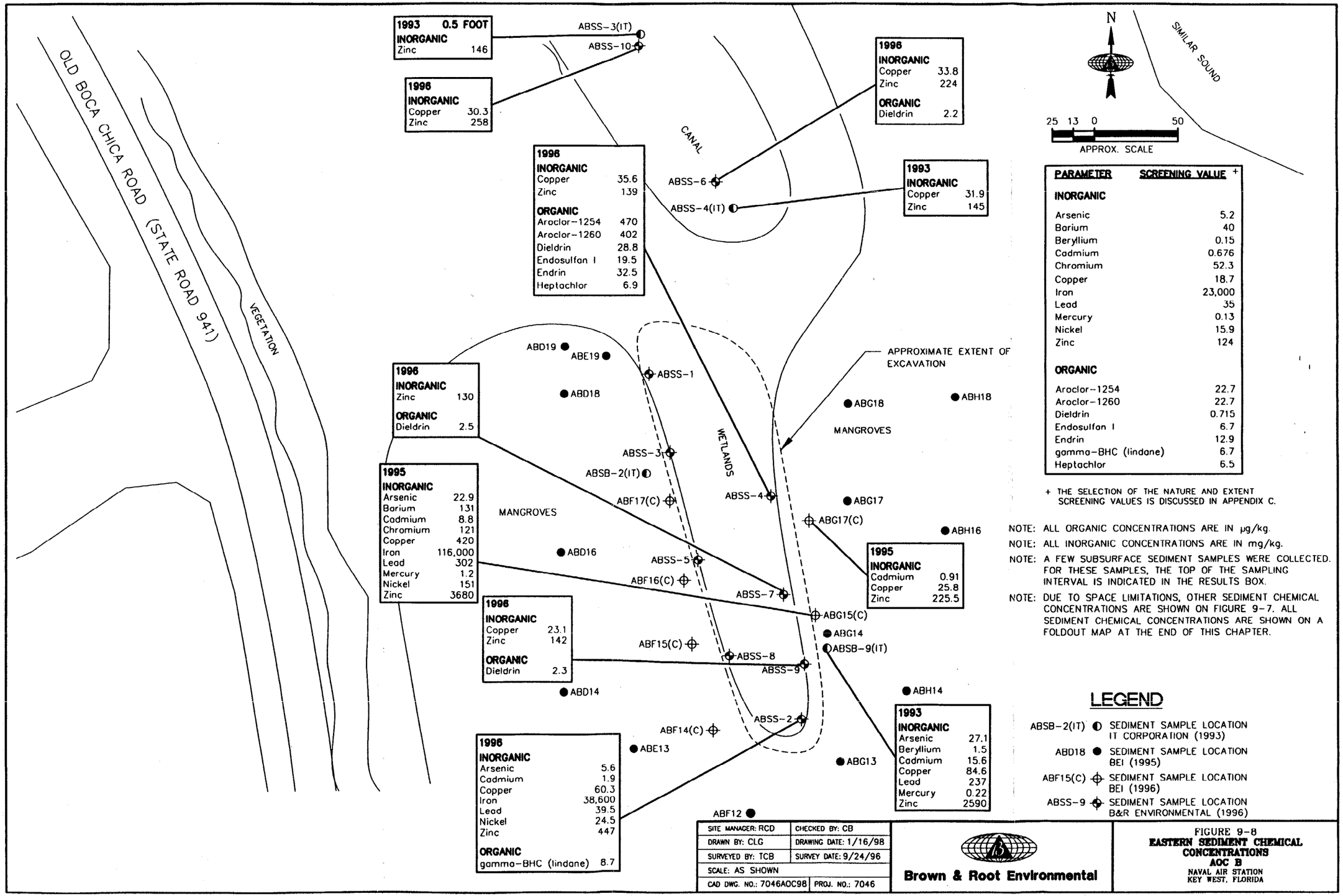


FIGURE 9-7
WESTERN SEDIMENT CHEMICAL CONCENTRATIONS
AOC B
NAVAL AIR STATION
KEY WEST, FLORIDA



PARAMETER	SCREENING VALUE +
INORGANIC	
Arsenic	5.2
Barium	40
Beryllium	0.15
Cadmium	0.676
Chromium	52.3
Copper	18.7
Iron	23,000
Lead	35
Mercury	0.13
Nickel	15.9
Zinc	124
ORGANIC	
Aroclor-1254	22.7
Aroclor-1260	22.7
Dieldrin	0.715
Endosulfan I	6.7
Endrin	12.9
gamma-BHC (lindane)	6.7
Heptachlor	6.5

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg.

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg.

NOTE: A FEW SUBSURFACE SEDIMENT SAMPLES WERE COLLECTED. FOR THESE SAMPLES, THE TOP OF THE SAMPLING INTERVAL IS INDICATED IN THE RESULTS BOX.

NOTE: DUE TO SPACE LIMITATIONS, OTHER SEDIMENT CHEMICAL CONCENTRATIONS ARE SHOWN ON FIGURE 9-7. ALL SEDIMENT CHEMICAL CONCENTRATIONS ARE SHOWN ON A FOLDOUT MAP AT THE END OF THIS CHAPTER.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Phenanthrene was identified as a COPC (Section 9.6.2.2) in the human health risk assessment based on a qualitative evaluation. The phenanthrene concentration in sediment at AOC B was less than the Florida Sediment Quality Assessment Guidelines selected for nature and extent screening.

9.4.2.3 Pesticides

Several pesticides were detected in excess of screening criteria at AOC B. Maximum concentrations for all pesticide compounds detected in excess of screening values were from ABSS-4 on the eastern side of the wetlands area, except for the maximum concentration (and only exceedance) of gamma-BHC (lindane) which was located at ABSS-2 at the southern tip of the wetlands area. Maximum concentrations detected at ABSS-4 included 4,4'-DDD (12.6 µg/kg), 4,4'-DDE (15.7 µg/kg), dieldrin (28.8 µg/kg), endosulfan I (19.5 µg/kg), endrin (32.5 µg/kg), and heptachlor (6.9 µg/kg). ABSS-4 was the only sediment sample in which 4,4'-DDD, 4,4'-DDE, endrin, and heptachlor exceeded their respective screening values, although each was detected at several other locations at lower concentrations. 4,4'-DDE was the most widespread pesticide in sediment at AOC B, detected in all ten samples tested for pesticides. 4,4'-DDD and 4,4'-DDT had the next highest frequency of detection, each occurred in eight of ten samples. Pesticides detected consistently below screening values at AOC B included 4,4'-DDT, endosulfan sulfate, and heptachlor epoxide. Pesticides were tested for only in the ten samples collected by B&R Environmental in 1996.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. 2,4,5-TP (silvex), endosulfan sulfate, and heptachlor epoxide were identified as ecological COPCs (Section 9.7.4.1.2) since no ecological thresholds were available. 4,4'-DDT was selected as an ecological COPC (see Section 9.7.4.1.2) its hazard quotient was greater than one. However, all concentrations of 2,4,5-TP (silvex), 4,4'-DDT, endosulfan sulfate, and heptachlor epoxide in sediment at AOC B were less than selected for nature and extent screening levels. 2,4,5-TP (silvex) and endosulfan sulfate had no nature and extent screening values. Nature and extent screening levels for 4,4'-DDT and heptachlor epoxide were selected based on twice the average background concentration and Residential Soil RBCs, respectively.

9.4.2.4 Polychlorinated Biphenyls

Two PCBs, Aroclor-1254 and Aroclor-1260, were detected in sediment at AOC B. Aroclor-1254 was detected at a single sample location, ABSS-4 (470 µg/kg) and was in excess of its 22.7 µg/kg screening value. Aroclor-1260 was detected in excess of its 22.7 µg/kg screening criteria at the same location (402 µg/kg). It was also detected below its screening value at two sample locations (ABSS-3 and ABSS-9). PCBs were tested only in samples collected by IT Corporation in 1993 and by B&R Environmental in 1996.

9.4.2.5 Inorganics

Inorganic contamination in surface sediment appears fairly widespread at AOC B. Maximum concentrations commonly appeared along the southeastern boundary between the wetlands area and the mangrove swamp at ABSS-9(IT) or ABG15(C). Maximum concentrations detected there in excess of screening criteria included arsenic (27.1 mg/kg), beryllium (1.5 mg/kg), cadmium (15.6 mg/kg), chromium (141 mg/kg), copper (420 mg/kg), iron (116,000 mg/kg), lead (302 mg/kg), mercury (1.2 mg/kg), nickel (151 mg/kg), and zinc (3,680 mg/kg). The maximum concentration of barium (213 mg/kg) was detected at ABF17(C) midway up the western side of the wetlands area. The chemicals most frequently detected in excess of screening values included zinc, at 21 of 37 sample locations; copper, at 18 of 37 sample locations; and arsenic and cadmium, at 12 of 37 sample locations. Other inorganics detected at AOC B included aluminum, antimony, cobalt, manganese, selenium, silver, tin, and vanadium. Aluminum and manganese were the most frequently detected chemicals that were consistently below screening criteria; each was detected in 28 of 37 surface sediment sample locations. Overall, chromium was the most frequently detected inorganic, detected at all 37 samples. Arsenic, barium, chromium, and zinc were detected in 31 of 37 samples. Most inorganics detected in sediment at AOC B were found in six or more samples. Silver and tin were the only exceptions.

Two metals, arsenic and zinc, were detected in excess of screening values in subsurface sediment at AOC B, each at a single sample location. Arsenic exceeded its 5.21 mg/kg screening value at ABD14 (5.44 mg/kg) inside the mangroves to the west of the wetlands area. Zinc was detected in excess of its 124 mg/kg screening criteria at ABSS-3(IT) in the canal. Other metals detected in subsurface sediment samples included aluminum, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, and vanadium. The overall detection frequency was highest for barium and zinc, which were detected at all 11 subsurface sediment sample locations, and aluminum, arsenic, chromium, and manganese, which were each detected in 10 of the 11 subsurface sediment samples.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Antimony and manganese were identified as COPCs (see Section 9.6.2.2) in the human health risk assessment. Antimony and manganese did not exceed their selected nature and extent screening level due to the conservative non-cancer hazard index applied to the EPA RBCs during the risk assessment process. Aluminum and tin were selected as ecological COPCs (see Section 9.7.4.1.2) based on a comparison with twice the average background concentration, because no suitable ecological threshold was available. The selected nature and extent screening values for these compounds were not ecological screening levels, and were higher than twice the average background concentrations.

9.4.3 Surface Water

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI were considered in the analysis of surface-water contamination at AOC B. Chemicals that were detected in surface-water samples are listed in Table 9-3. This table lists analytical results from all applicable historical sampling events, as well as this Supplemental RFI/RI. Figure 9-9 shows the occurrence of analytes that exceeded screening values and indicated possible surface-water contamination. Inorganics were the dominant class of contaminants detected in these samples.

Screening values were obtained from a variety of sources including FDEP SWQSs, EPA Region IV Freshwater and Marine Screening Values, EPA AWQCs for Fresh and Marine Waters, Proposed RCRA ALs, EPA Region III Fresh and Marine BTAG Screening Levels, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-3 contains all values considered, as well as those actually selected for the nature and extent screening of surface-water samples..

9.4.3.1 Volatile Organic Compounds

No VOCs were detected in the surface-water samples at AOC B. VOCs were not tested by B&R Environmental in 1996 sampling as per the approved Sampling and Analysis Plan (ABB, 1995).

TABLE 9-3

CHEMICALS DETECTED IN SURFACE WATER AT AOC B
NAS KEY WEST
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Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
ABSS-1(IT)	IT 1993	Antimony	268	
ABSS-2(IT)	IT 1993	Antimony	217	
ABSS-4(IT)	IT 1993	Antimony	202	
ABSS-3(IT)	IT 1993	Antimony	181	
ABSS-1(IT)	IT 1993	Arsenic	70.3	
ABSS-1(IT)	IT 1993	Barium	116	B_1
ABSW-1	B&RE 1996	Barium	46.1	J
ABSW-5	B&RE 1996	Barium	45.6	J
ABSW-3	B&RE 1996	Barium	41	J
ABSW-7	B&RE 1996	Barium	34.4	J
ABSW-8	B&RE 1996	Barium	34.4	J
ABSW-2	B&RE 1996	Barium	31.5	J
ABSW-9	B&RE 1996	Barium	30.7	J
ABSW-4	B&RE 1996	Barium	27.3	J
ABSS-2(IT)	IT 1993	Barium	24.8	B_1
ABSW-10	B&RE 1996	Barium	11.7	
ABSW-6	B&RE 1996	Barium	10.9	
ABSS-4(IT)	IT 1993	Barium	7	B_1
ABSS-3(IT)	IT 1993	Barium	6.7	B_1
ABSS-1(IT)	IT 1993	Beryllium	1.6	B_1
ABSS-1(IT)	IT 1993	Chromium	115	
ABSW-5	B&RE 1996	Cobalt	2	
ABSS-1(IT)	IT 1993	Copper	72.5	
ABSS-2(IT)	IT 1993	Copper	21.6	B_1
ABSW-6	B&RE 1996	Copper	11.9	J
ABSW-5	B&RE 1996	Copper	11.8	J
ABSW-3	B&RE 1996	Copper	10.3	J
ABSW-1	B&RE 1996	Copper	9.5	J
ABSW-2	B&RE 1996	Copper	9.4	J
ABSW-9	B&RE 1996	Copper	8.5	J
ABSW-4	B&RE 1996	Copper	7.3	J

Location	Source[1]	Parameter	Result	Qual.[2]
ABSW-4	B&RE 1996	Iron	1,970	
ABSW-5	B&RE 1996	Iron	900	
ABSW-1	B&RE 1996	Iron	785	
ABSW-3	B&RE 1996	Iron	381	
ABSW-2	B&RE 1996	Iron	328	
ABSW-8	B&RE 1996	Iron	286	
ABSW-9	B&RE 1996	Iron	279	
ABSW-7	B&RE 1996	Iron	227	
ABSS-1(IT)	IT 1993	Lead	71	
ABSS-2(IT)	IT 1993	Lead	40	
ABSW-3	B&RE 1996	Manganese	48.4	J
ABSW-5	B&RE 1996	Manganese	42.8	J
ABSW-4	B&RE 1996	Manganese	40.3	J
ABSW-7	B&RE 1996	Manganese	38.3	J
ABSW-2	B&RE 1996	Manganese	34.2	J
ABSW-1	B&RE 1996	Manganese	31.6	J
ABSW-9	B&RE 1996	Manganese	16.5	J
ABSW-8	B&RE 1996	Manganese	5.3	J
ABSW-7	B&RE 1996	Mercury	1.5	
ABSW-10	B&RE 1996	Mercury	0.26	
ABSS-2(IT)	IT 1993	Mercury	0.24	
ABSS-1(IT)	IT 1993	Mercury	0.24	
ABSW-6	B&RE 1996	Mercury	0.21	
ABSW-4	B&RE 1996	Mercury	0.16	
ABSS-1(IT)	IT 1993	Nickel	49.6	
ABSW-7	B&RE 1996	Nickel	41.2	
ABSW-1	B&RE 1996	Nickel	5.5	
ABSW-8	B&RE 1996	Thallium	4.7	J
ABSW-6	B&RE 1996	Thallium	4.1	
ABSS-1(IT)	IT 1993	Tin	98.7	B_1
ABSS-1(IT)	IT 1993	Vanadium	66.1	
ABSS-1(IT)	IT 1993	Zinc	1,290	

TABLE 9-3

CHEMICALS DETECTED IN SURFACE WATER AT AOC B
NAS KEY WEST
PAGE 2 OF 2

Location	Source[1]	Parameter	Result	Qual.[2]
ABSS-2(IT)	IT 1993	Zinc	232	
ABSS-3(IT)	IT 1993	Zinc	35.4	
ABSS-4(IT)	IT 1993	Zinc	6.2	B_1
PESTICIDES/PCBs (µg/L)				
ABSW-3	B&RE 1996	2,4,5-TP (silvex)	0.11	
ABSS-1(IT)	IT 1993	Aroclor-1016	2	*
ABSS-1(IT)	IT 1993	Aroclor-1232	2	*
ABSS-1(IT)	IT 1993	Aroclor-1242	2	*
ABSS-1(IT)	IT 1993	Aroclor-1248	2	*

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

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.
* - Sample exhibits alteration of standard Aroclor pattern.

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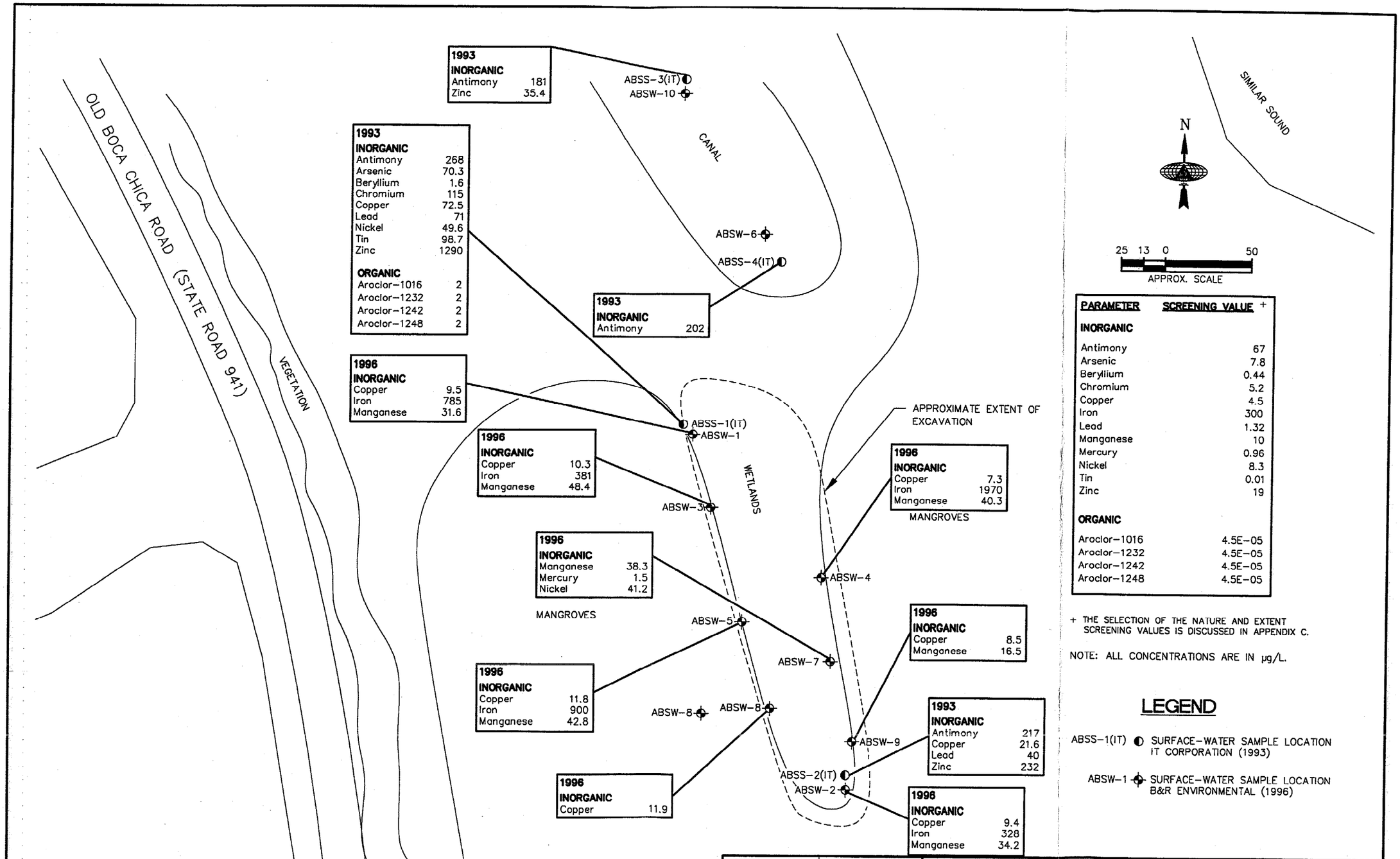

PARAMETER	SCREENING VALUE +
INORGANIC	
Antimony	67
Arsenic	7.8
Beryllium	0.44
Chromium	5.2
Copper	4.5
Iron	300
Lead	1.32
Manganese	10
Mercury	0.96
Nickel	8.3
Tin	0.01
Zinc	19
ORGANIC	
Aroclor-1016	4.5E-05
Aroclor-1232	4.5E-05
Aroclor-1242	4.5E-05
Aroclor-1248	4.5E-05

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL CONCENTRATIONS ARE IN µg/L.

LEGEND

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

ABSW-1 ⊕ SURFACE-WATER SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/24/96
SCALE: AS SHOWN	
CAD DWG. NO.: 7046AOC99	PROJ. NO.: 7046

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FIGURE 9-9
SURFACE-WATER CHEMICAL CONCENTRATIONS AOC B
NAVAL AIR STATION KEY WEST, FLORIDA

9.4.3.2 Semivolatile Organic Compounds

No SVOCs were detected in surface-water samples at AOC B. SVOCs were not tested by B&R Environmental in 1996 sampling as per the approved Sampling and Analysis Plan (ABB, 1995).

9.4.3.3 Pesticides

A single pesticide, 2,4,5-TP (silvex), was detected below its screening value in surface water at AOC B. 2,4,5-TP was detected at a single site, ABSW-3 (0.11 µg/L), in the canal at the northern edge of AOC B. Pesticides analysis was not performed on samples collected by IT Corporation in 1993.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. 2,4,5-TP (silvex) was identified as a COPC (see Section 9.6.2.2) in the human health risk assessment based on quantitative toxicity since they do not have RBCs. 2,4,5-TP (silvex) was also selected as an ecological COPC (see Section 9.7.4.1.2) because no suitable ecological threshold was available. However, the 2,4,5-TP (silvex) had no nature and extent screening.

9.4.3.4 Polychlorinated Biphenyls

Four PCBs were detected in excess of screening values at a single surface-water sample location [ABSS 1 (IT)]. The selected screening value for each of the PCBs was 4.5E-05 µg/L, and Aroclor-1016, Aroclor-1232, Aroclor-1242, and Aroclor-1248 were all detected at 2 µg/L. These PCBs were detected in a single sample collected by IT Corporation in 1993. The sample was qualified as exhibiting "alteration of standard aroclor pattern," since the mixture of PCB congeners detected in the environment had changed from the commercial mixture.

9.4.3.5 Inorganics

At least one inorganic was detected at each surface-water sample location at AOC B, and several were detected in excess of screening values. Maximum concentrations were detected most frequently at ABSS-1(IT), at the northwest edge of the wetlands area, including antimony (268 µg/L), beryllium, (1.6 µg/L), chromium (115 µg/L), copper (72.5 µg/L), lead (71 µg/L), nickel (49.6 µg/L), tin (98.7 µg/L), and zinc (1,290 µg/L). ABSS-1 (IT) was the only location where beryllium, chromium, and tin (which exceeded screening values) were detected, as well as arsenic and vanadium (not in excess of screening values).

The maximum concentration of manganese (48.4µg/L) was detected in an area slightly to the south at ABSW-3. The maximum concentration of mercury (and its only exceedance) was detected on the other side of the wetlands area at ABSW-7 (1.5 µg/L). The maximum concentration of iron (1,970 µg/L) was detected to the north at ABSW-4. Exceedances occurred most frequently for copper (9 of 14 sample locations) and manganese (seven of 14 sample locations). Barium was detected at all 14 sample locations at levels below the screening values. Other metals detected at AOC B include cobalt and thallium. B&R Environmental sampled near each of the four locations where IT Corporation collected surface water in 1993. Inorganics detected by IT Corporation in 1993 generally exhibited reduced concentrations in 1996 or were not detected at all. Mercury was the only exception. Mercury was detected at ABSW-10 in 1996 but was not detected at the neighboring 1993 surface-water sample location, ABSS-3(IT).

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but concentrations fell below the selected nature and extent screening levels. Human health surface-water RBCs were based on water quality standards for the consumption of organisms. Barium, cobalt, and vanadium were identified as COPCs (see Section 9.6.2.2) in the human health risk assessment based on quantitative toxicity since they do not have RBCs. Barium, cobalt, and vanadium concentrations in surface water at AOC B were less than proposed RCRA ALs and Tap Water RBCs selected for nature and extent screening. Cobalt was also selected as an ecological COPC (see Section 9.7.4.1.2) based on comparison with twice the average background concentration, because no suitable ecological threshold was available. However, as mentioned previously, cobalt concentrations did not exceed Tap Water RBCs selected for nature and extent screening which was greater than twice the average background concentration.

9.4.4 Groundwater

Data from two sampling efforts, the 1993 IT Corporation RFI/RI and this Supplemental RFI/RI, were considered in the analysis of contamination in groundwater at AOC B. In 1993, IT Corporation collected groundwater grab samples from two boreholes at AOC B. B&R Environmental installed and sampled three monitoring wells in 1996. Chemicals that were detected in groundwater samples are listed in Table 9-4. This table includes analytical results from all applicable historical sampling events as well as this Supplemental RFI/RI. Figures 9-10 and 9-11 show the occurrence of analytes, by year, that exceeded screening values and indicated possible contamination.

TABLE 9-4

CHEMICALS DETECTED IN GROUNDWATER AT AOC B
NAS KEY WEST

Location	Source[1]	Parameter	Result	Qual.[2]
INORGANICS (µg/L)				
ABSB-3	IT 1993	Antimony	240	
ABSB-10	IT 1993	Antimony	215	
ABSB-3	IT 1993	Arsenic	83.4	
ABSB-10	IT 1993	Arsenic	48.4	
ABSB-3	IT 1993	Barium	201	
ABSB-10	IT 1993	Barium	105	B_1
ABMW-3	B&RE 1996	Barium	32.9	
ABMW-1	B&RE 1996	Barium	32.6	
ABMW-2	B&RE 1996	Barium	18.8	
ABSB-3	IT 1993	Cadmium	6.2	
ABSB-3	IT 1993	Chromium	428	
ABSB-10	IT 1993	Chromium	102	
ABMW-2	B&RE 1996	Chromium	2.2	
ABSB-3	IT 1993	Copper	531	
ABSB-10	IT 1993	Copper	253	
ABMW-1	B&RE 1996	Copper	8.9	
ABSB-3	IT 1993	Lead	309	
ABSB-10	IT 1993	Lead	96.1	
ABMW-1	B&RE 1996	Lead	2.9	
ABSB-10	IT 1993	Mercury	2.4	
ABSB-3	IT 1993	Mercury	0.3	
ABSB-3	IT 1993	Nickel	161	
ABSB-10	IT 1993	Nickel	123	
ABMW-1	B&RE 1996	Nickel	8.6	
ABSB-3	IT 1993	Selenium	11.1	
ABMW-1	B&RE 1996	Thallium	5	
ABSB-3	IT 1993	Tin	121	B_1
ABSB-10	IT 1993	Tin	118	B_1
ABSB-3	IT 1993	Vanadium	23.1	B_1
ABSB-3	IT 1993	Zinc	3,040	
ABSB-10	IT 1993	Zinc	1,090	
PESTICIDES/PCBs (µg/L)				
ABMW-2	B&RE 1996	2,4-D	0.66	J
ABMW-3	B&RE 1996	4,4'-DDD	0.93	
ABMW-3	B&RE 1996	4,4'-DDE	0.65	J
ABMW-3	B&RE 1996	4,4'-DDT	1	
ABMW-1	B&RE 1996	4,4'-DDT	0.062	
ABMW-3	B&RE 1996	Aldrin	0.071	
ABMW-3	B&RE 1996	beta-BHC	0.11	
ABMW-3	B&RE 1996	delta-BHC	0.097	
ABMW-3	B&RE 1996	Dieldrin	0.64	J
ABMW-3	B&RE 1996	Endosulfan I	0.42	
ABMW-3	B&RE 1996	Endosulfan II	0.69	
ABMW-3	B&RE 1996	Endosulfan sulfate	0.7	
ABMW-3	B&RE 1996	Endrin aldehyde	0.59	
ABMW-1	B&RE 1996	Endrin aldehyde	0.05	J
ABMW-3	B&RE 1996	Heptachlor	0.026	J
ABMW-3	B&RE 1996	Heptachlor epoxide	0.43	
ABMW-1	B&RE 1996	Heptachlor epoxide	0.022	J

Shading indicates a concentration in excess of the screening values (see Table C.3-4).

1 Data Sources:
IT 1993 - RFI/RI conducted in 1993 by IT Corporation (1994)
B&RE 1996 - Supplemental RFI/RI conducted in 1996 by B&R Environmental

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.

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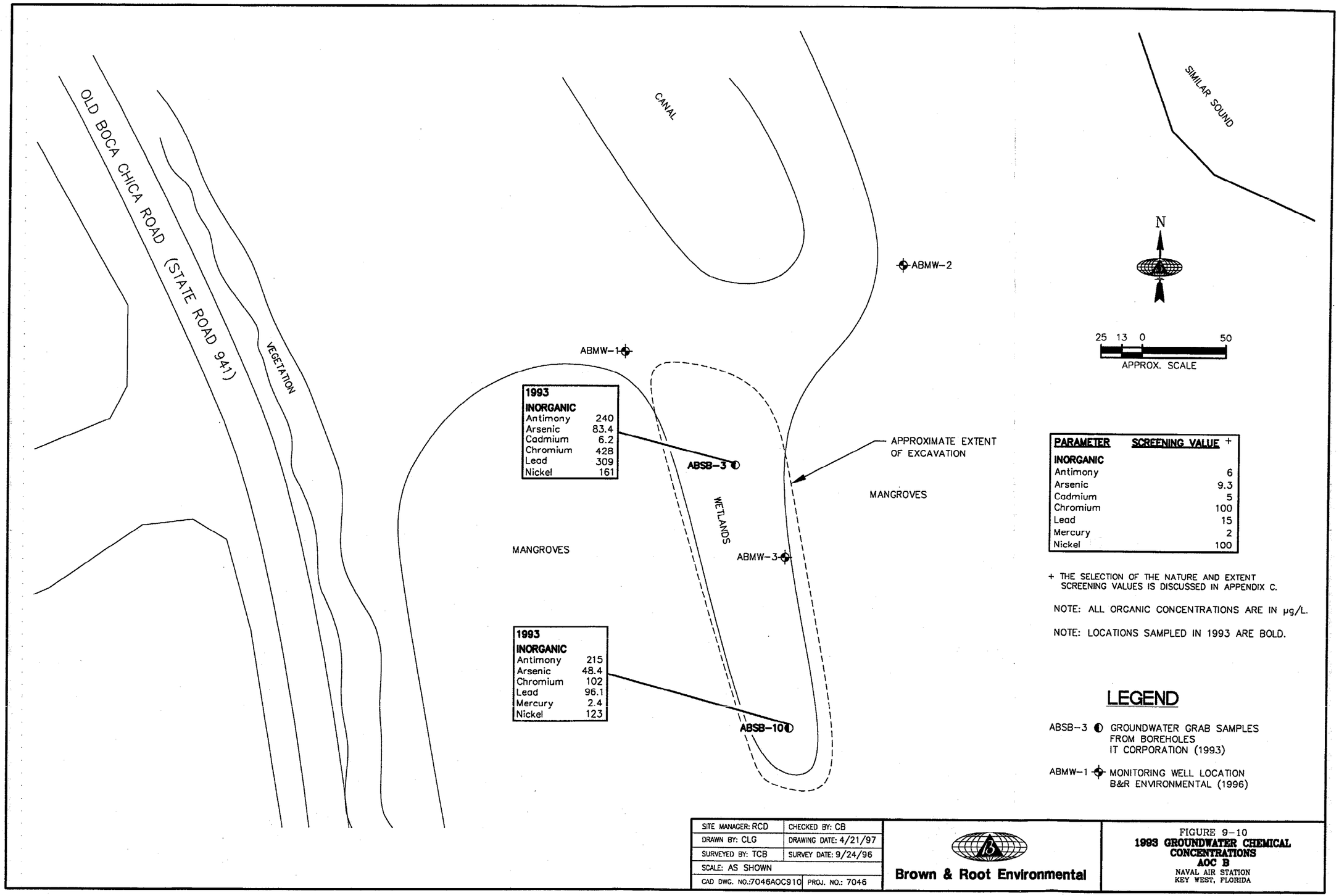
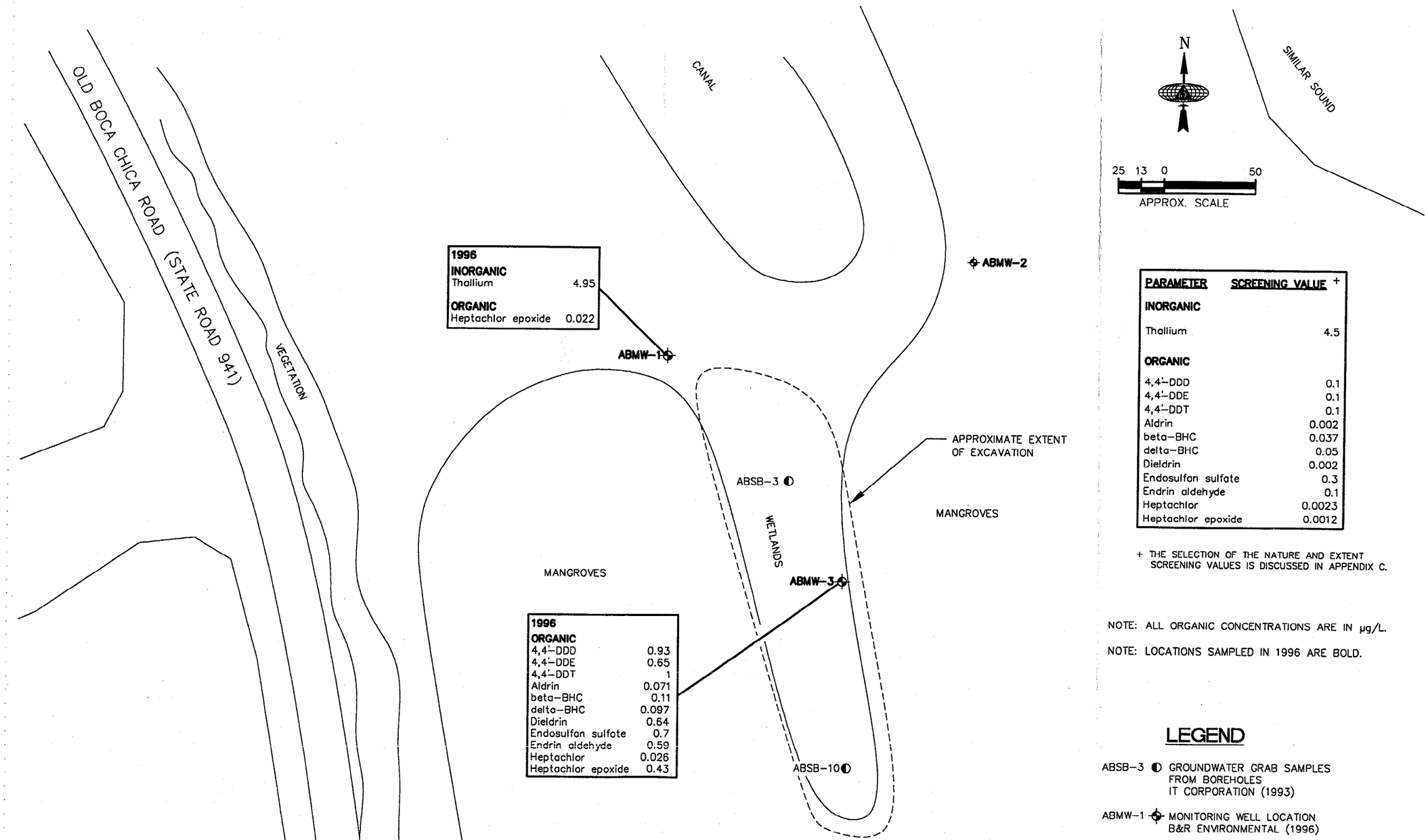

OLD BOCA CHICA ROAD (STATE ROAD 941)
VEGETATION
CANAL
SIMILAR SOUND
N
ABMW-2
ABMW-1
25 13 0 50
APPROX. SCALE
1993
INORGANIC
Antimony 240
Arsenic 83.4
Cadmium 6.2
Chromium 428
Lead 309
Nickel 161
ABSB-3
APPROXIMATE EXTENT OF EXCAVATION
MANGROVES
WETLANDS
ABMW-3
MANGROVES
1993
INORGANIC
Antimony 215
Arsenic 48.4
Chromium 102
Lead 96.1
Mercury 2.4
Nickel 123
ABSB-10
PARAMETER SCREENING VALUE +
INORGANIC
Antimony 6
Arsenic 9.3
Cadmium 5
Chromium 100
Lead 15
Mercury 2
Nickel 100
+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.
NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/L.
NOTE: LOCATIONS SAMPLED IN 1993 ARE BOLD.
LEGEND
ABSB-3 GROUNDWATER GRAB SAMPLES FROM BOREHOLES IT CORPORATION (1993)
ABMW-1 MONITORING WELL LOCATION B&R ENVIRONMENTAL (1996)
SITE MANAGER: RCD
CHECKED BY: CB
DRAWN BY: CLG
DRAWING DATE: 4/21/97
SURVEYED BY: TCB
SURVEY DATE: 9/24/96
SCALE: AS SHOWN
CAD DWG. NO.:7046AOC910
PROJ. NO.: 7046
Brown & Root Environmental
FIGURE 9-10
1993 GROUNDWATER CHEMICAL CONCENTRATIONS
AOC B
NAVAL AIR STATION
KEY WEST, FLORIDA



SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: CLG	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/24/96
SCALE: AS SHOWN	
CAD DWG. NO.:7046AOC911	PROJ. NO.: 7046

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FIGURE 9-11
1996 GROUNDWATER CHEMICAL CONCENTRATIONS AOC B
NAVAL AIR STATION KEY WEST, FLORIDA

Screening values were obtained from a variety of sources including SDWA MCLs, SDWA Secondary MCLs, SDWA MCLGs, FDEP MCLs, FDEP Secondary MCLs, Proposed RCRA ALs, FDEP GCs, Tap Water RBCs, and background levels from the Comprehensive Background Report (Appendix F). The selection process for the nature and extent screening values is described in Appendix C Section 3.1.4.1, and Table C.3-4 contains all values considered, as well as those actually selected for the nature and extent screening of groundwater samples.

9.4.4.1 Volatile Organic Compounds

No VOCs were detected in groundwater samples at AOC B.

9.4.4.2 Semivolatile Organic Compounds

No SVOCs were detected in groundwater samples at AOC B.

9.4.4.3 Pesticides

Several pesticides were detected at AOC B in excess of screening criteria in 1996 samples collected by B&R Environmental. IT Corporation did not test for pesticides in its 1993 sampling. Exceedances were almost exclusively limited to ABMW-3 in the center of the wetlands area. The pesticides detected at ABMW-3 in excess of screening values included 4,4'-DDD (0.93 µg/L), 4,4'-DDE (0.65 µg/L), 4,4'-DDT (1 µg/L), aldrin (0.071 µg/L), beta-BHC (0.11 µg/L), delta-BHC (0.097 µg/L), dieldrin (0.64 µg/L), endosulfan sulfate (0.7 µg/L), endrin aldehyde (0.59 µg/L), heptachlor (0.026 µg/L), and heptachlor epoxide (0.43 µg/L). Heptachlor epoxide also exceeded its screening value at ABMW-1 (0.022 µg/L). This was the only compound to exceed its screening criteria outside ABMW-3. Other pesticides detected at ABMW-1 (to the northwest of the wetlands area) included 4,4'-DDT and endrin aldehyde, both at levels below the screening criteria. 2,4-D was detected at a level below its screening value at ABMW-2 to the east of the canal.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Endosulfan I and endrin aldehyde were selected as ecological COPCs (see Section 9.7.4.2.1) due to hazard quotients greater than one. However, concentrations of endosulfan I and endrin aldehyde were less than the proposed RCRA ALs and Florida Groundwater Guidance Concentrations selected for nature and extent screening.

9.4.4.4 Polychlorinated Biphenyls

No PCBs were detected in groundwater at AOC B.

9.4.4.5 Inorganics

Several inorganics were detected in the groundwater at AOC B. Most concentrations in excess of screening values were detected in the grab samples collected by IT Corporation in 1993. The two IT Corporation grab samples were located within the wetlands area, ABSB-3 to the north and ABSB-10 at the southern end. Antimony, chromium, lead, and nickel were detected in excess of screening values at both IT Corporation sample locations. Arsenic was detected in both samples but exceeded its screening value only at ABSB-3. Mercury was also detected in both grab samples but exceeded its 2 µg/L screening value only at ABSB-10. Other inorganics detected in groundwater samples collected in 1993 by IT Corporation included barium, copper, selenium, tin, vanadium, and zinc. Inorganics detected in 1996 B&R Environmental samples were much more limited. A single inorganic, thallium, was detected in slight excess of its 4.5 µg/L screening criteria at a single 1996 sample location, ABMW-1 (5 µg/L), at the northern edge of the wetlands area. Other inorganics detected in 1996 samples included barium, chromium, copper, lead, and nickel, all at levels below the screening criteria. Generally, inorganic groundwater concentrations decreased between 1993 and 1996. Thallium, not detected in 1993, was the only inorganic parameter which did not follow this trend.

As discussed in Section 3.1.4.1 of Appendix C, there are several unique situations where COPCs may be considered in one or both of the risk assessments, but their concentrations fell below the selected nature and extent screening levels. Copper was selected as an ecological COPC (see Section 9.7.4.2.1) based on a comparison with twice the average background concentrations, because no suitable ecological threshold was available. The selected nature and extent screening values for copper was not an ecological screening level, and was higher than twice the average background concentration.

9.5 FATE AND TRANSPORT

This section describes the behavior of contaminants in the environment at AOC B. Section 9.5.1 presents those chemicals detected in excess of the screening values discussed in the nature and extent sections, along with apparent temporal and spatial trends. Section 9.5.2 addresses potential routes of migration, and Section 9.5.3 addresses the persistence and transport potential of these chemicals. The chemical and physical properties of the detected chemicals impact their relative persistence and transport potential.

Section 3.1.5.1 of Appendix C quantifies the physical and chemical properties of the detected contaminants.

9.5.1 Contaminant Summary and Trends

AOC B encompasses 10 acres and includes a former disposal area that contained discarded car and truck body and frame parts in a horseshoe-shaped area at the southeastern end. The time and method of debris placement is not known. In 1996, BEI conducted an IRA that involved the removal 993 cubic yards of surface soil from the area shown in Figure 9-1 for offsite treatment and disposal. This IRA at AOC B effectively removed most of the discarded car and truck body and frame parts except for debris in the outlying mangrove swamp areas surrounding the excavated horseshoe-shaped area (BEI, 1997).

The soil, sediment, surface-water, and groundwater samples collected at AOC B were mostly from (1) the edge of the excavated area created from the IRA removal of debris and soil, (2) the surrounding mangrove swamp, and (3) the southern portion of the nearby canal. Due to the wet nature of this area, most solid samples collected at AOC B were classified as sediment. Metals and pesticides were the most widespread contaminants detected at AOC B.

Zinc was the only metal present in excess of screening levels in the single soil sample collected at AOC B (see Figure 9-6). The sediment samples from the edges of the wetland area (especially the southeastern portion of the wetland area) and beyond into the surrounding mangrove swamp had 10 metals in excess of nature and extent screening levels as discussed in Section 9.4.2.5. Zinc, copper, arsenic, and cadmium were the most frequent metals detected in the sediment in the mangrove swamp and wetland in excess of nature and extent screening levels. The sediment in the canal also had copper and zinc concentrations in excess of screening levels. In general, the number of metals detected and the concentrations of these metals were highest at the edge of the excavated area and decreased with distance into the surrounding mangrove swamp (although zinc and arsenic were detected in the mangrove swamp in higher concentrations to the west of the wetland area).

Metals present in excess of nature and extent screening levels in surface water at AOC B (for the wetland area and the canal) were similar to the sediment sampling results. Metals present in excess of screening levels in the surface water but not detected in excess of nature and extent screening levels in the sediment included: antimony (canal and wetland area), manganese (wetland area only), and tin (wetland area only). Barium and cadmium were not present in surface water in excess of nature and extent screening levels even though they were present in the sediment at the wetland and mangrove swamp in excess of nature and extent screening levels (see Section 9.4.3.5 for additional details). Finally, antimony,

arsenic, cadmium, chromium, lead, mercury, nickel, and thallium were the only metals found in the groundwater under or near the excavated area in excess of nature and extent screening levels (see Figures 9-10 and 9-11). Thallium was the only metal that was found in excess of nature and extent screening levels exclusively in groundwater and in no other environmental media. It was also the only inorganic detected in excess of nature and extent groundwater screening values in 1996.

Although many pesticides including 4,4'-DDE and dieldrin were found in the groundwater (11 in excess of screening levels) and sediment (7 in excess of screening levels), no pesticides were detected above nature and extent screening levels in surface water. As shown in Figures 9-8 and 9-11, most of the pesticides found in the sediment and groundwater occurred at one isolated location in the east-central portion of the wetland area. Sections 9.4.4.3 and 9.4.2.3 provide a detailed discussion of the pesticides present in sediment and surface water at AOC B.

VOCs and SVOCs were tested only in a limited number of sediment, surface-water, and groundwater samples at AOC B. In the samples tested, phenanthrene was the only SVOC detected and it was below the nature and extent screening value. No VOCs were detected in any media.

PCBs were detected in isolated samples in the sediment and surface water from the wetland area (see Sections 9.4.2.4 and 9.4.3.4 for specific aroclors). In one surface-water sample collected from the western edge of the wetland area [ABSS-1(IT)], PCBs were present in excess of screening values. PCBs were not detected in any other surface-water sample collected. Sediment from one sample collected from the eastern edge of the wetland area [ABSS-4 (IT)] also contained PCBs in excess of the screening value. None of the nearby samples from other media in either of these areas contained PCBs.

9.5.2 Potential Routes of Migration

The contaminant source at AOC B consisted of the debris (e.g., discarded car and truck body and frame parts) and associated soil that was removed from AOC B during the IRA completed in 1996. Debris left in the outlying mangrove swamp and residual sediment contamination (metals, pesticides, and PCBs) in the excavated area remain as potential contamination sources.

The contaminant release pathways from the historic debris area could have included volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in soil could have volatilized from surficial material or become airborne via wind erosion. Contaminated fugitive dust may have been generated during the IRA conducted at AOC B during 1996. The contaminants could then have been dispersed in the surrounding environment and transported to downwind locations where they could

repartition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. In addition, precipitation runoff may have carried contaminants to the nearby mangrove swamp and canal and associated sediments.

However, volatilization, wind erosion, and overland runoff from the disposal area no longer exist to an appreciable degree since the debris disposal area has been excavated. The extensive area of surface water in the surrounding mangrove swamp and the wet nature of the excavated area also serves to minimize the airborne transport of volatile contaminants.

Chemical reactions (e.g., oxidation) of the debris left in the mangrove swamp may contribute to the partitioning of contaminants into associated surface water and sediments. Infiltration of contaminants from surface water and sediments into groundwater is also possible. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. After reaching the water table, contaminants can be carried with the flow of groundwater to downgradient locations. Data from 1996 groundwater sampling indicate that groundwater flow from the former disposal area is toward the canal (see Figure 9-5).

9.5.3 Contaminant Transport Potential and Persistence

Inorganics (i.e., metals), were the predominant parameters detected at AOC B in the soil, sediment, surface water, and groundwater. However, pesticides were also found in excess of nature and extent screening levels in sediment and groundwater, and PCBs were found in isolated locations in the sediment and surface water of the wetland area. Appendix C provides a thorough description of the physical and chemical properties of the contaminants detected at AOC B.

In general, metals are adsorbed onto soil and organic matter, greatly reducing both mobility and potential for transport in the aqueous phase. Geotechnical data collected during the preliminary RI present a relatively high total organic content of 6,100 mg/kg indicating the media's ability to minimize metals migration by adsorption. Although many metals are water-insoluble, (e.g., zinc and copper) the solubility of some species, like arsenic, is heavily influenced by factors such as pH and speciation. The transport of lead in the environment is strongly influenced by the speciation of the ion. Since sorption appears to exert a dominant effect on the distribution of lead in the environment, lead is strongly complexed to organic materials in soil (Clement Associates, 1985). Although sorption tends to reduce the mobility of inorganics in the subsurface, strong associations with soil particles may increase the persistence of inorganic contamination. Contaminants that persist in the solid media may also continue to be present in

groundwater due to contact with the solid media; however, as long as environmental factors that affect sorption and solubility (like pH) remain unchanged, aqueous concentrations would remain low.

Pesticides were also detected in isolated areas of sediment and groundwater at AOC B (e.g., 4,4'-DDE and dieldrin). The pesticides are not expected to migrate significantly due to (1) the relatively low solubility of pesticides in water, (2) low vapor pressures, (3) low Henry's Law constants, and especially, (4) soil and sediment/water partition coefficients that strongly favor soil and sediment sorption. As shown in Appendix C, pesticides are some of the most immobile and persistent of environmental organic contaminants. For example, the half-lives for the biodegradation in groundwater of 4,4'-DDE (i.e., for groundwater under anaerobic conditions) can be as long as 31 years while the half-life for dieldrin could be 6 years (Howard et. al., 1991).

For the same reasons as pesticides, PCBs are also some of the most immobile and persistent of environmental organic contaminants. However, in the environment, the composition of PCBs may differ from commercial mixtures (e.g., Aroclor-1016, -1232, -1260, etc.). This difference occurs because after release into the environment, the composition of PCB mixtures change over time, through partitioning and chemical transformation, and preferential bioaccumulation (EPA, 1996b). The efficiency of these mechanisms often depends on the chlorine content of the PCB mixture or congener. Of the PCB mixtures detected in excess of screening levels, Aroclor-1260 is the most highly chlorinated with an average chlorine content of 60 percent. Aroclor-1016 has approximately 41 percent chlorine while Aroclor-1232 has the lowest average chlorine content of 32 percent.

Partitioning in the environment of PCB congeners would be by adsorption of PCBs to organic materials, sediments, and soils. This behavior tends to increase with chlorine content of the PCBs and organic content of the other material. Volatilization and solubility of the lower chlorinated congeners (e.g., the PCB congeners present in Aroclor-1232) would occur while limited volatilization and solubility of the higher chlorinated congeners would take place (e.g., the PCB congeners present in Aroclor-1260). During biodegradation of PCBs, anerobic bacteria in sediments selectively remove chlorines from meta and para positions of the PCB congener appearing to reduce the toxicity and bioaccumulation potential of residues. Aerobic bacteria break open the carbon rings through oxidation and also remove chlorines; however, aerobic biodegradation occurs mostly with PCBs containing lower percentages of chlorine (e.g., PCB congeners found in Aroclor-1016 and Aroclor-1232 and other congeners that typically contain 1 to 4 chlorines). Photolysis can also slowly break down congeners with high chlorine content.

Because PCB detections were isolated and in the low range, these chemicals do not have a significant potential for contaminant migration at AOC B.

The IRA completed at AOC B in 1996 removed most of the contaminant source (i.e., debris and associated contaminated soil) for proper offsite treatment and disposal. It appears this IRA was effective in reducing inorganic groundwater contamination (i.e., by metals) between 1993 and 1996 (only thallium was detected in excess of screening levels in groundwater in 1996). The pesticide contamination of groundwater that was detected for the first time in 1996 was detected at levels that are consistent with historic non-point uses in the vicinity of AOC B.

9.6 BASELINE HUMAN HEALTH RISK ASSESSMENT - AOC B

This section presents the baseline human health risk assessment for AOC B. It describes a qualitative and quantitative assessment of actual or potential risks for AOC B. It also includes the preliminary risk evaluation, data evaluation, toxicity assessment, exposure assessment, risk characterization, and RGOs. The methodologies and techniques used in the assessment are outlined in Section 3.2 of Appendix C. Conclusions about the baseline human health risk assessment are presented in Section 9.1.6.8.

9.6.1 Preliminary Risk Evaluation

A PRE was conducted to determine if a baseline human health risk assessment was required. The PRE entails a risk screening process whereby ratios of the maximum media concentration as compared to their respective screening values are derived (EPA, 1994b). If the risk ratio for carcinogens is greater than 1E-04 or the risk ratio for noncarcinogenic chemicals is greater than 1.0, the site will require further evaluation. Appendix C, Section 3.2.1 contains the methods used for preliminary risk assessment analysis.

Tables 9-5 and 9-6 summarize the PRE for AOC B for carcinogenic risks and noncarcinogenic risks, respectively. The risk ratios calculated for the industrial land use scenario are less than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. However, the risk ratios calculated for the residential land use scenario are greater than 1E-04 and 1.0 for carcinogenic and noncarcinogenic effects, respectively. Therefore, a baseline human health risk assessment is necessary for AOC B. The primary contributor to carcinogenic risk in arsenic and beryllium in sediment and surface water. The primary contributors to noncarcinogenic risk in sediment are antimony, arsenic, cadmium, chromium VI, copper, iron, manganese, zinc, and Aroclor-1016. In surface water contributors to noncarcinogenic risk are antimony, chromium VI, iron, mercury, thallium, zinc, and Aroclor-1016.

TABLE 9-5

PRELIMINARY RISK EVALUATION - CARCINOGENIC EFFECTS
AOC B
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Arsenic	0.73	27.1	70.3	0.43	0.43	0.045	3.8	2E-06	6E-05	2E-03	2E-07
Beryllium	ND	1.5	1.6	0.15	0.15	0.016	1.3	NA	1E-05	1E-04	NA
PESTICIDES/PCBs											
4,4'-DDD	ND	12.6	ND	2,700	2,700	0.28	24,000	NA	5E-09	NA	NA
4,4'-DDE	ND	15.7	ND	1,900	1,900	0.2	17,000	NA	8E-09	NA	NA
4,4'-DDT	ND	6.4	ND	1,900	1,900	0.2	17,000	NA	3E-09	NA	NA
Aroclor-1016	ND	ND	2	319	319	0.0335	2,860	NA	NA	6E-05	NA
Aroclor-1232	ND	ND	2	319	319	0.0335	2,860	NA	NA	6E-05	NA
Aroclor-1242	ND	ND	2	319	319	0.0335	2,860	NA	NA	6E-05	NA
Aroclor-1248	ND	ND	2	319	319	0.0335	2,860	NA	NA	6E-05	NA
Aroclor-1254	ND	470	ND	319	319	0.0335	2,860	NA	2E-06	NA	NA
Aroclor-1260	ND	402	ND	319	319	0.0335	2,860	NA	1E-06	NA	NA
Dieldrin	ND	28.8	ND	40	40	0.0042	360	NA	7E-07	NA	NA
gamma-BHC (lindane)	ND	8.7	ND	490	490	0.052	4,400	NA	2E-08	NA	NA
Heptachlor	ND	6.9	ND	140	140	0.0023	1,300	NA	5E-08	NA	NA
Heptachlor Epoxide	ND	3	ND	70	70	0.0012	630	NA	4E-08	NA	NA
							Risk Sums by Medium	**2E-06**	**7E-05**	**2E-03**	**2E-07**
							Risk Sums by Use Scenario	**2E-03**			**2E-07**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and pesticide/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

TABLE 9-6

PRELIMINARY RISK EVALUATION - NONCARCINOGENIC EFFECTS
AOC B
NAS KEY WEST

Chemical*	Media Concentration (Maximum Detected Value)			Screening Values				Risk Ratio			
				Residential			Industrial	Residential			Industrial
	Soil	Sediment	Surface Water	Soil	Sediment	Surface Water	Soil	Soil	Sediment	Surface Water	Soil
INORGANICS											
Aluminum	677	5,470	ND	78,000	78,000	37,000	1,000,000	9E-02	7E-01	NA	7E-03
Antimony	ND	11.2	268	31	31	15	820	NA	4E+00	2E+02	NA
Arsenic	0.73	27.1	70.3	23	23	11	610	3E-01	1E+01	6E+01	1E-02
Barium	16.8	213	116	5,500	5,500	2,600	140,000	3E-02	4E-01	5E-01	1E-03
Beryllium	ND	1.5	1.6	390	390	180	1,000	NA	4E-02	9E-02	NA
Cadmium	ND	15.6	ND	39	39	18	1,000	NA	4E+00	NA	NA
Chromium VI	4.1	141	115	390	390	180	10,000	1E-01	4E+00	6E+00	4E-03
Cobalt	1.3	9.7	2	4,700	4,700	2,200	120,000	3E-03	2E-02	9E-03	1E-04
Copper	11.9	420	72.5	3,100	3,100	1,500	82,000	4E-02	1E+00	5E-01	2E-03
Iron	2,000	116,000	1,970	23,000	23,000	11,000	610,000	9E-01	5E+01	2E+00	3E-02
Manganese	11.7	388	48.4	1800	1800	840	47,000	7E-02	2E+00	6E-01	3E-03
Mercury	ND	1.2	1.5	23	23	11	610	NA	5E-01	1E+00	NA
Nickel	2.18	151	49.6	1,600	1,600	730	41,000	1E-03	9E-01	7E-01	5E-04
Selenium	ND	1.3	ND	390	390	180	10,000	NA	3E-02	NA	NA
Silver	ND	0.7	ND	390	390	180	10,000	NA	2E-02	NA	NA
Thallium	ND	ND	4.7	6.3	6.3	2.9	160	NA	NA	2E+01	NA
Tin	ND	12.2	98.7	47,000	47,000	22,000	1,000,000	NA	3E-03	5E-02	NA
Vanadium	ND	40.5	66.1	550	550	2,600	14,000	NA	7E-01	3E-01	NA
Zinc	61.8	3,680	1,290	23,000	23,000	11,000	610,000	3E-02	2E+00	1E+00	1E-03
PESTICIDES/PCBs											
2,4,5-TP (silvex)	ND	5.2	0.11	780,000	780,000	370	20,000,000	NA	7E-05	3E-03	NA
4,4'-DDT	ND	6.4	ND	39,000	39,000	18	1,000,000	NA	2E-03	NA	NA
Aroclor-1016	ND	ND	2	5,500	5,500	2.6	140,000	NA	NA	8E+00	NA
Aroclor-1254	ND	470	ND	1,600	1,600	0.73	41,000	NA	3E+00	NA	NA
Dieldrin	ND	28.8	ND	3,900	3,900	1.8	100,000	NA	7E-02	NA	NA
Endosulfan I	ND	19.5	ND	470,000	470,000	220	12,000,000	NA	4E-04	NA	NA
Endosulfan sulfate	ND	1.9	ND	47,0000	470,000	220	12,000,000	NA	4E-05	NA	NA
Endrin	ND	32.5	ND	23,000	23,000	11	610,000	NA	1E-02	NA	NA
gamma-BHC (lindane)	ND	8.7	ND	39,000	39,000	180	610,000	NA	4E-03	NA	NA
Heptachlor	ND	6.9	ND	39,000	39,000	18	1,000,000	NA	2E-03	NA	NA
Heptachlor epoxide	ND	3	ND	1,000	1,000	0.47	27,000	NA	3E-02	NA	NA
							Hazard Sums by Medium	**2E+00**	**8E+01**	**3E+02**	**6E-02**
							Hazard Sums by Use Scenario	**4E+02**			**6E-02**

*All soil and sediment metal concentrations are in mg/kg; all soil and sediment VOC, SVOC, and Pesticides/PCB concentrations are in µg/kg; and all water site data are in µg/L.
ND = Not detected.
NA = Not applicable.

9.6.2 Data Evaluation

A list of the COPCs was developed for each environmental medium, as necessary. The COPCs were selected in accordance with the protocol established in the workplan (ABB, 1995). Only those chemicals found to be of potential concern were considered for evaluation in the quantitative risk assessment. A discussion of those chemicals identified as COPCs for each medium is provided in this section.

9.6.2.1 Soils

Several metals were detected in the surface soil sample collected at AOC B. The occurrence and distribution of chemicals in surface soils are presented in Table 9-7. Summary statistics, COPC selection results, and representative concentrations for chemicals detected in AOC B soils are also presented in this table. The following chemicals were selected as COPCs at AOC B for surface and subsurface soils:

SURFACE SOILS		SUBSURFACE SOILS	
Inorganics	Organics	Inorganics	Organics
None Selected	None Sampled	None Sampled	None Sampled

Inorganic chemicals in surface soils were detected at levels below RBCs developed for the residential land use scenario. Therefore, no inorganic COPCs were selected from surface soils. Organic chemicals were not analyzed for in surface soil samples.

9.6.2.2 Sediment and Surface Water

Several pesticides, PCBs, and metals were detected in one or more of the sediment samples collected at AOC B. Four Aroclors, 2,4,5-TP (Silvex), and several metals were detected in one surface-water sample collected at AOC B. The occurrence and distribution of chemicals in sediment and surface water are presented in Tables 9-8 through 9-11. Summary statistics, COPC selection results, and representative

TABLE 9-7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE SOILS AT AOC B (mg/kg) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	14/14	120 - 4,250	1,887	1/1	677 - 677	677	677	7,800	677	N	A
Arsenic	6/15	0.63 - 2.7	1.29	1/1	0.727 - 0.73	0.727	0.727	0.43	0.727	N	G
Barium	15/15	4.4 - 17.7	10.51	1/1	16.8 - 16.8	16.8	16.8	550	16.8	N	A
Chromium**	15/15	1.9 - 15.5	6.02	1/1	4.12 - 4.12	4.12	4.12	39	4.12	N	A
Cobalt	7/15	0.22 - 0.51	0.29	1/1	1.32 - 1.32	1.32	1.32	470	1.32	N	A
Copper	14/15	1.3 - 15.6	5.43	1/1	11.9 - 11.9	11.9	11.9	310	11.9	N	A
Iron	14/14	98.1 - 2,260	1,167	1/1	2,000 - 2,000	2,000	2,000	2,300	2,000	N	A
Manganese	14/14	2.6 - 33.7	17.65	1/1	11.7 - 11.7	11.7	11.7	180	11.7	N	A
Nickel	11/15	0.63 - 4.1	1.67	1/1	2.18 - 2.18	2.18	2.18	160	2.18	N	A
Zinc	12/15	0.63 - 89.1	15.22	1/1	61.8 - 61.8	61.8	61.8	2,300	61.8	N	A

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

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, incidental soil 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 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

G - Not COPC (Max>RBC & Max<2XBkgdAvg)

**As Chromium VI

TABLE 9-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
INORGANICS IN SEDIMENT AT AOC B (mg/kg)
NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
Aluminum	12/12	97.7 - 3,350	1,332	38/38	1,090 - 5,470	3,174	3,174	7,800	3,610	N	A
Antimony	0/13	Not detected	–	6/42	0.5 - 11.2	3.2	4.21	3.1	8.98	Y	C
Arsenic	8/12	1.5 - 7	2.63	42/42	0.856 - 27.1	4.97	4.97	0.43	6.36	Y	C
Barium	13/13	5. - 15.2	9.27	42/42	5.4 - 213	22.83	22.83	550	24.9	N	A
Beryllium	1/13	0.12 - 0.12	0.06	7/42	0.07 - 1.5	0.29	0.23	0.15	0.368	Y	C
Cadmium	3/13	0.06 - 0.9	0.22	13/42	0.58 - 15.6	4.03	1.61	3.9	2.04	Y	C
Chromium**	8/13	2.1 - 11.7	5.01	41/42	3.25 - 141	19.41	19.00	39	22.6	Y	C
Cobalt	2/13	0.12 - 0.56	0.47	35/42	0.43 - 9.7	2.98	2.90	470	4.42	N	A
Copper	13/13	0.76 - 34.6	8.88	28/42	1.99 - 420	61.52	41.51	310	123	Y	C
Iron	12/12	109. - 3,640	1,199	38/38	824 - 116,000	11,496	11,496	2,300	16,400	Y	C
Lead	12/13	5.5 - 56.5	17.97	21/42	7.7 - 302	60	34.52	400	42.1	N	A
Manganese	12/12	4 - 38.6	15.39	38/38	8.75 - 388	50.26	50.26	180	63.1	Y	C
Mercury	4/13	0.04 - 0.07	0.05	15/42	0.02 - 1.2	0.14	0.10	2.3	0.111	N	A
Nickel	10/13	0.7 - 5.5	2.15	31/42	2.64 - 151	20.85	15.97	160	22.2	N	A
Selenium	2/13	0.24 - 0.59	0.68	6/42	0.53 - 1.3	0.87	38.20	39	1.3	N	A
Silver	1/13	0.5 - 0.5	0.27	2/42	0.46 - 0.7	0.58	0.79	39	0.7	N	A
Tin	1/2	0.99 - 0.99	2.85	1/4	12.2 - 12.2	12.2	8.29	4,700	12.2	N	A
Vanadium	13/13	1.6 - 11.7	5.08	22/42	1.4 - 40.5	9.87	5.47	55	12.8	N	A
Zinc	8/13	3.5 - 140	25.74	42/42	2.19 - 3,680	440.26	440.26	2,300	2,110	Y	C

Notes:

Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Sediment RBCs are adapted using residential soil RBC.

An RBC for lead based on cancer risk or hazard index is not available. The 400 mg/kg OSWER residential soil guideline is used as an RBC for soil ingestion.

*A - Not COPC (Max<RBC)

C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)

**As Chromium VI

TABLE 9-9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
ORGANICS IN SEDIMENT AT AOC B (µg/kg)
NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
PESTICIDES/PCBs											
2,4,5-TP (silvex)	0/10	Not detected	–	1/10	5.2 - 5.2	5.2	4.46	63,000	5.2	N	A
4,4'-DDD	1/12	3.9 - 3.9	13.03	8/8	2.2 - 12.6	4.34	4.34	2,700	7.59	N	A
4,4'-DDE	5/12	2.2 - 149	19.85	10/10	1.7 - 15.7	4.53	4.53	1,900	7.2	N	A
4,4'-DDT	1/12	3.7 - 3.7	13.02	8/8	3.2 - 6.4	4.54	4.54	1,900	5.67	N	A
Aroclor-1254	0/9	Not detected	–	1/12	470 - 470	470	56.22	320	448	Y	B
Aroclor-1260	1/15	40.8 - 40.8	70.57	3/12	17 - 402	146	53.02	320	328	Y	B
Dieldrin	0/12	Not detected	–	4/9	2.2 - 28.8	8.95	4.63	40	12.3	N	A
Endosulfan I	3/12	1.2 - 2.7	6.7	8/8	2.4 - 19.5	6.1	6.10	47,000	11.1	N	A
Endosulfan sulfate	0/9	Not detected	–	1/8	1.9 - 1.9	1.9	2.30	47,000	1.9	N	A
Endrin	1/12	1.4 - 1.4	12.89	5/8	1.4 - 32.5	7.7	5.24	2,300	19.6	N	A
gamma-BHC (lindane)	4/12	1.2 - 2.1	6.72	5/6	1.2 - 8.7	3.0	3.31	490	8.7	N	A
Heptachlor	2/12	1.1 - 1.3	6.51	5/8	0.85 - 6.9	2.23	1.60	140	3.91	N	A
Heptachlor epoxide	0/9	Not detected	–	6/8	0.85 - 3	1.73	1.96	70	3	N	A
SEMIVOLATILE ORGANIC COMPOUNDS											
Phenanthrene	0/13	Not detected	–	1/4	55 - 55	55	137.50		55	Y	F

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

Sediment RBCs are adapted using residential soil RBC

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

*A - Not COPC (Max<RBC)

B - COPC (Max>RBC, organics)

F - COPC (eval. qual.)

TABLE 9-10

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN SURFACE WATER AT AOC B (µg/L) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site Range of Positive Detection	Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
Antimony	4/13	3.5 - 205	33.71	4/14	181 - 268	217	63.51	14	268	Y	C
Arsenic	3/13	2.6 - 5.2	3.97	1/14	70.3 - 70.3	70.3	7.66	0.018	11.9	Y	C
Barium	11/13	4.7 - 16.3	6.93	14/14	6.7 - 116	33.44	33.44	–	60.3	Y	H
Beryllium	2/13	0.17 - 0.26	0.22	1/14	1.6 - 1.6	1.6	0.29	0.0077	0.533	Y	C
Chromium**	1/13	16.4 - 16.4	2.62	1/14	115 - 115	115	10.12	170	17.1	N	A
Cobalt	0/13	Not detected	–	1/14	2 - 2	2	3.64	–	2	Y	H
Copper	1/13	2 - 2	2.26	9/14	7.3 - 72.5	18.09	12.95	1,300	24.3	N	A
Iron	5/12	8.5 - 170	24.7	8/10	227 - 1,970	644.5	516	–	1,970	Y	H
Lead	0/12	Not detected	–	2/14	40 - 71	55.5	11.37	50	24.4	Y	C
Manganese	2/12	3.2 - 12.3	2	8/10	5.3 - 48.4	32.18	25.94	–	48.4	Y	H
Mercury	6/13	0.29 - 4.2	0.52	6/14	0.16 - 1.5	0.44	0.22	0.14	0.427	Y	C
Nickel	0/13	Not detected	–	3/14	5.5 - 49.6	32.10	10.16	610	25.6	N	A
Thallium	2/13	7.4 - 12	4.73	2/14	4.1 - 4.7	4.4	4.63	1.7	4.7	N	G
Tin	0/4	Not detected	–	1/4	98.7 - 98.7	98.7	35.93	–	98.7	Y	H
Vanadium	2/13	2 - 2.8	1.99	1/14	66.1 - 66.1	66.1	6.51	–	11.9	Y	H
Zinc	5/13	1.4 - 39.6	7.19	4/14	6.2 - 1,290	391	112.40	–	1,290	Y	H

Notes:
Metals are selected as COPCs if maximum values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg)
RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.
Surface water RBCs are adapted using Water Quality Standards (WQS) for consumption of water and organisms.

*A - Not COPC (Max<RBC)
C - COPC (Max>RBC & Max>2XBkgdAvg, inorganics)
G - Not COPC (Max>RBC & Max<2XBkgdAvg)
H - COPC (lacks an RBC, but has a quantitative toxicity)
**As Chromium VI

TABLE 9-11

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENICAL CONCERN ORGANICS IN SURFACE WATER AT AOC B (µg/L) NAS KEY WEST

Chemical	Background		Average	Site		Average of Detected Values	Average of all Values	Applicable Risk-Based Concentration	Representative Concentration for Site Data	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection		Frequency of Detection	Range of Positive Detection						
PESTICIDES/PCBs											
2,4,5-TP (silvex)	0/8	Not detected	–	1/10	0.11 - 0.11	0.11	0.06	–	0.0661	Y	H
Aroclor-1016	0/13	Not detected	–	1/14	2 - 2	2	0.26	0.000044	0.477	Y	B
Aroclor-1232	0/13	Not detected	–	1/14	2 - 2	2	0.26	0.000044	0.477	Y	B
Aroclor-1242	0/13	Not detected	–	1/14	2 - 2	2	0.26	0.000044	0.477	Y	B
Aroclor-1248	0/12	Not detected	–	1/14	2 - 2	2	0.26	0.000044	0.477	Y	B

Notes:

Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).

RBCs represent concentrations associated with a 10E-06 cancer risk level or a non-cancer hazard index of 0.1.

Surface-water RBCs are adapted using Water Quality Standards (WQSs) for consumption of water and organisms.

B - COPC (Max>RBC, organics)

H - COPC (lacks an RBC, but has a quantitative toxicity)

concentrations for chemicals detected in AOC B sediment and surface water are also presented in these tables. The following chemicals were selected as COPCs for AOC B sediment and surface water:

SEDIMENT		SURFACE WATER		
Inorganics	Organics	Inorganics		Organics
Antimony	Aroclor-1254	Antimony	Tin**	Aroclor-1016
Arsenic	Aroclor-1260	Arsenic	Vanadium**	Aroclor-1232
Beryllium	Phenanthrene*	Beryllium	Zinc**	Aroclor-1242
Cadmium		Lead*		Aroclor-1248
Chromium		Mercury		2,4,5-TP (silvex)**
Copper		Barium**		
Iron		Cobalt**		
Manganese		Iron**		
Zinc		Manganese**		

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section. No WQSs (for consumption of water and organisms) are listed for those chemicals identified with two asterisks (**); however, quantitative toxicity values are available for these chemicals and they will be evaluated quantitatively under the surface-water exposure pathway.

Metals selected as COPCs for sediment at AOC B were detected in 50 percent or more of the samples except antimony and beryllium. Antimony and beryllium were detected in approximately 15 percent of the sediment samples analyzed. Maximum and representative concentrations of these metals exceeded RBCs for residential soil exposure. Two PCBs [Aroclor-1254 and Aroclor-1260] were the only organics detected at maximum concentrations exceeding RBCs for residential soil exposure. Phenanthrene will be evaluated qualitatively in the uncertainty section because it lacks a qualitative toxicity value. Soil RBCs are used because RBCs protective of human health for sediment exposure are not currently published by EPA. Sediment exposures are significantly less than soil exposures; therefore, using residential soil RBCs for sediment ingestion is very conservative regarding protection of human health.

The metals selected as COPCs for surface water (antimony, arsenic, beryllium, lead, and manganese) were detected in less than 50 percent of the surface-water samples analyzed. These chemicals were detected at a maximum concentration that exceeded an applicable WQS. WQSs were used as a point of comparison because RBCs for typical surface-water exposure (i.e., recreational exposures) are not currently published by EPA. It should be noted that surface-water exposure (recreational) is significantly less than the exposure that provides the basis for developing an applicable WQS. Therefore, the use of WQSs as RBCs to select surface-water COPCs is conservative regarding protection of human health.

No surface-water RBC for lead based on a cancer risk or HI is available. Therefore, the EPA (1996a) drinking water action level of 15 µg/L was used to represent the surface-water RBC. Consequently, lead will be evaluated qualitatively in the uncertainty section. Barium, cobalt, iron, manganese, tin, vanadium, zinc, and 2,4,5-TP (silvex) were also selected as COPCs for surface water at AOC B. These chemicals did not have listed WQSs, but they do have available quantitative toxicity values. Therefore, to be conservative regarding protection of human health, these chemicals were included as COPCs and evaluated quantitatively under the surface-water exposure pathway scenario.

9.6.2.3 Shellfish Tissue

Several pesticides and several metals were detected in one or more of the blue crab tissue samples collected at AOC B. The occurrence and distribution of chemicals in crab tissue is presented in Tables 9-12 through 9-13. Summary statistics and COPC selection results for chemicals detected in AOC B crab tissue samples are also presented in these tables. The following chemicals were selected as COPCs for AOC B crab tissue:

CRAB TISSUE

Inorganics	Organics
Manganese	Aldrin
Lead*	Alpha-BHC
	Chlorobenzilate
	Dieldrin
	Heptachlor Epoxide

No quantitative toxicity values are listed for those chemicals identified with an asterisk (*); therefore, they will be evaluated qualitatively in the uncertainty section.

Manganese was selected as a COPC for crab tissue at AOC B. It was detected in all eight samples at a range of 2.1 mg/kg to 10.9 mg/kg. Aldrin, alpha-BHC, chlorobenzilate, dieldrin, and heptachlor epoxide were selected as COPCs for crab tissue at AOC B. They were detected in greater than fifty percent of the eitght crab samples collected with the exception of alpha-BHC, which was only detected in one crab tissue sample. Maximum and average concentrations for chlorobenzilate exceeded its fish RBC. Chemicals that lack toxicity criteria (i.e. lead) will be evaluated qualitatively in the uncertainty section.

TABLE 9-12

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN INORGANICS IN CRAB TISSUE AT AOC B (mg/kg) NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values			
Arsenic	14/15	4.1 - 31	15.14	6/8	3.6 - 5.2	4.32	3.64	0.0021	N	G
Barium	7/15	1.1 - 3.5	1.13	3/8	1.6 - 3	2.3	1.12	9.5	N	A
Chromium	0/15	-	-	1/8	0.97 - 0.97	0.97	0.48	6.8	N	A
Copper	14/15	5.5 - 60.5	20.38	8/8	16.6 - 30.2	23.31	23.31	5.4	N	G
Lead	5/15	0.37 - 0.6	0.27	5/8	0.38 - 1.7	1.03	0.71	-	Y	F
Manganese	12/15	0.36 - 3.6	1.30	8/8	2.1 - 10.9	4.6	4.60	3.1	Y	C
Zinc	15/15	8.6 - 58	33.87	8/8	17.1 - 46.1	32.18	32.18	41	N	A

Notes:

Metals are selected as COPCs if average values exceed risk-based screening levels (RBCs) and site results are above background (2XBkgdAvg).

RBCs represent concentrations associated with a 1E-06 cancer risk level or a non-cancer hazard index of 0.1.

Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)

C - COPC (Avg>RBC & Avg>2XBkgdAvg, inorganics)

F - COPC (eval. qual.)

G - Not COPC (Avg>RBC & Avg<2XBkgdAvg)

TABLE 9-13

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN ORGANICS IN CRAB TISSUE AT AOC B (µg/kg) NAS KEY WEST

Chemical	Background			Site				Applicable Risk-Based Concentration	COPC	Basis of COPC Selection*
	Frequency of Detection	Range of Positive Detection	Average	Frequency of Detection	Range of Positive Detection	Average of Detected Values	Average of all Values			
PESTICIDES/PCBs										
4,4'-DDD	10/15	0.41 - 1.6	1.14	3/8	1.1 - 2.7	2.13	2.04	13.	N	A
4,4'-DDE	5/15	0.37 - 1.9	1.37	8/8	0.69 - 3.7	1.61	1.61	9.3	N	A
4,4'-DDT	5/15	0.48 - 1.6	1.37	7/8	0.74 - 4.9	2.03	1.99	9.3	N	A
Aldrin	9/15	0.13 - 3.4	0.78	5/8	0.22 - 0.27	0.24	0.58	0.19	Y	B
alpha-BHC	0/15	Not detected	-	1/8	0.75 - 0.75	0.75	1.05	0.5	Y	B
beta-BHC	1/15	0.56 - 0.56	0.83	4/8	0.47 - 1.2	0.69	0.87	1.8	N	A
Chlorobenzilate	8/15	4.4 - 140	23.49	6/8	24 - 100	73	56.83	12	Y	B
Dieldrin	9/15	0.38 - 2.3	1.24	3/8	2.9 - 4.6	3.47	2.64	0.02	Y	B
Endosulfan I	1/15	0.4 - 0.4	0.82	8/8	0.38 - 1.8	1.18	1.18	810	N	A
Endosulfan II	6/15	0.14 - 2.6	1.29	2/8	0.64 - 0.9	0.77	1.64	810	N	A
Endosulfan sulfate	1/15	1.1 - 1.1	1.61	7/8	0.55 - 3	1.56	1.58	810	N	A
Endrin	11/15	0.22 - 2.7	1.07	3/8	0.43 - 2.7	1.28	1.92	41	N	A
Endrin aldehyde	13/15	0.34 - 2.8	1.68	8/8	2.2 - 5.7	4.15	4.15	41	N	A
Heptachlor	5/15	0.05 - 0.52	0.66	4/8	0.29 - 0.57	0.44	0.64	0.7	N	A
Heptachlor epoxide	3/15	0.37 - 8.2	1.28	4/8	2.3 - 5.4	3.63	2.34	0.35	Y	B
Methoxychlor	2/15	5 - 11	8.43	2/8	2.3 - 5.8	4.05	8.45	6,800	N	A

Notes:
Because most organics are not naturally occuring, selection of organic COPCs is based solely on exceedance of risk-based screening levels (RBCs).
Applicable RBCs originate from Region III EPA Fish RBCs.

*A - Not COPC (Avg<RBC)
B - COPC (Avg>RBC, organics)

9.6.3 Toxicity Assessment

The toxicological profiles for selected COPCs at AOC B are presented in Appendix A. All relevant quantitative and qualitative toxicity assessment information and methods are presented in Section 3.2.3 of Appendix C.

9.6.4 Exposure Assessment

The COPCs that were selected for each environmental medium sampled at AOC B are presented in Section 9.6.2. The potential receptors identified in Appendix C, Section 3.2.4.2 include current adolescent and adult trespassers, current occupational workers, current site maintenance workers, and future residents. Consequently, the potential receptors and exposure pathways presented in Section 3.2.4 of Appendix C were evaluated quantitatively. Exposure parameters, exposure routes, intakes, and other relevant exposure assessment information are presented in Section 3.2.4 of Appendix C. Example calculations for estimated intakes are presented in Appendix A.

9.6.5 Risk Characterization

This section presents the results of the quantitative risk assessment evaluated under an RME and a CTE. CTE will only be included if the total carcinogenic risk for an exposure pathway exceeds 1E-06 or if an HI (noncarcinogenic risk) for an exposure pathway exceeds 1.0. This section discusses the human health risk in three parts:

- Carcinogenic risks
- Noncarcinogenic risks
- Comparison of groundwater results to screening criteria

A target risk range of 1E-04 to 1E-06 for carcinogens and an HI of 1.0 for noncarcinogens are used by EPA in setting standards and criteria and in determining the need for environmental remediation. FDEP has established a target cancer risk of 1E-06. The risks estimated in this risk assessment will be compared to these benchmarks.

9.6.5.1 Carcinogenic Risks

Table 9-14 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults, and trespasser adolescents. The estimated carcinogenic risk for the hypothetical future residents (6E-05)

TABLE 9-14

CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE
AOC B*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	6E-06	3E-07	4E-07	NA	NA	NA
Dermal Contact	2E-05	3E-06	2E-06	NA	NA	NA
Subtotal	2E-05	3E-06	3E-06	NA	NA	NA
Surface Water						
Incidental Ingestion	8E-06	7E-07	9E-07	NA	NA	NA
Dermal Contact	3E-06	4E-07	3E-07	NA	NA	NA
Subtotal	1E-05	1E-06	1E-06	NA	NA	NA
Shellfish* **						
Ingestion	3E-05	NA	NA	NA	NA	NA
Subtotal	3E-05	NA	NA	NA	NA	NA
TOTAL	6E-05	4E-06	4E-06	NA	**	NA
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	5E-01	1E-02	3E-02	NA	NA	NA
Dermal Contact	2E-01	4E-02	6E-02	NA	NA	NA
Subtotal	7E-01	5E-02	8E-02	NA	NA	NA
Surface Water						
Incidental Ingestion	2E+00	9E-02	2E-01	NA	NA	NA
Dermal Contact	1E+00	5E-02	8E-02	NA	NA	NA
Subtotal	3E+00	1E-01	3E-01	NA	NA	NA
Shellfish* **						
Ingestion	4E-01	NA	NA	NA	NA	NA
Subtotal	4E-01	NA	NA	NA	NA	NA
TOTAL	4E+00	2E-01	4E-01	NA	**	NA

* = Chemical-Specific Risks are presented in Section 9.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
***= Adult residents only.
NA = Not Applicable; pathway is not applicable for the respective media.

trespasser adults (4E-06), and trespasser adolescents (4E-06) are within the EPA "target risk range" of 1E-04 to 1E-06 and exceed FDEP's target risk of 1E-06. Dermal contact with sediment contributes the most to the cumulative carcinogenic risk for these receptors. This exposure route is also associated with high uncertainty based on the absorption efficiency ($ABSEFF_{oral}$) presented in Appendix C, Section 3.2.3.4. The principal COPC contributing to this cancer risk is arsenic in sediment. Chemical-specific risks for COPCs are presented in Section 9.6.8.

Table 9-15 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults and trespasser adolescents. The estimated carcinogenic risk for the hypothetical future resident of 6E-06 is at the lower end of the EPA "target risk range" of 1E-04 to 1E-06 and slightly exceeds FDEP's 1E-06 target risk. Dermal contact with sediment contributes the most to the cumulative carcinogenic risk for these receptors. The estimated carcinogenic risks for trespasser adults and trespasser adolescents are below both the EPA target risk range and the FDEP target risk. Chemical-specific risks for COPCs are presented in Section 9.6.8.

Table 9-14 lists the estimated cumulative RME carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The estimated carcinogenic risk due to shellfish ingestion for the hypothetical future adult resident (3E-05) is within the EPA "target risk range" of 1E-04 to 1E-06 and exceeds FDEPs target risk (1E-06). Dieldrin and heptachlor epoxide are the primary contributors to the cumulative carcinogenic risk. Table 9-15 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario The estimated carcinogenic risk due to shellfish ingestion for the hypothetical future adult resident (1E-06) is at the lower end of the EPA "target risk range" of 1E-04 to 1E-06 and just meets the FDEP target risk (1E-06). Chemical-specific risks for COPCs are presented in Section 9.6.8.

9.6.5.2 Noncarcinogenic Risks

Table 9-14 lists the estimated cumulative RME carcinogenic risks for future residents, trespasser adults and trespasser adolescents. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The principal COPC contributing to the noncarcinogenic risk is antimony in surface water. The target organ for antimony is the heart. The HI for antimony (via ingestion of sediment and surface water) is greater than 1.0. There is uncertainty associated with antimony because it may be in the range of background. The HIs for all other receptors at AOC B are less than 1.0. Chemical-specific risks for COPCs are presented in Section 9.6.8.

Table 9-15 lists the estimated cumulative CTE carcinogenic risks for future residents, trespasser adults, and trespasser adolescents. The cumulative HI for the hypothetical future resident exceeds 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated. The HI for antimony

TABLE 9-15

CUMULATIVE RISKS - CENTRAL TENDENCY EXPOSURE
AOC B*
NAS KEY WEST

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Maintenance Worker	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	9E-07	3E-08	2E-08	NA	NA	NA
Dermal Contact	6E-07	9E-08	4E-08	NA	NA	NA
Subtotal	1E-06	1E-07	6E-08	NA	NA	NA
Surface Water						
Incidental Ingestion	1E-06	1E-07	8E-08	NA	NA	NA
Dermal Contact	1E-06	7E-08	3E-08	NA	NA	NA
Subtotal	2E-06	2E-07	1E-07	NA	NA	NA
Shellfish* **						
Ingestion	1E-06	NA	NA	NA	NA	NA
Subtotal	1E-06	NA	NA	NA	NA	NA
TOTAL	5E-06	3E-07	2E-07	NA	**	NA
HAZARD INDEX						
Surface Soil						
Incidental Ingestion	**	**	**	**	NA	**
Dermal Contact	**	**	**	**	NA	**
Inhalation of Fugitive Dust	**	**	**	**	NA	**
Subtotal	**	**	**	**	NA	**
Subsurface Soil						
Incidental Ingestion	NA	NA	NA	NA	**	NA
Dermal Contact	NA	NA	NA	NA	**	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	**	NA
Subtotal	NA	NA	NA	NA	**	NA
Sediment						
Incidental Ingestion	3E-01	3E-03	7E-03	NA	NA	NA
Dermal Contact	2E-02	4E-03	6E-03	NA	NA	NA
Subtotal	3E-01	7E-03	1E-02	NA	NA	NA
Surface Water						
Incidental Ingestion	9E-01	4E-02	1E-01	NA	NA	NA
Dermal Contact	8E-01	3E-02	4E-02	NA	NA	NA
Subtotal	2E+00	7E-02	1E-01	NA	NA	NA
Shellfish* **						
Ingestion	4E-02	NA	NA	NA	NA	NA
Subtotal	4E-02	NA	NA	NA	NA	NA
TOTAL	2E+00	8E-02	2E-01	NA	**	NA

* = Chemical-Specific Risks are presented in Section 9.6.8.
** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
***= Adult residents only.
NA = Not Applicable; pathway is not applicable for the respective media.

(via ingestion of sediment and surface water) is greater than 1.0. The HIs for all other receptors at AOC B are less than 1.0. Chemical-specific risks for COPCs are presented in Section 9.6.8.

Table 9-14 lists the estimated cumulative RME noncarcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The cumulative HI due to shellfish ingestion for the hypothetical future resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Table 9-15 lists the estimated cumulative CTE carcinogenic risks for future adult resident via ingestion of shellfish exposure scenario. The cumulative HI due to shellfish ingestion for the hypothetical future resident is less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under conditions established in the exposure assessment. Chemical-specific risks for COPCs are presented in Section 9.6.8.

9.6.5.3 Groundwater and the Quantitative Risk Assessment

Groundwater was not evaluated as part of the baseline human health risk assessment because it is classified as Class G-III, unpotable water by FDEP. As discussed in Section 3.2.2.2 of Appendix C, groundwater obtained from the surficial aquifer at Key West has a high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. No freshwater public or registered domestic 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 authority to regulate all potable supplies in the Keys.

A preliminary comparison of unfiltered groundwater concentrations at the AOC B versus tap water RBCs (EPA, 1996a) and MCLs (EPA, 1996a) is presented in Tables 9-16 and 9-17 for inorganics and organics, respectively. The results of this preliminary comparison for AOC B are presented in this section.

The maximum values of antimony, arsenic, cadmium, chromium VI, lead, mercury, nickel, thallium, and heptachlor epoxide exceeded both their respective MCL and RBC values. Detections of antimony, arsenic, and heptachlor epoxide exceeded both MCLs and RBCs. The maximum detected values for mercury, chromium VI, lead, and nickel exceeded both MCLs and RBCs. Thallium and cadmium were each detected in one sample above MCLs and RBCs. Copper and zinc concentrations exceeded tap water RBCs; however, this is not uncommon for unfiltered groundwater. 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, aldrin, beta-BHC, dieldrin, and heptachlor all exceeded tap water RBC values.

TABLE 9-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF COMPARISON WITH MCLs AND RBCs INORGANICS IN GROUNDWATER AT AOC B (µg/L) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site 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?
Antimony	0/12	Not detected	–	2/5	215 - 240	227.5	92.24	6	Y	1.5	Y
Arsenic	3/13	4.1 - 12	4.54	2/5	48.4 - 83.4	66	27.56	50	Y	0.045	Y
Barium	10/13	6.4 - 19	10.20	5/5	18.8 - 201	78.05	78.05	2,000	N	260	N
Cadmium	0/13	Not detected	–	1/5	6.2 - 6.2	6.2	1.87	5	Y	1.8	Y
Chromium*	3/13	0.71 - 13	2.51	3/5	2.2 - 428	177.4	106.84	100	Y	18	Y
Copper	1/13	3.15 - 3.2	2.45	3/5	8.9 - 531	264.3	159.39	1,300**	N	150	Y
Lead	1/12	2.5 - 2.5	1.39	3/5	2.9 - 309	136	82.38	15***	Y	15	Y
Mercury	4/13	0.13 - 0.2	0.10	2/5	0.3 - 2.4	1.35	0.57	2	Y	1.1	Y
Nickel	0/13	Not detected	–	3/5	8.6 - 161	97.52	59.31	100	Y	73	Y
Selenium	1/10	3.05 - 3.1	2.71	1/5	11.1 - 11.1	11.1	4.42	50	N	18	N
Thallium	1/13	4.925 - 4.9	2.24	1/5	5 - 5	5	6.99	2	Y	0.29	Y
Tin	0/3	Not detected	–	2/2	118 - 121	119.5	119.50	–	NA	2,200	N
Vanadium	4/13	3.4 - 3.9	2.62	1/5	23.1 - 23.1	23.1	6.22	–	NA	26	N
Zinc	3/13	3.425 - 15	2.82	2/5	1,090 - 3,040	2,065	831.94	–	NA	1,100	Y

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
**Copper Action Level
***Lead Action Level

TABLE 9-17

OCCURRENCE, DISTRIBUTION, AND SELECTION OF COMPARISON WITH MCLs AND RBCs ORGANICS IN GROUNDWATER AT AOC B (µg/L) NAS KEY WEST

Chemical	Background Frequency of Detection	Background Range of Positive Detection	Average	Site Frequency of Detection	Site 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?
PESTICIDES/PCBs											
2,4-D	0/9	Not detected	–	1/3	0.66 - 0.66	0.66	0.31	70	N	6.1	N
4,4'-DDD	0/10	Not detected	–	1/3	0.93 - 0.93	0.93	0.34	–	NA	0.28	Y
4,4'-DDE	0/10	Not detected	–	1/3	0.65 - 0.65	0.65	0.24	–	NA	0.2	Y
4,4'-DDT	0/10	Not detected	–	2/3	0.062 - 1	0.53	0.37	–	NA	0.2	Y
Aldrin	0/10	Not detected	–	1/3	0.071 - 0.071	0.071	0.04	–	NA	0.004	Y
Beta-BHC	0/10	Not detected	–	1/3	0.11 - 0.11	0.11	0.05	–	NA	0.037	Y
Delta-BHC	0/10	Not detected	–	1/3	0.097 - 0.097	0.097	0.05	–	NA	–	NA
Dieldrin	0/10	Not detected	–	1/3	0.64 - 0.64	0.64	0.24	–	NA	0.0042	Y
Endosulfan I	0/10	Not detected	–	1/3	0.42 - 0.42	0.42	0.15	–	NA	22	N
Endosulfan II	0/10	Not detected	–	1/3	0.69 - 0.69	0.69	0.26	–	NA	22	N
Endosulfan sulfate	0/10	Not detected	–	1/3	0.7 - 0.7	0.7	0.26	–	NA	22	N
Endrin aldehyde	0/7	Not detected	–	2/3	0.05 - 0.59	0.32	0.23	–	NA	1.1	N
Heptachlor	0/10	Not detected	–	1/3	0.026 - 0.026	0.026	0.02	0.4	N	0.0023	Y
Heptachlor epoxide	0/10	Not detected	–	2/3	0.022 - 0.43	0.23	0.16	0.2	Y	0.0012	Y

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.

9.6.6 Uncertainties for AOC B

Beyond the uncertainties associated with the human health risk assessment process discussed in Appendix C, the following uncertainties should be considered in any evaluation of AOC B risk assessment results:

- The uncertainty associated with the dermal exposure is high because of the derivation of the dermal slope factor and reference dose (See Appendix C, Section 3.2.3.4). The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors. It eventually causes dermal exposure to be a primary contributor to the cumulative cancer risk and HI (via sediment) for the future residential receptors. The uncertainty associated with the dermal exposure route may overestimate the risk at AOC B.

- Arsenic is a major contributor to the cumulative carcinogenic risks in sediment, but arsenic was detected at levels in AOC B that slightly exceed background levels. The inclusion of arsenic as site-related surface soil COPC could overestimate the quantitative risk at AOC B for the future residential, trespasser adult and trespasser child receptors. Furthermore, the carcinogenicity of arsenic via ingestion is not confirmed by the available data. However, the EPA has proposed an oral unit risk factor that was used for oral and dermal exposures to arsenic. Additionally, arsenic may not be associated with past site activities which include disposal of car and truck frames and body parts. Since arsenic is a major contributor to the risk, risks may be overstated.

- Antimony is a major contributor to the noncarcinogenic risks in surface water. Antimony was detected at levels in surface water that may be associated with background concentrations. Antimony may not be associated with past site activities which include disposal of car and truck frames and body parts. The inclusion of antimony as site-related surface-water COPC could overestimate the quantitative risk at AOC B for the future residential receptor.

- Use of residential RBCs (sediment) and WQSs (surface water) probably influences the selection of COPCs at the site by potentially designating chemicals as COPCs that do not contribute significantly to the quantitative risk at AOC B (i.e., certain metals in sediment and surface water). This selection bias is based on sediment and surface-water exposure that is generally well above intakes to which a receptor would be typically exposed under a true residential soil and groundwater exposure pathway.

- In order to be conservative, chemicals without WQSs, but with toxicity values, were included as COPCs. Risks were evaluated for these COPCs for the surface-water exposure pathway. The

inclusion of these COPCs would tend to overestimate the cumulative risks for the surface-water exposure pathway.

- Lead was determined to be a COPC in surface water at AOC B. Lead exposure to surface water is not estimated under the IEUBK Lead Model for the baseline human health risk assessment at AOC B. This probably underestimates the risks to potential receptors exposed to lead in surface water, especially to residential children. Exposure to lead in surface water by residential children is lower than exposure to lead in surface soil at AOC B. It is generally desirable to avoid contact with lead for all potential receptors, especially for young children.

- One chemical, phenanthrene in sediment, did not have listed toxicity values for use in the quantitative risk assessment; therefore, no risks were estimated for exposure to COPCs. This chemical was detected infrequently in sediment at low levels. This could possibly underestimate the carcinogenic and noncarcinogenic risk at AOC B, but without additional toxicity information, the uncertainty remains unknown.

9.6.7 Chemicals of Concern and Remedial Goal Options

This section presents the selected COCs and RGOs for AOC B.

9.6.7.1 Selection of Chemicals of Concern

From the COPCs chosen for each medium in the baseline risk assessment (based on RME), a subset of chemicals, called COCs, was selected for the evaluation of RGOs. At AOC B, COCs were included in the RGO evaluation only if the COC's contribution to risk exceeds a cancer risk level of 1E-06 or a HQ of 0.1. The COCs selected at AOC B are as follows:

- Sediment
  - Arsenic
  - Iron

Arsenic was selected as a COC in sediment because its contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor). Iron was selected as a COC in sediment because its contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor).

- Surface Water
  - Antimony

Antimony was selected as a COC in surface water because its contribution to the noncarcinogenic risk was greater than 0.1 (future residential receptor).

9.6.7.2 Remedial Goal Options

RGOs based on generic FDEP and RCRA TBCs for COCs in surface water are listed in Table 9-18 for residential exposure scenarios. RGOs are not listed for sediment because generic levels for sediment exposure have not been established. The RGOs developed according to site-specific baseline risk assessment assumptions are listed for a range of three target risk levels in Table 9-19 (sediment - future resident) and Table 9-20 (surface water - future resident). These site-specific RGOs are intended to provide the risk manager with a range of values that can facilitate the evaluation of potential remediation strategies. Further explanation of the derivations and assumptions related to these RGOs is presented in Section 3.2.7 of Appendix C.

9.6.8 Conclusions

RME and CTE chemical-specific risks for COPCs are presented in Tables 9-21 and 9-22. The purpose of these tables is to present individual COPC risks to allow for verification of individual and total risks and primary COPC drivers for each applicable medium. These tables provide for the following information:

- Quantitative toxicity values for carcinogenic and noncarcinogenic effects used to estimate risks for each COPC in each medium.

- Representative concentrations for each COPC in each applicable medium.

- Estimated individual and total carcinogenic noncarcinogenic risks arranged by receptor and land use.

- Cumulative carcinogenic and noncarcinogenic risks for individual receptor pathways.

TABLE 9-18

TO BE CONSIDERED REMEDIAL GOAL OPTION CRITERIA FOR SURFACE WATER AT AOC B NAS KEY WEST

COC	Human Health Criteria Water+Organism Consumption (µg/L)
Antimony	14

TABLE 9-19

REMEDIAL GOAL OPTIONs DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SEDIMENT AT AOC B NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Arsenic	–	–	–	2.4	24	71
Iron	–	–	–	7,800	78,000	230,000

TABLE 9-20

REMEDIAL GOAL OPTIONs DEVELOPED FOR PROTECTION OF FUTURE RESIDENT EXPOSURE TO SURFACE WATER AT AOC B NAS KEY WEST

COC	Carcinogenic Cleanup Levels			Noncarcinogenic Cleanup Levels		
	1.00E-06	1.00E-05	1.00E-04	0.1	1	3
INORGANICS (mg/kg)						
Antimony	–	–	–	10.1	101	302

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]	Concentration[3]	Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	8.2E-02	3.9E-03	NA	8.6E-02
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	4.3E-06	1.6E-05	NA	2.1E-05	7.7E-02	1.2E-01	NA	2.0E-01
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	7.1E-07	8.5E-08	NA	7.9E-07	2.7E-04	1.3E-05	NA	2.8E-04
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	7.5E-03	3.6E-03	NA	1.1E-02
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	1.7E-02	7.9E-04	NA	1.7E-02
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	1.1E-02	5.4E-04	NA	1.2E-02
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	2.0E-01	9.6E-03	NA	2.1E-01
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	1.6E-03	7.9E-05	NA	1.7E-03
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	2.6E-02	1.2E-03	NA	2.7E-02
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00	–	448	4.0E-07	1.2E-06	NA	1.6E-06	8.2E-02	9.4E-02	NA	1.8E-01
Aroclor-1260	–	–	–	2.00E+00	4.00E+00	–	328	2.9E-07	8.4E-07	NA	1.1E-06	NA	NA	NA	
Subtotal	NA	NA	NA	NA	NA	NA	NA	5.7E-06	1.8E-05	NA	2.4E-05	5.0E-01	2.3E-01	NA	7.4E-01
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA		1.6E+00	1.1E+00	NA	2.7E+00
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	6.7E-06	2.5E-06	NA	9.2E-06	9.4E-02	6.3E-02	NA	1.6E-01
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	2.0E-03	1.4E-03	NA	3.4E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	8.7E-07	3.2E-07	NA	1.2E-06	2.5E-04	1.7E-04	NA	4.2E-04
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	7.9E-05	5.3E-05	NA	1.3E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	1.6E-02	1.0E-02	NA	2.6E-02
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	5.0E-03	3.4E-03	NA	8.3E-03
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	3.4E-03	2.3E-03	NA	5.6E-03
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	3.9E-04	2.6E-04	NA	6.5E-04
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	4.0E-03	2.7E-03	NA	6.7E-03
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	1.0E-02	6.8E-03	NA	1.7E-02

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	2.0E-05	NA	NA	2.0E-05
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	7.2E-08	NA	NA	7.2E-08	1.6E-02	NA	NA	1.6E-02
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	7.2E-08	NA	NA	7.2E-08	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	7.2E-08	NA	NA	7.2E-08	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	7.2E-08	NA	NA	7.2E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	7.9E-06	2.8E-06	NA	1.1E-05	1.7E+00	1.2E+00	NA	2.9E+00
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	1.5E-01	NA	NA	1.5E-01
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	3.26E-06	NA	NA	3.3E-06	1.49E-02	NA	NA	1.5E-02
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	2.19E-06	NA	NA	2.2E-06	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	5.07E-06	NA	NA	5.1E-06	2.19E-03	NA	NA	2.2E-03
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	1.40E-05	NA	NA	1.4E-05	4.07E-02	NA	NA	4.1E-02
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	7.04E-06	NA	NA	7.0E-06	1.39E-01	NA	NA	1.4E-01
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.2E-05	NA	NA	3.2E-05	3.5E-01	NA	NA	3.5E-01
TOTAL	NA	NA	NA	NA	NA	NA	NA	4.5E-05	2.1E-05	NA	6.6E-05	2.6E+00	1.4E+00	NA	4.0E+00

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	2.1E-03	6.1E-04	NA	2.7E-03
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	2.4E-07	2.2E-06	NA	2.5E-06	2.0E-03	1.8E-02	NA	2.0E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	4.0E-08	1.2E-08	NA	5.2E-08	6.9E-06	2.0E-06	NA	8.9E-06
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	1.9E-04	5.5E-04	NA	7.4E-04
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	4.2E-04	1.2E-04	NA	5.5E-04
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	2.9E-04	8.3E-05	NA	3.7E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	5.1E-03	1.5E-03	NA	6.6E-03
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	4.2E-05	1.2E-05	NA	5.5E-05
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	6.6E-04	1.9E-04	NA	8.5E-04
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00	–	448	2.3E-08	1.6E-07	NA	1.8E-07	2.1E-03	1.5E-02	NA	1.7E-02
Aroclor-1260	–	–	–	2.00E+00	4.00E+00	–	328	1.7E-08	1.2E-07	NA	1.3E-07	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.2E-07	2.5E-06	NA	2.8E-06	1.3E-02	3.6E-02	NA	4.9E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	8.2E-02	4.7E-02	NA	1.3E-01
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	5.9E-07	3.4E-07	NA	9.3E-07	4.8E-03	2.8E-03	NA	7.6E-03
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	1.1E-04	6.0E-05	NA	1.7E-04
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	7.6E-08	4.4E-08	NA	1.2E-07	1.3E-05	7.5E-06	NA	2.1E-05
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	4.1E-06	2.3E-06	NA	6.4E-06
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	8.0E-04	4.6E-04	NA	1.3E-03
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	2.6E-04	1.5E-04	NA	4.0E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	1.7E-04	1.0E-04	NA	2.7E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	2.0E-05	1.2E-05	NA	3.2E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	2.1E-04	1.2E-04	NA	3.3E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	5.3E-04	3.0E-04	NA	8.3E-04

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA		1.0E-06	NA	NA	1.0E-06
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	6.3E-09	NA	NA	6.3E-09	8.3E-04	NA	NA	8.3E-04
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	6.3E-09	NA	NA	6.3E-09	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	6.3E-09	NA	NA	6.3E-09	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	6.3E-09	NA	NA	6.3E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	6.9E-07	3.8E-07	NA	1.1E-06	9.0E-02	5.1E-02	NA	1.4E-01
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.0E-06	2.9E-06	NA	3.9E-06	1.0E-01	8.7E-02	NA	1.9E-01

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	4.6E-03	9.5E-04	NA	5.6E-03
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	3.1E-07	2.0E-06	NA	2.3E-06	4.4E-03	2.9E-02	NA	3.3E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	5.1E-08	1.1E-08	NA	6.2E-08	1.5E-05	3.1E-06	NA	1.8E-05
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	4.2E-04	8.7E-04	NA	1.3E-03
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	9.3E-04	1.9E-04	NA	1.1E-03
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	6.3E-04	1.3E-04	NA	7.6E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	1.1E-02	2.3E-03	NA	1.4E-02
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	9.3E-05	1.9E-05	NA	1.1E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	1.4E-03	3.0E-04	NA	1.7E-03
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00	–	448	2.9E-08	1.4E-07	NA	1.7E-07	4.6E-03	2.3E-02	NA	2.7E-02
Aroclor-1260	–	–	–	2.00E+00	4.00E+00	–	328	2.1E-08	1.1E-07	NA	1.3E-07	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	4.1E-07	2.3E-06	NA	2.7E-06	2.8E-02	5.6E-02	NA	8.5E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268.	NA	NA	NA	NA	1.8E-01	7.4E-02	NA	2.5E-01
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	7.5E-07	3.1E-07	NA	1.1E-06	1.1E-02	4.4E-03	NA	1.5E-02
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	2.3E-04	9.5E-05	NA	3.3E-04
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	9.6E-08	4.0E-08	NA	1.4E-07	2.8E-05	1.2E-05	NA	4.0E-05
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	8.9E-06	3.7E-06	NA	1.3E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	1.8E-03	7.2E-04	NA	2.5E-03
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	5.6E-04	2.3E-04	NA	7.9E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	3.8E-04	1.6E-04	NA	5.4E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	4.4E-05	1.8E-05	NA	6.2E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	4.5E-04	1.9E-04	NA	6.4E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	1.1E-03	4.7E-04	NA	1.6E-03

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

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Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	2.2E-06	NA	NA	2.2E-06
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	8.0E-09	NA	NA	8.0E-09	1.8E-03	NA	NA	1.8E-03
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	8.0E-09	NA	NA	8.0E-09	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	8.0E-09	NA	NA	8.0E-09	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	8.0E-09	NA	NA	8.0E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	8.8E-07	3.5E-07	NA	1.2E-06	2.0E-01	8.0E-02	NA	2.8E-01
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.3E-06	2.6E-06	NA	3.9E-06	2.2E-01	1.4E-01	NA	3.6E-01

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RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00	–	448	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	–	–	–	2.00E+00	4.00E+00	–	328	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

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Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA			NA				NA	

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00	–	448	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	–	–	–	2.00E+00	4.00E+00	–	328	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA			NA				NA	

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00	–	448	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	–	–	–	2.00E+00	4.00E+00	–	328	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-21

RME-CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA			NA				NA	

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	4.1E-02	3.9E-04	NA	4.1E-02
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	6.8E-07	4.9E-07	NA	1.2E-06	3.9E-02	1.2E-02	NA	5.0E-02
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	1.1E-07	2.6E-09	NA	1.2E-07	1.3E-04	1.3E-06	NA	1.4E-04
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	3.7E-03	3.5E-04	NA	4.1E-03
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	8.3E-03	7.8E-05	NA	8.3E-03
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	5.6E-03	5.3E-05	NA	5.7E-03
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	1.0E-01	9.5E-04	NA	1.0E-01
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	8.2E-04	7.8E-06	NA	8.3E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	1.3E-02	1.2E-04	NA	1.3E-02
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00		448	6.4E-08	3.5E-08	NA	9.9E-08	4.1E-02	9.3E-03	NA	5.0E-02
Aroclor-1260	–	–	–	2.00E+00	4.00E+00		328	4.7E-08	2.6E-08	NA	7.3E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	9.1E-07	5.6E-07	NA	1.5E-06	2.5E-01	2.3E-02	NA	2.7E-01
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	8.0E-01	7.1E-01	NA	1.5E+00
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	1.1E-06	1.0E-06	NA	2.1E-06	4.7E-02	4.2E-02	NA	8.9E-02
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	1.0E-03	9.1E-04	NA	1.9E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	1.4E-07	1.3E-07	NA	2.7E-07	1.3E-04	1.1E-04	NA	2.4E-04
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	4.0E-05	3.5E-05	NA	7.5E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	7.8E-03	6.9E-03	NA	1.5E-02
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	2.5E-03	2.2E-03	NA	4.7E-03
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	1.7E-03	1.5E-03	NA	3.2E-03
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	2.0E-04	1.7E-04	NA	3.7E-04
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	2.0E-03	1.8E-03	NA	3.8E-03
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	5.1E-03	4.5E-03	NA	9.6E-03

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Future Resident -- Child and Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	9.8E-06	NA	NA	9.8E-06
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	1.1E-08	NA	NA	1.1E-08	8.1E-03	NA	NA	8.1E-03
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	1.1E-08	NA	NA	1.1E-08	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	1.1E-08	NA	NA	1.1E-08	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	1.1E-08	NA	NA	1.1E-08	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.2E-06	1.1E-06	NA	2.4E-06	8.7E-01	7.7E-01	NA	1.6E+00
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	1.9E-02	NA	NA	1.9E-02
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	1.18E-07	NA	NA	1.2E-07	1.80E-03	NA	NA	1.8E-03
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	7.90E-08	NA	NA	7.9E-08	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	1.83E-07	NA	NA	1.8E-07	2.64E-04	NA	NA	2.6E-04
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	5.04E-07	NA	NA	5.0E-07	4.90E-03	NA	NA	4.9E-03
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	2.54E-07	NA	NA	2.5E-07	1.67E-02	NA	NA	1.7E-02
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.1E-06	NA	NA	1.1E-06	4.2E-02	NA	NA	4.2E-02
TOTAL	NA	NA	NA	NA	NA	NA	NA	3.3E-06	1.7E-06	NA	5.0E-06	1.2E+00	7.9E-01	NA	2.0E+00

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	5.3E-04	6.1E-05	NA	5.9E-04
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	2.2E-08	8.2E-08	NA	1.0E-07	5.0E-04	1.8E-03	NA	2.3E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	3.7E-09	4.3E-10	NA	4.1E-09	1.7E-06	2.0E-07	NA	1.9E-06
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	4.8E-05	5.5E-05	NA	1.0E-04
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	1.1E-04	1.2E-05	NA	1.2E-04
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	7.2E-05	8.3E-06	NA	8.1E-05
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	1.3E-03	1.5E-04	NA	1.4E-03
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	1.1E-05	1.2E-06	NA	1.2E-05
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	1.7E-04	1.9E-05	NA	1.8E-04
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00		448	2.1E-09	5.8E-09	NA	7.9E-09	5.3E-04	1.5E-03	NA	2.0E-03
Aroclor-1260	–	–	–	2.00E+00	4.00E+00		328	1.5E-09	4.3E-09	NA	5.8E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	3.0E-08	9.3E-08	NA	1.2E-07	3.2E-03	3.6E-03	NA	6.8E-03
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	4.1E-02	2.4E-02	NA	6.4E-02
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	1.1E-07	6.3E-08	NA	1.7E-07	2.4E-03	1.4E-03	NA	3.8E-03
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	5.3E-05	3.0E-05	NA	8.3E-05
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	1.4E-08	8.0E-09	NA	2.2E-08	6.5E-06	3.7E-06	NA	1.0E-05
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	2.0E-06	1.2E-06	NA	3.2E-06
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	4.0E-04	2.3E-04	NA	6.3E-04
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	1.3E-04	7.4E-05	NA	2.0E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	8.7E-05	5.0E-05	NA	1.4E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	1.0E-05	5.8E-06	NA	1.6E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	1.0E-04	6.0E-05	NA	1.6E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	2.6E-04	1.5E-04	NA	4.1E-04

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adult							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	5.0E-07	NA	NA	5.0E-07
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	1.2E-09	NA	NA	1.2E-09	4.2E-04	NA	NA	4.2E-04
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	1.2E-09	NA	NA	1.2E-09	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	1.2E-09	NA	NA	1.2E-09	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	1.2E-09	NA	NA	1.2E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.3E-07	7.1E-08	NA	2.0E-07	4.5E-02	2.6E-02	NA	7.0E-02
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	1.6E-07	1.6E-07	NA	3.2E-07	4.8E-02	2.9E-02	NA	7.7E-02

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	1.2E-03	9.8E-05	NA	1.3E-03
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	1.4E-08	3.8E-08	NA	5.2E-08	1.1E-03	3.0E-03	NA	4.0E-03
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	2.3E-09	2.0E-10	NA	2.5E-09	3.8E-06	3.2E-07	NA	4.1E-06
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	1.0E-04	8.9E-05	NA	1.9E-04
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	2.3E-04	2.0E-05	NA	2.5E-04
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	1.6E-04	1.3E-05	NA	1.7E-04
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	2.8E-03	2.4E-04	NA	3.0E-03
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	2.3E-05	2.0E-06	NA	2.5E-05
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	3.6E-04	3.1E-05	NA	3.9E-04
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00		448	1.3E-09	2.7E-09	NA	4.0E-09	1.2E-03	2.3E-03	NA	3.5E-03
Aroclor-1260	–	–	–	2.00E+00	4.00E+00		328	9.6E-10	2.0E-09	NA	2.9E-09	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	1.9E-08	4.3E-08	NA	6.1E-08	7.1E-03	5.8E-03	NA	1.3E-02
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	8.9E-02	3.8E-02	NA	1.3E-01
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	6.8E-08	2.9E-08	NA	9.7E-08	5.3E-03	2.2E-03	NA	7.5E-03
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	1.2E-04	4.9E-05	NA	1.6E-04
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	8.7E-09	3.7E-09	NA	1.2E-08	1.4E-05	6.0E-06	NA	2.0E-05
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	4.5E-06	1.9E-06	NA	6.3E-06
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	8.8E-04	3.7E-04	NA	1.2E-03
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	2.8E-04	1.2E-04	NA	4.0E-04
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	1.9E-04	8.1E-05	NA	2.7E-04
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	2.2E-05	9.3E-06	NA	3.1E-05
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	2.3E-04	9.6E-05	NA	3.2E-04
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	5.7E-04	2.4E-04	NA	8.2E-04

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Trespasser--Adolescent							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	1.1E-06	NA	NA	1.1E-06
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	7.3E-10	NA	NA	7.3E-10	9.1E-04	NA	NA	9.1E-04
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	7.3E-10	NA	NA	7.3E-10	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	7.3E-10	NA	NA	7.3E-10	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	7.3E-10	NA	NA	7.3E-10	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	8.0E-08	3.3E-08	NA	1.1E-07	9.8E-02	4.1E-02	NA	1.4E-01
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	9.8E-08	7.6E-08	NA	1.7E-07	1.1E-01	4.7E-02	NA	1.5E-01

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00		448	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	–	–	–	2.00E+00	4.00E+00		328	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Maintenance Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00		448	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	–	–	–	2.00E+00	4.00E+00		328	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268.	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Excavation Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
SEDIMENT															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	8.98	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	6.36	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.368	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.00E-03	2.00E-04	–	–	–	–	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	5.00E-03	1.00E-03	–	–	–	4.20E+01	22.6	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.00E-02	8.00E-03	–	–	–	–	123	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	16400	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.40E-01	2.80E-02	–	–	–	–	63.1	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	2110	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aroclor-1254	2.00E-05	1.00E-05	–	2.00E+00	4.00E+00		448	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	–	–	–	2.00E+00	4.00E+00		328	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SURFACE WATER															
Inorganics															
Antimony	4.00E-04	8.00E-05	–	–	–	–	268	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	3.00E-04	6.00E-05	–	1.50E+00	7.50E+00	1.51E+01	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7.00E-02	1.40E-02	1.43E-04	–	–	–	60.3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	5.00E-03	1.00E-03	–	4.30E+00	–	6.30E+00	0.533	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	6.00E-02	1.20E-02	–	–	–	–	2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.00E-01	6.00E-02	–	–	–	–	1970	NA	NA	NA	NA	NA	NA	NA	NA
Lead	–	–	–	–	–	–	24.4	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	5.00E-03	1.00E-03	1.43E-05	–	–	–	48.4	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	1.00E-04	2.00E-05	8.57E-05	–	–	–	0.427	NA	NA	NA	NA	NA	NA	NA	NA
Tin	6.00E-01	1.20E-01	–	–	–	–	98.7	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7.00E-03	1.40E-03	–	–	–	–	11.9	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	3.00E-01	6.00E-02	–	–	–	–	1290	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 9-22

CTE--CHEMICAL SPECIFIC RISKS AT AOC B
NAS KEY WEST

Parameter	Dose-Response Parameters						Representative Concentration[3]	Occupational Worker							
								Cancer Risk				Non-Cancer Risk[4]			
	Oral RfD[1]	Dermal RfD[1]	Inhalation RfD[1]	Oral SF[2]	Dermal SF[2]	Inhalation SF[2]		Ingestion	Dermal	Inhalation	Total	Ingestion	Dermal	Inhalation	Total
Pesticides/PCBs															
2,4,5-TP	8.00E-03	4.00E-03	–	–	–	–	0.0661	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1016	7.00E-05	3.50E-05	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248	–	–	–	2.00E+00	4.00E+00	–	0.477	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SHELLFISH-- CRAB[5]															
Inorganics															
Manganese	2.03E-02	–	–	–	–	–	4.6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs															
Aldrin	3.00E-05	–	–	1.70E+01	–	–	0.00058	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	–	–	–	6.30E+00	–	–	0.00105	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	2.00E-02	–	–	2.70E-01	–	–	0.05683	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	5.00E-05	–	–	1.60E+01	–	–	0.00264	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	1.30E-05	–	–	9.10E+00	–	–	0.00234	NA	NA	NA	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 Units are (mg/kg)/day.
2 Units are [(mg/kg)/day]-1.
3 Units are µg/L for surface water, mg/kg for sediment and soil inorganics, and µg/kg for all other compounds in sediment and soil.
4 Noncancer risks are calculated conservatively for residents, considering only the child receptor.
5 The shellfish ingestion scenario applies to adult residents only.

Noncarcinogenic and carcinogenic human health risks were estimated for potential current (trespasser) and hypothetical future (residents) receptors. COPCs in AOC B media were not present at sufficient concentrations to cause possible adverse noncarcinogenic health effects to current potential receptors. COPCs in AOC B media were present at sufficient concentrations to cause possible adverse noncarcinogenic health effects to future residential receptors. Arsenic in sediment and antimony in surface water are the main contributors to the noncarcinogenic risks. Uncertainty at this site exists because arsenic and antimony may be associated with levels that are not above background concentrations. Additionally, arsenic and antimony may not be associated with past activities at the site which include the disposal of car frame and body parts. The cancer risks estimated for the current potential receptors and the future resident were below or within the 1E-04 to 1E-06 target risk range, often used by EPA in setting standards and criteria and in evaluating the need for environmental remediation.

9.7 ECOLOGICAL RISK ASSESSMENT

This section discusses the results of the ecological risk assessment performed at AOC B including a discussion of the problem formulation, effects characterization, exposure assessment, and risk characterization.

9.7.1 Problem Formulation

This section presents the problem formulation including a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, selection of ecological COPCs, assessment and measurement endpoints, and the conceptual site model.

9.7.1.1 Habitat Types and Ecological Receptors

Section 9.1 (See Figure 9-12) describes the physical setting at AOC B. The former disposal area is bordered on the east, south, and west by a dense mangrove swamp. This swamp, consisting primarily of red and black mangroves, extends to the eastern end of Big Coppitt Key. A dead-end canal is located to the north of the site. Vegetation in the area between Old Boca Chica Road and the canal is sparse and consists of glasswort (*Salicornia* spp.), saltwort (*Batis maritima*), and sea oxeye daisy. Most of the canal is bordered by a thin strip of black mangroves. Buttonwood and white mangroves are found in the slightly more elevated portions of the site. The area surrounding the canal is slightly higher in elevation than the mangrove swamp. Thus, surface water from the mangrove swamp does not drain into the canal. In addition, the canal (unlike the swamp) is not subjected to tidal input, except in major storm events such as hurricanes.

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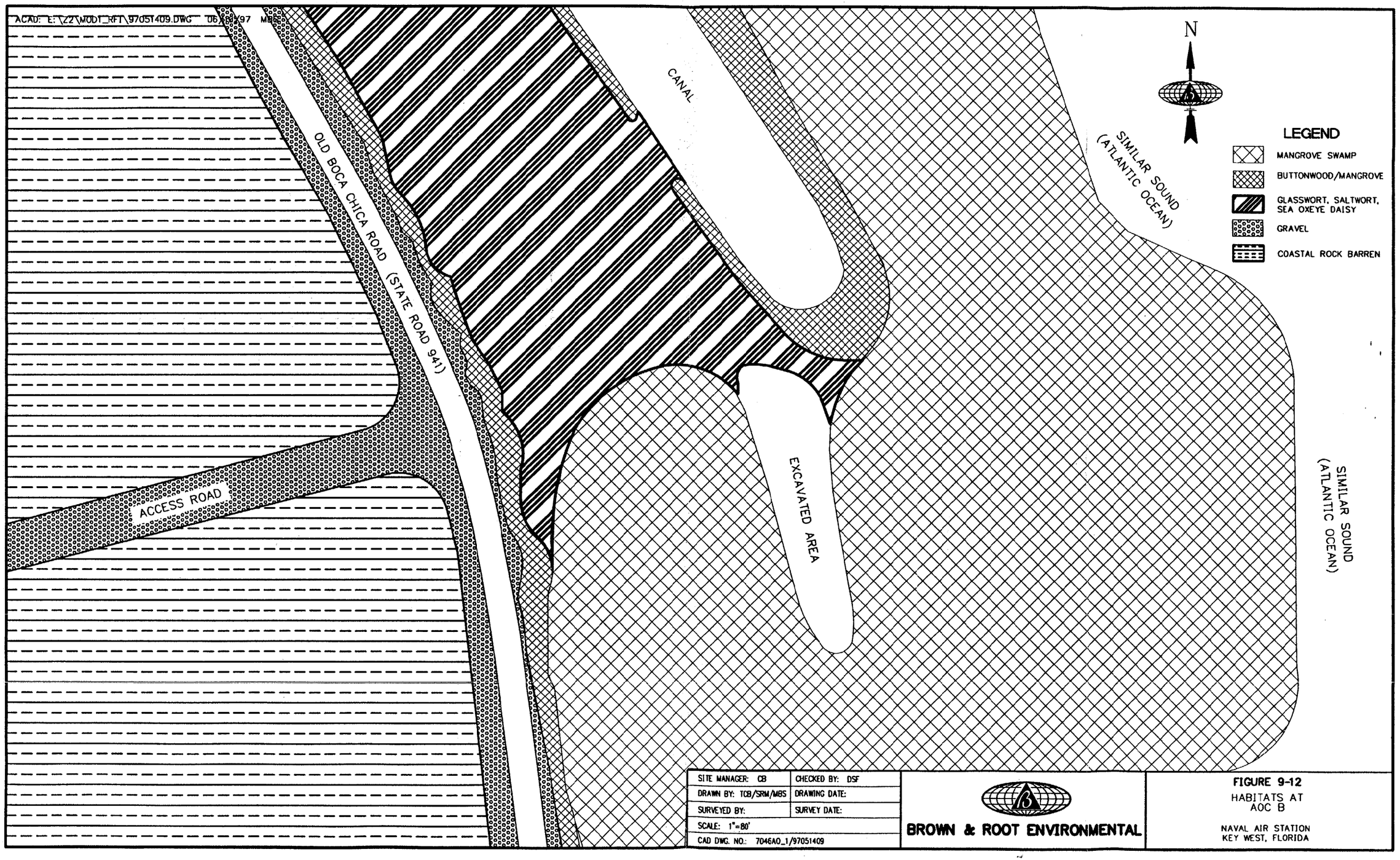
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N
LEGEND
MANGROVE SWAMP
BUTTONWOOD/MANGROVE
GLASSWORT, SALTWORT, SEA OXEYE DAISY
GRAVEL
COASTAL ROCK BARREN
CANAL
OLD BOCA CHICA ROAD (STATE ROAD 941)
ACCESS ROAD
EXCAVATED AREA
SIMILAR SOUND (ATLANTIC OCEAN)
SIMILAR SOUND (ATLANTIC OCEAN)
SITE MANAGER: CB
CHECKED BY: DSF
DRAWN BY: TCB/SRM/MBS
DRAWING DATE:
SURVEYED BY:
SURVEY DATE:
SCALE: 1"=80'
CAD DWG. NO.: 7046AO_1/97051409
BROWN & ROOT ENVIRONMENTAL
FIGURE 9-12
HABITATS AT AOC B
NAVAL AIR STATION KEY WEST, FLORIDA

The canal is approximately 65 feet wide and 12 feet deep, and extends north approximately 450 yards to a filled area over which a road has been constructed. Presumably, the canal was once linked to nearby ocean waters, but presently the outlet is blocked by riprap, concrete, and fill. This barrier prevents the passage of aquatic organisms, but some water probably seeps through the barrier. The salinity ranged from 27.3 to 31.3 ppt in August through October of 1996, slightly lower than sea water, suggesting a small freshwater influence (probably rain water and surface-water runoff). DO concentrations ranged from 3.5 to 5.01 mg/L in the canal in August through October, indicating marginal conditions that would support a limited community of aquatic organisms. Various marine fish and invertebrate species exist in the canal. Minnows (sailfin molly and crested goby), tarpon, blue crabs (*Callinectes sapidus*), and mud crabs (*Panopeus herbstii*) were collected from the canal for tissue analysis. There are no freshwater resources at the site, except for shallow ephemeral pools after rain showers.

Terrestrial habitat is absent except in the area north of the former disposal area, where vegetation is sparse. However, the extensive mangrove swamp adjacent to the site provides good habitat for a variety of terrestrial receptors such as invertebrates, reptiles, amphibians, small mammals, and arboreal birds. Wading bird species seen foraging either along the edge of the canal or in the remediated area during August through October 1996 sampling activities consisted of white ibis, little blue heron, snowy egret, tricolored heron (all state listed as SSC), and yellow-crowned night heron (*Nycticorax violaceus*). Other ecological receptors listed as threatened, endangered, or of special concern that could potentially occur on the site include the red rat snake (state listed as SSC), the indigo snake (threatened), and the silver rice rat (endangered). The Lower Keys marsh rabbit is not known to exist in the vicinity (Schuetz, 1996).

9.7.1.2 Contaminant Sources, Release Mechanisms, and Migration Pathways

A detailed description of contaminant sources, release mechanisms, and migration pathways at AOC B is presented in Section 9.5.2.

9.7.1.3 Exposure Routes

Terrestrial animals may be exposed to AOC B-related contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Terrestrial vegetation can be exposed to contaminants through direct aerial deposition and root translocation. Yet since airborne migration of contaminants is minimal, only the root translocation route was considered for terrestrial plants. Terrestrial receptors can also come in contact with contaminants in surface water by using it for drinking, although this exposure route generally represents a negligible

portion of total exposure for most receptors. In addition, the salt content in onsite surface water precludes the use of the water for drinking. Exposure to contaminants in the soil via dermal contact can occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue. Volatile constituents could be present in some site soils, soil-bound contaminant resuspension can occur, and combustion can release contaminants into the air at AOC B. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors.

Aquatic and terrestrial organisms inhabiting the mangrove swamp and canal may be exposed to contaminants through direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semiaquatic organisms can also be exposed to constituents in contaminated groundwater that flows into surface water.

9.7.1.4 Selection of Ecological Chemicals of Potential Concern

Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media because they are essential nutrients that are toxic only in extremely high concentrations. Similarly, iron was excluded as a COPC in all media except surface water. Otherwise, contaminants selected for evaluation consisted of all analytes detected during current and previous sampling of groundwater, surface water, sediment, and surface soil at AOC B. Groundwater analytes selected for evaluation consisted of analytes detected during 1996 sampling of three monitoring wells at the site (ABMW-1, ABMW-2, and ABMW-3; Figure 9-5). Inorganic contaminants whose maximum detected concentration was less than twice the average background concentration were excluded as COPCs.

9.7.1.5 Assessment and Measurement Endpoints

A detailed description of assessment and measurement endpoints for this investigation is presented in Section 3.3.1.1.5 of Appendix C.

9.7.1.6 Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with the site were determined by

identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 9-13 shows the conceptual model for AOC B.

9.7.2 Ecological Effects Characterization

Ecologically-based thresholds (e.g., concentrations of contaminants in various media protective of ecological receptors) were selected to screen against exposure point concentrations of detected analytes in groundwater, surface water, sediment, and soil to determine if they qualify as ecological COPCs at AOC B. Brief descriptions of each COPC are included in Appendix B Part 3. Terrestrial plant thresholds were obtained to assess potential risks to plants from soil contaminants. Contaminant intake doses for the cotton rat, kestrel, and great blue heron were modeled, and estimated doses were compared to TRVs, (doses above which potential risks might be present). Example doses and TRVs are provided in Appendix B, Part 4. Groundwater, surface-water, sediment, terrestrial plant, and surface soil thresholds, as well as TRVs used in foodchain modeling, are provided in Appendix C. Section 3.3.1.2 of Appendix C discusses threshold selection.

Minnows, tarpon, blue crabs, and mud crabs were collected from the canal for tissue analysis. Tissue samples were analyzed for pesticides, PCBs, and metals. Concentrations of contaminants detected in the fish and crabs were compared to threshold concentrations considered to be protective of piscivorous receptors (Appendix C, Table C.3-26), and to concentrations in fish and crabs collected at background sites. Maximum and mean concentrations in fish samples were used to estimate doses to the great blue heron, and maximum and mean concentrations in crab samples were used to estimate doses to the raccoon.

9.7.3 Exposure Assessment

This section presents the ecological exposure assessment for AOC B, which includes a discussion of exposure point contaminant concentrations and dose calculations.

9.7.3.1 Exposure Point Contaminant Concentrations

The maximum detected contaminant concentrations in groundwater, surface water, sediment, and soil were used as representative exposure point concentrations for screening against threshold values. Background values were obtained from several locations at NAS Key West. Background sampling is described in detail in Appendix F.

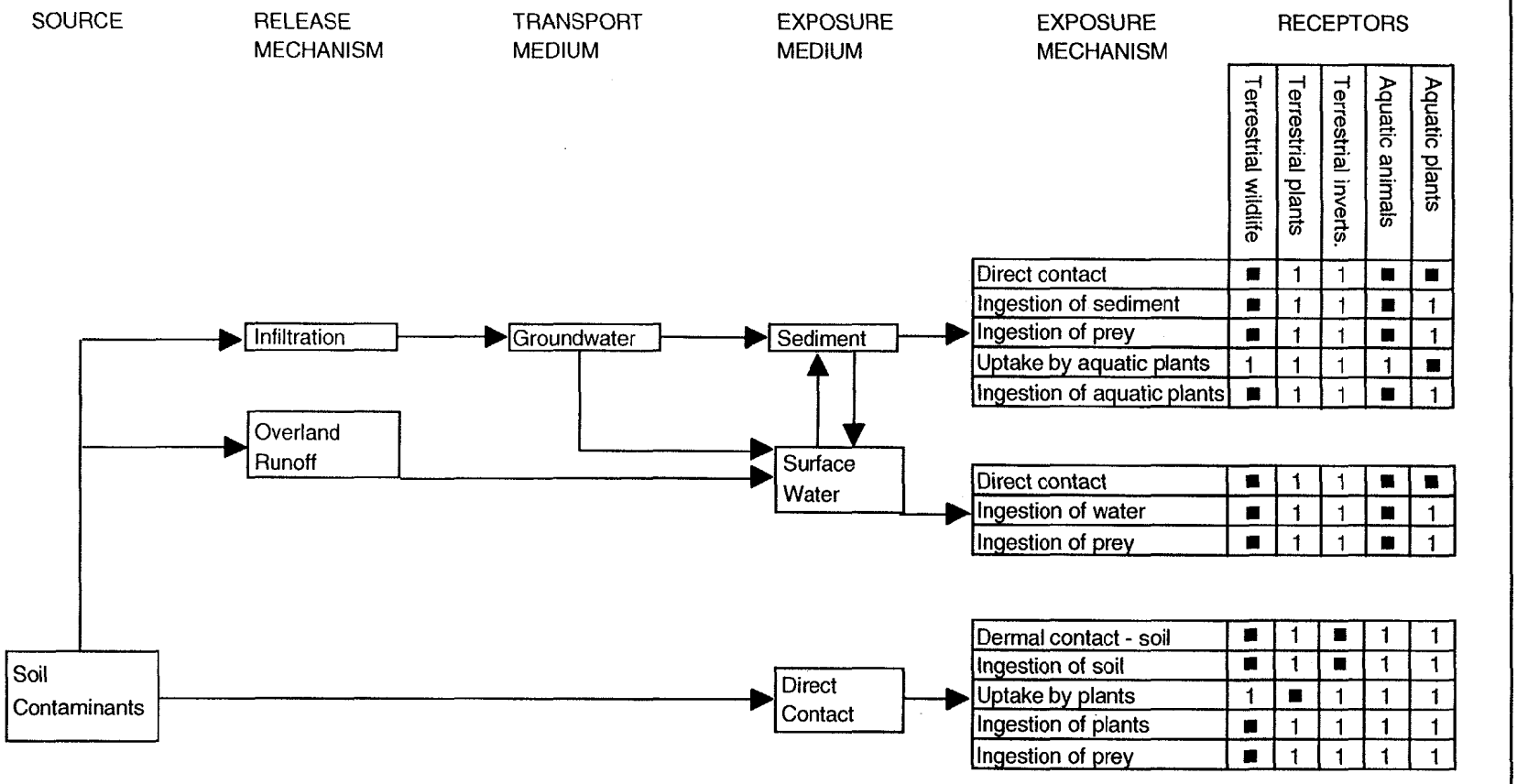

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Figure 9-13. Conceptual Site Model - AOC B, NAS Key West, Big Coppitt Key, Florida

9.7.3.2 Dose Calculations

The potential risks to ecological receptors resulting from exposure to AOC B-related contaminants were also evaluated by estimating the total contaminant dose that an organism inhabiting the site might receive for each contaminant and comparing those doses to TRVs, which are doses above which adverse effects might occur. The cotton rat, kestrel, and raccoon were selected as representative terrestrial receptors, and the great blue heron was selected as the representative piscivorous receptor for foodchain modeling at AOC B. Section 3.3.2.1.2 of Appendix C provides a detailed description of dose calculations and exposure parameters used for the foodchain modeling.

9.7.4 Risk Characterization

This section presents the results and a discussion of the ecological risks at AOC B.

9.7.4.1 Results

The results of the ecological risk characterization at AOC B are presented in this section, including a discussion of the results from the Phase I and Phase II ecological screening assessments, foodchain modeling for selected terrestrial and piscivorous receptors, and tissue analyses.

9.7.4.1.1 Phase I

No quantitative ecological risk assessment was performed during Phase I investigations at AOC B. However, IT Corporation (1994) suggested that a more comprehensive Phase II ecological evaluation be conducted due to the presence of potential contaminant exposure pathways.

9.7.4.1.2 Phase II - Ecological Screening Assessment

Copper and nickel were retained as COPCs in groundwater (Table 9-23). Several chlorinated pesticides in groundwater exceeded surface-water thresholds and were retained as COPCs. In AOC B surface water, the metals arsenic, beryllium, chromium, copper, iron, manganese, mercury, and zinc were retained as COPCs since their maximum detected concentrations exceeded two times their average background concentrations and threshold values (Table 9-24). Lead, nickel, and tin were retained as COPCs since their maximum concentrations exceeded threshold values and they were not detected in background samples. Cobalt was conservatively retained as a surface-water COPC since its maximum exceeded two

TABLE 9-23

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER (µg/L) - AOC B
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 Chemicals of Potential Concern (COPC)
INORGANICS						
Barium	3/3	10.2	18.8 - 32.9	10,000	0.00	Eliminated - does not exceed threshold
Chromium	1/3	2.51	2.2	50	0.04	Eliminated - does not exceed 2 X background
Copper	1/3	2.45	8.9	2.4	3.71	Retained - exceeds 2x background and HQ>1
Lead	1/3	1.39	2.9	5.6	0.52	Eliminated - does not exceed threshold
Nickel	1/3	ND	8.6	8.2	1.04	Retained - HQ>1
Thallium	1/3	2.24	5	6.3	0.79	Eliminated - does not exceed threshold
PESTICIDES/PCBs						
2,4-D	1/3	ND	0.66	100	0.01	Eliminated - does not exceed threshold
4,4'-DDD	1/3	ND	0.93	0.025	37.20	Retained - HQ > 1
4,4'-DDE	1/3	ND	0.65	0.14	4.64	Retained - HQ > 1
4,4'-DDT	2/3	ND	0.065-1.0	0.0006	1,666.67	Retained - HQ > 1
Aldrin	1/3	ND	0.071	0.00014	507.14	Retained - HQ > 1
beta-BHC	1/3	ND	0.11	0.046	2.39	Retained - HQ > 1
delta-BHC	1/3	ND	0.097	0.016	6.06	Retained - HQ > 1
Dieldrin	1/3	ND	0.64	0.00014	4571.4	Retained - HQ > 1
Endosulfan I	1/3	ND	0.42	0.0087	48.28	Retained - HQ > 1
Endosulfan sulfate	1/3	ND	0.7	0.0087	80.46	Retained - HQ > 1
Endrin aldehyde	2/3	ND	0.05-0.59	0.0023	256.52	Retained - HQ > 1
Endosulfan II	1/3	ND	0.69	0.0087	79.31	Retained - HQ > 1
Heptachlor	1/3	ND	0.026	0.00021	123.81	Retained - HQ > 1
Heptachlor epoxide	2/3	ND	0.022-0.43	0.00021	2,047.62	Retained - HQ > 1

ND = Not detected.

TABLE 9-24

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER (µg/L)- AOC B
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 Chemicals of Potential Concern (COPC)
INORGANICS						
Antimony	4/14	33.71	181 - 268	4,300	0.06	Eliminated - does not exceed threshold
Arsenic	1/14	3.97	70.30	50	1.4	Retained - exceeds 2 X background and HQ > 1
Barium	14/14	6.93	6.7 - 116	10,000	0.01	Eliminated - does not exceed threshold
Beryllium	1/14	0.22	1.60	0.13	12.3	Retained - exceeds 2 X background and HQ > 1
Chromium	1/14	2.62	115.00	50	2.3	Retained - exceeds 2 X background and HQ > 1
Cobalt	1/14	ND	2.00	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Copper	9/14	2.26	7.3 - 72.5	2.4	30.2	Retained - exceeds 2 X background and HQ > 1
Iron	8/10	24.70	227 - 1970	300	6.5	Retained - exceeds 2 X background and HQ > 1
Lead	2/14	ND	40 - 71	5.6	12.7	Retained - HQ > 1
Manganese	8/10	2.00	5.3 - 48.4	10	4.8	Retained - exceeds 2 X background and HQ > 1
Mercury	6/14	0.52	0.16 - 1.5	0.025	60	Retained - exceeds 2 X background and HQ > 1
Nickel	3/14	ND	5.5 - 49.6	8.2	6.0	Retained - HQ > 1
Thallium	2/14	4.73	4.1 - 4.7	NA	-	Eliminated - does not exceed 2 X background
Tin	1/4	ND	98.70	73	1.4	Retained - HQ > 1
Vanadium	1/14	1.99	66.10	10,000	0.007	Eliminated - does not exceed threshold
Zinc	4/14	7.19	6.2 - 1290	86	15	Retained - exceeds 2 X background and HQ > 1
PESTICIDES/PCBs						
2,4,5-TP (silvex)	1/10	ND	0.11	NA	-	Retained - no suitable threshold available
Aroclor-1016	1/14	ND	2.00	0.03	66.7	Retained - HQ > 1
Aroclor-1232	1/14	ND	2.00	0.03	66.7	Retained - HQ > 1
Aroclor-1242	1/14	ND	2.00	0.03	66.7	Retained - HQ > 1
Aroclor-1248	1/14	ND	2.00	0.03	66.7	Retained - HQ > 1

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

times its average background concentrations and no suitable threshold was available. The PCB mixtures Aroclor-1016, -1232, -1242, and -1248 were also retained as surface-water COPCs since their maxima exceeded thresholds, and 2,4,5-TP was conservatively retained as a COPC since no suitable threshold was available.

Barium was retained as an inorganic COPC in sediments since it exceeded two times its average background concentration and the only threshold available (Table 9-25). Arsenic and chromium were retained as sediment COPCs since their maxima exceeded two times their average background concentrations and the most conservative screening thresholds available but did not exceed less conservative thresholds used. Also, the maximum detected concentrations of cadmium, copper, iron, lead, mercury, and zinc exceeded two times average background concentrations and both most and less conservative thresholds. Aluminum, beryllium, tin, and vanadium were conservatively retained as sediment COPCs since their maxima exceeded two times average background and no suitable thresholds were available. Several pesticides and PCBs were retained as sediment COPCs since thresholds were exceeded, including some that exceeded most and less conservative thresholds used in this assessment. Two pesticides, 2,4,5-TP and endosulfan sulfate, were conservatively retained as sediment COPCs since no thresholds were available.

No analytes were selected as COPCs in surface soil (Table 9-26). Zinc was the only analyte that was detected at a concentration greater than two times its average background concentration and its terrestrial plant threshold (Table 9-27).

9.7.4.1.3 Tissue Analysis

Minnows (sailfin mollies and crested gobies) were collected from the canal and were composited by species into samples of approximately 30 grams each. Two tarpon were also collected from the canal. The inorganics aluminum, barium, chromium, copper, iron, lead, manganese, and zinc were detected in minnows (Table 9-28). Arsenic, manganese, and zinc were detected in tarpon from the canal. Several organochlorine pesticides and chlorobenzilate were also detected in both tarpon and minnows.

The inorganics arsenic, barium, chromium, copper, lead, manganese, and zinc were detected in blue crabs. In mud crabs, the inorganics barium, copper, iron, lead, manganese, and zinc were detected (Table 9-29). Several organochlorine pesticides and chlorobenzilate were also detected in both blue crabs and mud crabs.

TABLE 9-25

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT - AOC B
NAS KEY WEST
PAGE 1 OF 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemicals of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	38/38	39.15	1,090 - 5,470	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Antimony	6/42	ND	0.5 - 11.2	12	0.9	Eliminated - does not exceed threshold
Arsenic	42/42	2.63	0.856 - 27.1	7.24/70	3.7/0.4	Retained - exceeds 2 X background and HQ > 1
Barium	42/42	9.27	5.4 - 213	40	5.3	Retained - exceeds 2 X background and HQ > 1
Beryllium	7/42	0.06	0.07 - 1.5	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Cadmium	13/42	0.22	0.58 - 15.6	0.676/9.6	23.1/1.6	Retained - exceeds 2 X background and HQ > 1
Chromium	41/42	5.01	3.25 - 141	52.3/160	2.7/0.88	Retained - exceeds 2 X background and HQ > 1
Cobalt	35/42	0.47	0.43 - 9.7	50	0.2	Eliminated - does not exceed threshold
Copper	28/42	8.88	1.99 - 420	18.7/270	22.5/1.6	Retained - exceeds 2 X background and HQ > 1
Iron	38/38	1,199	824-116,000	20,000/40,000	5.8/2.9	Retained - exceeds 2 X background and HQ > 1
Lead	21/42	17.97	7.7 - 302	30.2/218	10.0/1.4	Retained - exceeds 2 X background and HQ > 1
Manganese	38/38	15.39	8.75 - 388	460	0.8	Eliminated - does not exceed threshold
Mercury	15/42	0.05	0.02 - 1.2	0.13/0.71	9.2/1.7	Retained - exceeds 2 X background and HQ > 1
Nickel	31/42	2.15	2.64 - 151	15.9/42.8	9.5/3.53	Retained - exceeds 2 X background and HQ > 1
Selenium	6/42	0.68	0.53 - 1.3	NA	-	Eliminated - does not exceed 2 X background
Silver	2/42	0.27	0.46 - 0.7	0.733	0.95	Eliminated - does not exceed threshold
Tin	1/4	2.85	12.20	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Vanadium	22/42	5.08	1.4 - 40.5	NA	-	Retained - exceeds 2 X background and no suitable threshold available
Zinc	42/42	25.74	2.19 - 3,680	124/410	29.7/9.0	Retained - exceeds 2 X background and HQ > 1

TABLE 9-25

ECOLOGICAL CHEMCIALS OF POTENTIAL CONCERN IN SEDIMENT - AOC B
NAS KEY WEST
PAGE 2 OF 2

Analytes	Frequency of Detection	Average Background Concentration	Range of Detected Values	Ecological Threshold	Hazard Quotient	Reason for Rention or Elimination as an Ecological Chemicals of Potential Concern (COPC)
PESTICIDES/PCBs (µg/kg)						
2,4,5-TP (silvex)	1/10	ND	5.20	NA	-	Retained - no suitable threshold available
4,4'-DDD	8/8	13.03	2.2 - 12.6	1.22/7.81	10.3/1.6	Retained - HQ > 1
4,4'-DDE	10/10	19.85	1.7 - 15.7	2.07/27	7.6/0.6	Retained - HQ > 1
4,4'-DDT	8/8	13.02	3.2 - 6.4	1.19/4.77	5.3/1.3	Retained - HQ > 1
Aroclor-1254	1/12	ND	470.00	60/340	7.8/1.4	Retained - HQ > 1
Aroclor-1260	3/12	70.57	17 - 402	5/240	80.4/1.7	Retained - HQ > 1
Dieldrin	4/9	ND	2.2 - 28.8	0.715/95	40.3/0.3	Retained - HQ > 1
Endosulfan I	8/8	6.7	2.4 - 19.5	2.9	6.7	Retained - HQ > 1
Endosulfan sulfate	1/8	ND	1.90	NA	-	Retained - no suitable threshold available
Endrin	5/8	12.89	1.4 - 32.5	3.3/3.5	9.8/9.3	Retained - HQ > 1
gamma-BHC (lindane)	5/6	6.72	1.2 - 8.7	0.32/0.99	27.2/8.8	Retained - HQ > 1
Heptachlor	5/8	6.51	0.85 - 6.9	4.9	1.4	Retained - HQ > 1
Heptachlor epoxide	6/8	ND	0.85 - 3	5	0.6	Eliminated - does not exceed threshold
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Phenanthrene	1/4	ND	55.00	86.7	0.6	Eliminated - does not exceed threshold

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

TABLE 9-26

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL - AOC B
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 Chemicals of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	1/1	1,887.29	677.00	600	1.1	Eliminated - does not exceed 2 X background
Arsenic	1/1	1.29	0.73	60	0.01	Eliminated - does not exceed 2 X background
Barium	1/1	10.51	16.80	440	0.04	Eliminated - does not exceed 2 X background
Chromium	1/1	6.02	4.12	0.4	10.3	Eliminated - does not exceed 2 X background
Cobalt	1/1	0.29	1.32	200	0.007	Eliminated - does not exceed threshold
Copper	1/1	5.43	11.90	50	0.2	Eliminated - does not exceed threshold
Iron	1/1	1,167	2,000	200	10.0	Eliminated - does not exceed 2 X background
Manganese	1/1	17.65	11.70	100	0.1	Eliminated - does not exceed 2 X background
Nickel	1/1	1.67	2.18	200	0.01	Eliminated - does not exceed 2 X background
Zinc	1/1	15.22	61.80	200	0.3	Eliminated - does not exceed threshold

TABLE 9-27

ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN PLANTS - AOC B
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 Chemicals of Potential Concern (COPC)
INORGANICS (mg/kg)						
Aluminum	1/1	1,887.29	677.00	50	13.5	Eliminated - does not exceed 2 X background
Arsenic	1/1	1.29	0.73	10	0.07	Eliminated - does not exceed 2 X background
Barium	1/1	10.51	16.80	500	0.03	Eliminated - does not exceed 2 X background
Chromium	1/1	6.02	4.12	1	4.1	Eliminated - does not exceed 2 X background
Cobalt	1/1	0.29	1.32	20	0.07	Eliminated - does not exceed threshold
Copper	1/1	5.43	11.90	100	0.12	Eliminated - does not exceed threshold
Iron	1/1	1,167	2,000	10	200	Eliminated - does not exceed 2 X background
Manganese	1/1	17.65	11.70	500	0.02	Eliminated - does not exceed 2 X background
Nickel	1/1	1.67	2.18	30	0.07	Eliminated - does not exceed 2 X background
Zinc	1/1	15.22	61.80	50	1.2	Retained - exceeds 2 X background and HQ > 1

TABLE 9-28

SUMMARY STATISTICS FOR ANALYTES DETECTED IN MINNOWS AND TARPON FROM AOC B AND BACKGROUND SITES NAS KEY WEST PAGE 1 OF 2

Analytes	AOC B			Background		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
INORGANICS (mg/kg)						
Aluminum						
Minnows	1/24	45.30	3.18	6/24	10.40-37.70	8.84
Arsenic						
Tarpon	2/2	5.80-6.50	6.15	NC		
Barium						
Minnows	8/24	2.00-5.70	1.49	39/58	0.67-9.90	2.43
Chromium						
Minnows	1/24	0.88	0.43	2/58	1.00-3.10	0.41
Copper						
Minnows	1/24	13.40	1.52	52/58	0.70-22.80	4.63
Iron						
Minnows	7/24	12.1-52.8	14.1	10/24	15.6-49.8	16.95
Lead						
Minnows	11/24	0.35-0.61	0.30	41/58	0.14-11.90	1.50
Manganese						
Tarpon	2/2	1.90-4.90	3.40	NC		
Minnows	24/24	2.10-7.60	5.37	1/24	16.20	1.38
Zinc						
Tarpon	2/2	17.5-30.00	23.75	NC		
Minnows	24/24	13.90-66.10	41.16	58/58	13.60-84.20	41.38
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD						
Tarpon	2/2	2.20-3.10	2.65	NC		
Minnows	15/24	0.26-4.00	1.59	48/58	0.25-16.60	3.95
4,4'-DDE						
Tarpon	2/2	4.70-9.50	7.10	NC		
Minnows	17/24	0.46-2.60	1.40	57/58	3.80-106.00	28.75
4,4'-DDT						
Tarpon	2/2	1.70-4.00	2.85	NC		
Minnows	10/24	0.99-6.50	2.32	4/58	0.63-2.50	1.02
Aldrin						
Tarpon	2/2	0.98-1.40	1.19	NC		
Minnows	18/24	0.22-3.80	1.65	5/58	0.28-2.00	0.70
alpha-BHC						
Minnows	6/24	0.68-1.30	1.06	0/58		
beta-BHC						
Tarpon	1/2	0.52	0.69	NC		
Minnows	14/24	0.91-4.40	1.79	5/58	1.30-6.00	0.95

TABLE 9-28

SUMMARY STATISTICS FOR ANALYTES DETECTED IN MINNOWS AND TARPON FROM AOC B AND BACKGROUND SITES
NAS KEY WEST
PAGE 2 OF 2

Analytes	AOC B			Background		
	Frequency of Detection	Range of Detected Values	Average[1]	Frequency of Detection	Range of Detected Values	Average[1]
delta-BHC						
Minnows	4/24	0.16-0.84	1.02	13/58	0.08-1.00	0.58
gamma-BHC (lindane)						
Tarpon	1/2	0.31	0.58	NC		
Minnows	10/24	0.21-1.50	0.89	0/58		
Chlorobenzilate						
Tarpon	2/2	25.00-74.00	49.50	NC		
Minnows	11/24	15.00-65.00	22.48	3/56	73.0-190.0	483.25
Dieldrin						
Tarpon	1/2	0.93	1.29	NC		
Minnows	15/24	0.17-3.80	1.63	11/58	0.34-4.90	1.13
Endosulfan I						
Tarpon	2/2	0.87-2.20	1.54	NC		
Minnows	13/24	0.12-2.10	0.90	6/58	0.66-2.60	0.73
Endosulfan II						
Tarpon	2/2	0.53-0.70	0.62	NC		
Minnows	15/24	0.13-0.70	1.07	1/58	1.90	1.02
Endosulfan sulfate						
Tarpon	1/2	4.80	3.23	NC		
Minnows	12/24	0.75-17.00	3.75	3/58	1.60-9.80	1.30
Endrin						
Tarpon	2/2	0.62-0.72	0.67	NC		
Minnows	4/24	0.27-1.70	1.99	2/58	1.00-1.10	0.98
Endrin aldehyde						
Tarpon	2/2	1.40-3.90	2.65	NC		
Minnows	23/24	0.68-18.00	2.69	3/58	3.40-5.40	1.15
Heptachlor						
Minnows	14/24	0.05-2.60	1.26	0/58		
Heptachlor epoxide						
Tarpon	2/2	0.59-3.00	1.80	NC		
Minnows	8/24	0.22-3.40	1.12	8/58	1.00-10.00	1.01
Isodrin						
Minnows	21/24	0.45-4.00	1.52	0/58		
Methoxychlor						
Minnows	10/24	1.30-7.80	8.05	1/58	1.90	3.73

1 One-half the detection limit used for all non-detected values.
NC = Not Collected.

TABLE 9-29

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CRABS FROM AOC B AND BACKGROUND SITES
NAS KEY WEST
PAGE 1 OF 2

	AOC B			Background[1]		
	Frequency of Detection	Range of Detected Values	Average[2]	Frequency of Detection	Range of Detected Values	Average[2]
INORGANICS (mg/kg)						
Arsenic				14/15	4.10-31.00	15.14
Blue Crab	6/8	3.60-5.20	3.64			
Barium				7/15	1.10-3.50	1.13
Blue Crab	3/8	1.60-3.00	1.12			
Mud Crab	2/2	4.10-4.80	4.45			
Chromium				0/15		
Blue Crab	1/8	0.97	0.48			
Copper				14/15	5.50-60.50	20.38
Blue Crab	8/8	16.60-30.20	23.31			
Mud Crab	2/2	16.50-18.80	17.65			
Iron				7/15	22.2-56.5	23.5
Minnows	1/2	34.4	23.6			
Lead				5/15	0.37-0.60	0.27
Blue Crab	5/8	0.38-1.70	0.71			
Mud Crab	2/2	0.52-0.60	0.56			
Manganese				12/15	0.36-3.60	1.30
Blue Crab	8/8	2.10-10.90	4.60			
Mud Crab	2/2	30.10-56.00	43.05			
Zinc				15/15	8.50-58.00	33.87
Blue Crab	8/8	17.10-46.10	32.18			
Mud Crab	2/2	52.10-56.20	54.15			
PESTICIDE/PCBs (µg/kg)						
4,4'-DDD				10/15	0.41-1.60	1.14
Blue Crab	3/8	1.10-2.70	2.04			
Mud Crab	1/3	0.36	1.95			
4,4'-DDE				5/15	0.37-1.90	1.37
Blue Crab	8/8	0.69-3.70	1.61			
Mud Crab	2/3	1.20-4.60	2.65			
4,4'-DDT				5/15	0.48-1.60	1.37
Blue Crab	7/8	0.74-4.90	1.99			
Mud Crab	2/3	0.52-1.70	1.71			
Aldrin				9/15	0.13-3.40	0.76
Blue Crab	5/8	0.22-0.27	0.58			
Mud Crab	1/3	0.19	1.01			
alpha-BHC				0/15		
Blue Crab	1/8	0.75	1.05			
beta-BHC				1/15	0.56	0.83
Blue Crab	4/8	0.47-1.20	0.87			

TABLE 9-29

SUMMARY STATISTICS FOR ANALYTES DETECTED IN CRABS FROM AOC B AND BACKGROUND SITES
NAS KEY WEST
PAGE 2 OF 2

	AOC B			Background[1]		
	Frequency of Detection	Range of Detected Values	Average[2]	Frequency of Detection	Range of Detected Values	Average[2]
Chlorobenzilate				8/15	4.40-140.00	23.49
Blue Crab	6/8	24.00-140.00	56.88			
Mud Crab	1/3	6.60	11.70			
Dieldrin				9/15	0.38-2.30	1.24
Blue Crab	3/8	2.90-4.60	2.54			
Mud Crab	2/3	0.77-1.20	1.52			
Endosulfan I				1/15	0.40	0.82
Blue Crab	8/8	0.38-1.80	1.18			
Mud Crab	1/3	0.50	1.03			
Endosulfan II				6/15	0.14-2.60	1.29
Blue Crab	2/8	0.64-0.90	1.64			
Mud Crab	1/3	0.30	1.93			
Endosulfan sulfate				1/15	1.10	1.61
Blue Crab	7/8	0.55-3.00	1.58			
Mud Crab	1/3	2.20	2.57			
Endrin				11/15	0.22-2.70	1.07
Blue Crab	3/8	0.43-2.70	1.92			
Mud Crab	1/3	0.29	1.93			
Endrin aldehyde				13/15	0.34-2.80	1.68
Blue Crab	8/8	2.20-5.70	4.15			
Mud Crab	2/3	3.10-8.30	4.52			
Heptachlor				5/15	0.05-0.52	0.66
Blue Crab	4/8	0.29-0.57	0.64			
Mud Crab	1/3	0.68	1.09			
Heptachlor epoxide				3/15	0.37-8.20	1.28
Blue Crab	4/8	2.30-5.40	2.34			
Mud Crab	1/3	0.51	1.12			
Isodrin				2/15	0.51-0.57	1.50
Mud Crab	1/3	0.78	1.84			
Methoxychlor				2/15	5.00-11.00	8.43
Blue Crab	2/8	2.30-5.80	8.45			
Mud Crab	1/3	10.00	12.00			

1 Blue crabs and mud crabs were not collected from background sites; values shown are for crabs of all species collected from background sites.
2 One-half the detection limit used for all non-detected values.

9.7.4.1.4 Food Chain Modeling

Aluminum, barium, zinc, arsenic, and copper were the major contributors to potential risks to the cotton rat at AOC B (Table 9-30). The HI value was 0.86 and incidental ingestion of contaminated soil accounted for the majority or contaminant exposure. Since only one soil sample was collected, the maximum and mean contaminant concentration scenario data are identical for this receptor. Zinc, arsenic, chromium, cobalt, and copper were the major contributors to potential risk to the kestrel, and the HI value was 0.35 (Table 9-31). Since ingestion of soil and water were not considered in the model for this raptor, ingestion of contaminated prey accounted for 100 percent of total contaminant exposure. Like the cotton rat results, since only one soil sample was collected, the maximum and mean contaminant concentration scenario data are identical for the kestrel. Barium, zinc, 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE were the major contributors to potential risks to the great blue heron for both the maximum and mean fish (prey) contaminant concentration scenarios (Tables 9-32 and 9-33). Total HI values for the maximum and average concentration scenarios were 3.29 and 1.22, respectively. Aroclor-1260 was the primary contributor to potential risks to the raccoon for the maximum concentration scenario, but the HI for Aroclor-1260 was only 0.01 (Table 9-34). No analytes had an HI above 0.0 for the mean contaminant concentration scenario (Table 9-35).

9.7.4.2 Discussion

Copper and nickel were the only inorganic COPCs in groundwater. The HQ values for these two metals were relatively low, and they were detected in only one groundwater sample (ABMW-1). Copper and nickel were not detected in surface water from the canal or in groundwater sample ABMW-2, which was collected from the monitoring well directly between sample ABMW-1 and open marine water. Because of this and because groundwater flow from the former disposal area is toward the south instead of eastward toward open marine water, groundwater to surface-water discharge of inorganics does not appear to be occurring. The surface-water samples from the area south of the canal were collected from shallow (1 to 4 inches), ephemeral standing water in the mangrove swamp. Based on the lack of elevated concentrations of inorganics in groundwater it is likely that inorganic contaminants in these shallow surface-water samples are probably a result of contaminants in adjacent sediment and soil, rather than a result of groundwater contamination. Several organochlorine pesticides were present in elevated concentrations in groundwater. None of the pesticides in groundwater were detected in surface water, but several of them were detected in sediment. Gamma-BHC (lindane), 4,4'-DDE, and dieldrin (as discussed in detail below) were the three organic compounds determined to pose significant potential risks in sediments and were elevated in sediment samples from the canal. Since 4,4'-DDE and dieldrin were detected in groundwater, migration of organics in groundwater to sediment may be occurring.

TABLE 9-30

MAJOR CONTRIBUTORS TO RISK FOR THE COTTON RAT MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - AOC B* NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aluminum	0.74	85.1
Barium	0.04	4.4
Zinc	0.04	4.4
Arsenic	0.03	3.0
Copper	0.02	2.5
All others	0.0	0.7
Total receptor HI	0.86	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.67	77.3
Food	0.20	22.7

*Since only one soil sample was collected, the maximum and mean results were identical.

TABLE 9-31

MAJOR CONTRIBUTORS TO RISK FOR THE KESTREL MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - AOC B* NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Zinc	0.34	97.5
Arsenic	0.01	1.6
Chromium	0.00	0.2
Cobalt	0.00	0.2
Copper	0.00	0.2
All others	0.00	0.3
Total receptor HI	0.35	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	0.35	100.0

*Since only one soil sample was collected, the maximum and mean results were identical.

TABLE 9-32

MAJOR CONTRIBUTORS TO RISK FOR THE GREAT-BLUE HERON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - AOC B NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Barium	1.62	49.2
Zinc	0.66	20.0
4,4'DDT	0.33	10.2
4,4'DDD	0.21	6.3
4,4'DDE	0.13	4.1
All others	0.34	10.3
Total receptor HI	3.29	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	3.29	100.0

TABLE 9-33

MAJOR CONTRIBUTORS TO RISK FOR THE GREAT-BLUE HERON MEAN CONTAMINANT CONCENTRATION SCENARIO - AOC B NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Barium	0.42	34.6
Zinc	0.41	33.4
4,4'-DDT	0.12	9.7
4,4'DDD	0.08	6.7
4,4'DDE	0.07	5.9
All others	0.12	9.7
Total receptor HI	1.22	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Soil	0.0	0.0
Food	1.22	100.0

TABLE 9-34

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MAXIMUM CONTAMINANT CONCENTRATION SCENARIO - AOC B NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
Aroclor-1260	0.01	52.9
beta-BHC	0.00	15.0
Heptachlor-epoxide	0.00	10.0
alpha-BHC	0.00	9.4
Endrin	0.00	5.0
All others	0.00	7.9
Total receptor HI	0.02	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.01	57.3
Food	0.01	42.7

TABLE 9-35

MAJOR CONTRIBUTORS TO RISK FOR THE RACCOON MEAN CONTAMINANT CONCENTRATION SCENARIO - AOC B NAS KEY WEST

Chemical	Total HI per Chemical for all Pathways	% Contribution of Chemical to Total Receptor HI
alpha-BHC	0.00	30.8
beta-BHC	0.00	27.2
Aroclor-1260	0.00	15.4
Endrin	0.00	10.1
Heptachlor epoxide	0.00	8.3
All others	0.00	8.1
Total receptor HI	0.01	

Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
Sediment	0.0	20.1
Food	0.01	79.9

Arsenic, beryllium, chromium, cobalt, and four PCB compounds were all COPCs in surface water, but were only detected in 1 of 14 samples. Another organic, 2,4,5-TP, was a surface-water COPC, but was only detected in 1 of 10 samples. Lead and nickel were surface-water COPCs, but were only detected in 2 and 3 of 14 samples, respectively. The COPC tin was detected in only 1 of 4 samples. Most of these COPCs were detected only in 1993 samples (prior to the IRA). Zinc was detected in 4 of 14 samples but was not detected in 1996 samples. Conversely, copper, iron, manganese, and mercury were detected in several 1993 and 1996 samples collected in the mangrove swamp and canal, and had HQ values significantly greater than 1.0. In addition, several detections of these four metals exceeded surface-water thresholds (Table 9-3), suggesting potential risks to aquatic receptors in the canal and mangrove swamp from these inorganics.

Arsenic and chromium had sediment maxima in excess of thresholds, but the HQ values were relatively low and their maxima did not exceed less conservative thresholds. Several other metals in sediments had maxima that exceeded both the most and less conservative sediment threshold used in the assessment, including cadmium, copper, iron, lead, mercury, nickel, and zinc. Mercury, however, had only 2 detections (out of 15) that exceeded the most conservative threshold and only one detection that exceeded the less conservative threshold used in this ERA (Table 9-2). Concentrations of iron exceeded the most conservative threshold in 5 of 38 sediment samples; four of these samples also exceeded the less conservative threshold. Cadmium, copper, lead, nickel, and zinc had several detected concentrations that exceeded the most conservative thresholds used or more than one detected concentration that exceeded the less conservative thresholds used. As a result, cadmium, copper, iron, lead, nickel, and zinc could pose potential risks to benthic organisms.

Tin was retained as a sediment COPC since the maximum detected concentration exceeded two times its average background and no suitable screening level was available, but it was only detected in 1 of 4 samples. Tin is not usually considered to pose a major problem as a heavy metal contaminant unless present largely in the rare methylated form (Mailman, 1980). In addition, aluminum, beryllium, and vanadium were conservatively retained as COPCs in lieu of thresholds. Aluminum is one of the most abundant metals in the earth's crust, and is ubiquitous in the environment (Goyer, 1986). Although beryllium can be toxic in the environment, beryllium toxicosis is usually associated with inhalation exposure to industrial workers (Goyer, 1986). Six of seven detected values for beryllium in sediment were relatively low (< 0.13 mg/kg; Table 9-2). Although the highest concentration of vanadium in sediments was 40.5 mg/kg, few detected values exceeded two times the average background concentration. Also, vanadium is not considered to be highly toxic in the environment (Mailman, 1980).

Organic compounds retained as sediment COPCs consisted of two PCB compounds and ten pesticides and daughter products. Endosulfan sulfate and 2,4,5-TP were conservatively retained as sediment COPCs since no ecological thresholds were available, but were detected in only 1 of 8 and 1 of 10 samples, respectively. Maximum concentrations of the remaining ten organic COPCs exceeded sediment threshold values. The maximum concentration of gamma-BHC (lindane) exceeded both most and less conservative thresholds, but all other lindane concentrations in sediment were ≤ 1.9 µg/kg, considerably less than the average background concentration of 6.72 µg/kg. All sediment concentrations of 4,4'-DDT (3.2 to 6.4 µg/kg) were less than the average background sediment concentration of 13.02 µg/kg.

Maximum concentrations of eight organic COPCs (Aroclor 1260, Aroclor 1248, heptachlor, endrin, dieldrin, endosulfan I, 4,4'-DDD, and 4,4'-DDT) were measured in sample ABSS-4, collected in 1996 (Table 9-2). The maximum concentration of Aroclor 1254 exceeded both most and less conservative thresholds, but was detected only in 1 of 12 samples. Aroclor 1260 was detected in only 3 of 12 samples; its maximum value was 402 µg/kg, and the other detected concentrations of this PCB compound were only 19 and 17 µg/kg. The maximum concentration of heptachlor was 6.9 µg/kg (HQ=1.4), other concentrations were ≤ 1.3 µg/kg, and were less than the ecological threshold. Dieldrin was detected in 4 of 9 sediment samples; its maximum concentration of 28.8 µg/kg was indicative of high potential risk (HQ=40.3) using the most conservative threshold available. Other detected values of dieldrin ranged from 2.2 to 2.5 µg/kg. The maximum concentration of endosulfan I was 19.5 µg/kg (HQ=6.7), but all other sediment concentrations of endosulfan I (≤ 6.2 µg/kg) were less than the average background concentration of 6.7 µg/kg. The maximum concentration of endrin was 32.5 µg/kg (HQ=9.8), but all other sediment concentrations of endrin (≤ 1.7 µg/kg) were less than the ecological threshold and less than the average background concentration of 6.7 µg/kg. The DDT daughter products 4,4'-DDD and 4,4'-DDE were detected in all sediment samples, with HQ values of 10.3 and 7.6 respectively, but all concentrations were less than average background values. In addition, with the exception of the maximum value of 4,4'-DDD and 4,4'-DDE, all concentrations of these two compounds were less than, or only slightly greater than, the most conservative ecological thresholds.

As discussed above, several organic compounds were retained as sediment COPCs. The COPCs of greatest concern, based on HQ values and frequencies of detection, are dieldrin, lindane, and possibly DDT and daughter products. However, the data indicate that sediment organic contaminants are primarily limited to "hot spots," especially in the vicinity of sample ABSS-4, which is located near the edge of the remediated area south of the canal. Concentrations of these COPCs in canal sediments were unremarkable. Most of the organic COPCs are organochlorine pesticides which were once widely used in the Florida Keys. The presence of these COPCs in AOC B sediments at concentrations similar to

background values suggests that (with the exception of "hot spots") the COPCs at AOC B are not due to site-related activities.

As discussed above, some metals and pesticides in AOC B sediments may be present in concentrations high enough to pose potential risks to benthos. However, the small, static nature of surface water in the canal most likely limits the potential diversity and abundance of the benthic macroinvertebrate community. Since the canal has been cut off from open water it does not receive the influx of nutrients and organisms from the ocean that could increase the productivity of the system. Also, the ephemeral nature of surface water in the swamp on and around the former landfill area also precludes the existence of a diverse benthic macroinvertebrate community. That is, since the area is frequently dry and water is shallow when present, conditions are not conducive to the existence of a diverse, abundant, and productive benthic community.

No COPCs were identified in AOC B surface soils. Only one soil sample was available due to the swampy nature of the site. Zinc was the only terrestrial plant COPC, but its HQ value of 1.2 was rather low. The total HI value for the cotton rat, used as a representative receptor in the foodchain modeling, was less than 1.0. This suggests that this small mammal and other similar species are not at potential risk from surface soil contaminants at AOC B. Similarly, the total HI value for the kestrel was less than 1.0. Therefore it is unlikely that this receptor and other raptors are at potential risk from surface soil contaminants. For the great blue heron, the total HI value exceeded 1.0 but was relatively low using the maximum detected contaminant concentrations in fish from the canal (total HI = 3.34). Using the mean contaminant concentrations in fish, the HI slightly exceeded 1.0 (total HI = 1.24). Although these numbers alone indicate potential risk to this piscivorous bird, several factors mitigate risks. First, the feeding territory (the area defended by a single heron while foraging) for this species is larger than the AOC B area. Feeding territory for the great blue heron can be as small as 0.6 ha but is usually larger, up to 8.4 ha (USPEPA, 1993b). The entire canal encompasses approximately 4.0 ha, and much of this is not suitable feeding habitat for wading birds (e.g., deep water). Thus, this species is unlikely to forage exclusively at AOC B, nor are other similar piscivorous bird species. Second, the model assumed an absorption fraction of 80 percent for the dose calculations describing the uptake of vegetation, prey, soil, and sediment. That is, 80 percent of the ingested contaminants were assumed to be absorbed into the body. Actual absorption fractions vary considerably but are generally considered to be less than 80 percent (Hrudey et al., 1996). Taking these factors into account, the HI values would be much lower.

The inorganics aluminum, chromium, and copper were detected in minnows collected in the canal but were detected only in 1 of 24 samples. Also, the average detected values of these three metals in AOC B fish were lower or comparable to the concentrations in minnows collected at background sites. Although barium, iron, lead, manganese, and zinc were each detected in several minnow samples collected from

AOC B, the average concentration of barium, iron, lead, and zinc in AOC B minnows was less than the average detected concentrations in background minnows. The maximum and average detected concentrations of lead in AOC B minnows was less than the value of 2.0 mg/kg in fish that is protective of marine animals (Maddock and Taylor, 1980). The average concentration of manganese in AOC B-related minnows was approximately 4 times the average concentration in background minnows. Manganese was a COPC in surface water but can occasionally be found in excessive amounts in both surface water and groundwater (Gaudy, 1980). It is an essential nutrient that is a cofactor in a number of enzymatic reactions (Goyer, 1986). Therefore, its slightly elevated presence in AOC B minnows is unremarkable.

Arsenic, manganese, and zinc were detected in tarpon collected in the canal. The maximum and average concentrations of manganese were below those detected in minnows at the site, and as mentioned above, the presence of this contaminant in fish is unlikely to pose potential risks. The accumulation of zinc depends on fish size, age, water hardness, temperature, pH, the presence of other elements, and other factors (Sorenson 1991; Eisler 1993). Because of this and, since no tarpon were collected at background sites, zinc concentrations in these two tarpon are difficult to interpret. However, zinc was detected in 75 of 77 total background fish at concentrations ranging from 5.0 to 248 mg/kg, and averaged 38.8 mg/kg (Appendix F, Table 7-4). Thus, the two values of zinc in tarpon (17.5 and 30.0 mg/kg) appear to be unremarkable. Arsenic concentrations from tarpon tissue samples (5.8 and 6.5 mg/kg) were slightly higher than the 2 to 5 mg/kg range considered to be common in marine finfish (Eisler, 1988). No background tarpon were available for comparison, but arsenic was detected at concentrations ranging from 0.29 to 8.3 mg/kg in 35 of 77 total background fish (Appendix F, Table 7-4). Arsenic was detected in only 1 of 14 surface-water samples from AOC B, was not detected in groundwater, and was only slightly elevated in sediment. Arsenic was not detected in AOC B minnows that tarpon may consume but was detected in blue crabs (3.6 to 5.2 mg/kg) that tarpon may consume. Mean concentrations of arsenic in freshwater fish in the United States were 0.14 to 0.16 mg/kg (Lowe et al., 1985). Whole fish in Lake Texoma on the Texas/Oklahoma border have arsenic levels of 0.1 to 34.0 mg/kg (Hunter et al., 1981). Marine organisms in general accumulate more arsenic from the water column than freshwater organisms (Maher, 1983), and marine teleosts may be unaffected by muscle residues up to 40 mg/kg (Eisler, 1988). For the above reasons, arsenic concentrations in the two tarpon from the AOC B canal appear to be unremarkable.

Several organics, primarily organochlorine pesticides, were detected in minnows collected from AOC B. The average concentrations of 4,4'-DDD, 4,4'-DDE, chlorobenzilate, dieldrin, endosulfan I, endosulfan II, and heptachlor epoxide were less than or comparable to the average concentrations detected in background minnows. The average concentrations of 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, endosulfan sulfate, endrin, endrin aldehyde, heptachlor, isodrin, and methoxychlor were either slightly to moderately higher than concentrations in background minnows or were detected in

AOC B minnows but not in background minnows. The average concentrations of all of these organics in minnows were 4 µg/kg or less, with the exception of methoxyclor which had an average of 8 µg/kg. The average concentrations of 4,4'-DDT, aldrin, BHC isomers, endrin, and heptachlor were all below the contaminant concentrations in fish protective of fish or piscivorous receptors (Table C.3-26). No similar protective thresholds were available for the other pesticides that exceeded background minnow concentrations. In general, a low level of risk is associated with whole body tissue residues of organochlorine compounds of less than 100 µg/kg (Gibson and Dillon, 1989). All detected concentrations of pesticides in fish collected from AOC B were below 100 µg/kg. For these reasons, it appears unlikely that organics are accumulating to levels in minnows that pose significant potential risks to small fish and wildlife that feed on them.

Since no tarpon could be collected at background sites, comparison of concentrations of organics in AOC B tarpon to background tarpon cannot be conducted. However, concentrations of all organics detected in tarpon were approximately 7 µg/kg or less, with the exception of chlorobenzilate. This organic was detected at an average of 49.5 µg/kg, which is much lower than the average detected in background minnows. More importantly, no organics were detected in tarpon in excess of the levels protective of fish presented in Table C.3-26.

Interpretation of contaminant concentrations in AOC B crab samples is confounded by the scarcity of toxicity data for these organisms, the lack of contaminant concentrations presented in the literature that are protective of crabs and crab-eating organisms, and the absence of the same species in background samples. Several inorganic contaminants were detected in blue crab samples collected from the canal at AOC B. Of these, chromium was detected in only one of eight samples. The maximum concentration of this inorganic was 0.48 mg/kg. Eisler (1986a), while not specific to crabs, presents a value of 1.0 mg/kg of chromium as presumptive evidence of contamination in fish and wildlife. Arsenic, barium, copper, and zinc were all detected in blue crabs but at average concentrations less than or comparable to those detected in crabs collected from background sites. Lead and manganese were detected in blue crabs at average concentrations slightly higher than those detected in background. As mentioned above, the presence of slightly elevated levels of manganese in biota is not an unusual phenomenon. The average concentration of lead in blue crabs of 0.71 mg/kg is below the concentration of 2.0 mg/kg in fish that is protective of marine animals (Maddock and Taylor, 1980).

Barium, copper, iron, lead, manganese, and zinc were detected in mud crab samples, although only two samples could be collected at AOC B. Concentrations of copper, iron, lead, and zinc in mud crabs were approximately equal to the concentrations of those metals in background crabs. Barium and manganese concentrations in AOC B crabs were higher than those detected in background crabs. Again, manganese

is a ubiquitous essential nutrient that does not appear to be present in concentrations high enough to elicit toxicity. Barium is not generally considered to be highly toxic the environment, is relatively abundant in nature, and is commonly found in plant and animal tissue (Goyer, 1986).

A number of organics, mainly organochlorine pesticides, were also detected in crab samples from AOC B. For blue crabs, the concentrations of 4,4'-DDE, 4,4'-DDT, aldrin, beta-BHC, endosulfan I, endosulfan II, endosulfan sulfate, endrin, isodrin, and methoxyclor were less than or comparable to the concentrations detected in background crabs. The concentrations of 4,4'-DDD, alpha-BHC, chlorobenzilate, dieldrin, endrin aldehyde, and heptachlor epoxide in blue crabs were slightly higher than the concentrations in background samples or were detected in AOC B blue crabs but not in background crabs. The average concentrations of organics detected in AOC B mud crabs were below or comparable to the concentrations detected in blue crabs from AOC B. None of the maximum or average concentrations of the compounds detected in blue or mud crabs exceeded concentrations in fish tissue protective of fish or piscivorous wildlife presented in Table C.3-26. Although the values in Table C.3-26 were not developed specifically for crabs of other shellfish, many of them were developed to be protective of piscivores from those concentrations in any prey.

9.7.4.3 Ecological Risk Summary

AOC B is comprised of a former automobile scrap disposal area surrounded on three sides by a mangrove swamp. A canal that appears to have been formerly connected to the ocean is present north of the disposal area. The mangrove swamp and former disposal area lie within a tidal zone that is periodically inundated with sea water. A recent IRA removed 993 cubic yards of soil from the former disposal area. Although terrestrial habitat is limited at the site, the mangrove swamp and canal provide excellent aquatic and semi-aquatic habitat.

Copper, iron, manganese, mercury, and zinc were present in surface water in concentrations that could pose potential risks to aquatic receptors. However, none of these metals appears to be accumulating in fish or crabs collected in the canal. Several contaminants in sediments were detected that could pose potential risks to aquatic receptors, including cadmium, copper, iron, lead, nickel, zinc, DDT and daughter products, dieldrin, and gamma-BHC (lindane). Of these, 4,4'-DDE and dieldrin were elevated in groundwater. Yet, none of these contaminants appear to be accumulating in fish or crabs from AOC B. All concentrations of organic contaminants were well below 100 µg/kg. As mentioned above, in a review of approximately 1,200 studies of tissue residues and sublethal effects in marine animals, Gibson and Dillon (1989) noted that 100 µg/kg or less of any organochlorine contaminant is considered to be low.

It is possible that metals in surface water may not be in the dissolved form which is the most bioavailable. It is also possible that metals and organics in sediments may be bound to acid volatile sulfide (AVS) and total organic carbon (TOC) and, therefore, may not be bioavailable. Arsenic concentrations in two tarpon collected from the canal were only slightly higher than the 2 to 5 mg/kg range considered to be common in marine finfish (Eisler, 1988). However, the concentrations were within the range of values in background fish at NAS Key West. Furthermore, arsenic was not found to pose significant potential risks in surface water or sediment; it was not detected in minnows and was not elevated in crabs. Thus, arsenic concentrations in the two tarpon are not considered to pose significant risks. The results of the foodchain modeling indicate that mammals and avian piscivores are not at risk from AOC B-related contaminants. HI values for the great blue heron exceeded 1.0 but were mitigated by a number of factors, suggesting relatively low potential risks to wading birds.

For these reasons, potential risks to ecological receptors at AOC B appear to be confined to potential risks to benthos. Nonetheless, the static nature of the aquatic system in the canal and the ephemeral nature of water in the swamp near the site probably preclude the existence of diverse and abundant benthic communities regardless of the presence of contaminants. Therefore, although remediation of the sediments at AOC B may remove contaminants from the site, it would not improve the quality of the benthic habitat. In addition, the contaminants present in AOC B surface water and sediments do not appear to be in bioavailable form, as evidenced by the absence of accumulation in biota. Disruption of sediments for remediation at the site may resuspend contaminants in the water column, thereby potentially increasing their bioavailability. As such, remediation at AOC B based on ecological concerns is not recommended. Further, the Phase I and Phase II ecological investigations were sufficient to characterize ecological risks at AOC B, and therefore, additional ecological study at the site is unwarranted.

9.8 CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of investigation at AOC B were to identify the existing nature and extent of contamination (after an IRA) in the on-site media, to provide a baseline human health risk assessment of COPCs identified in those media, and to perform an ecological risk assessment.

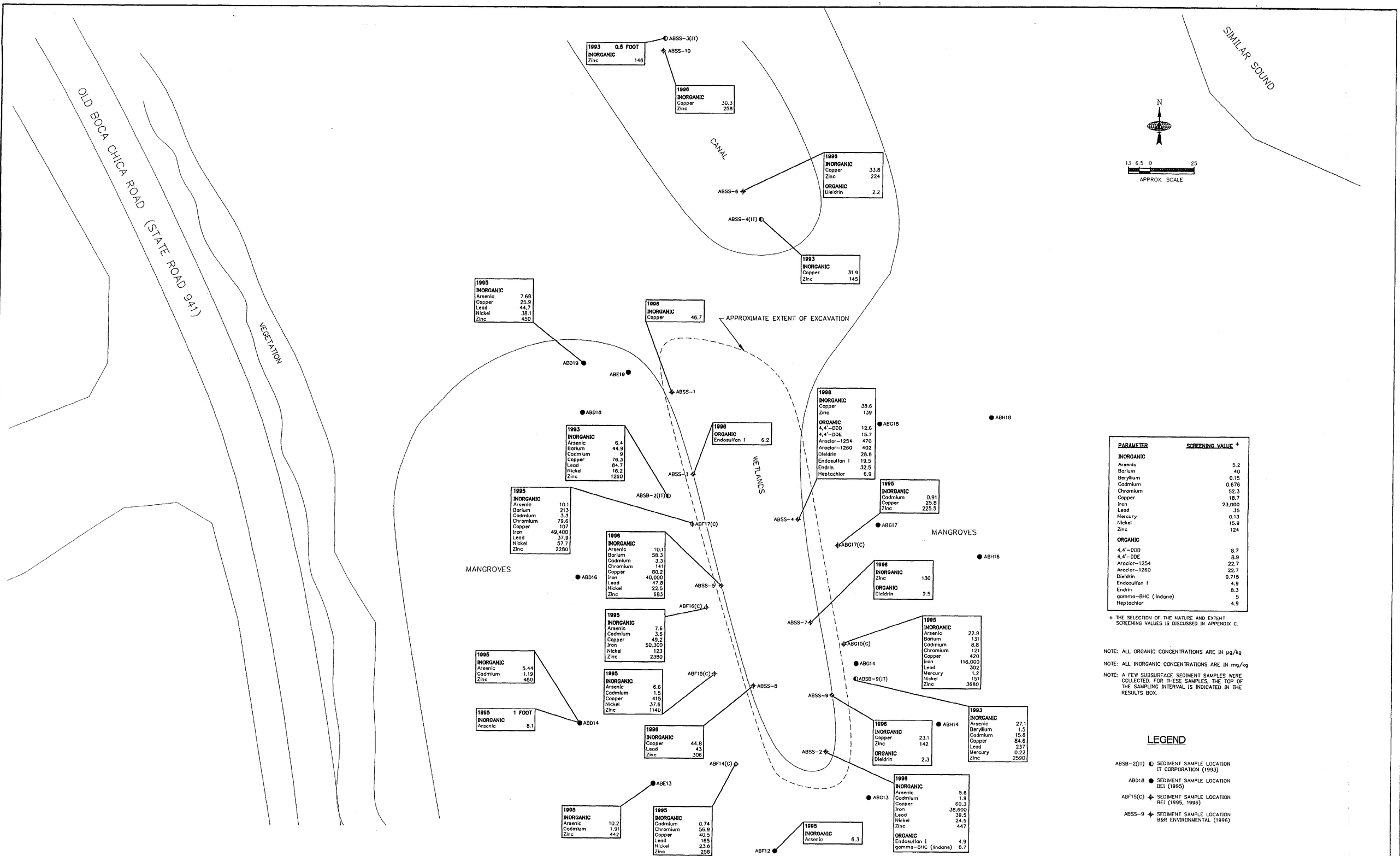
AOC B encompasses 10 acres, which include a former disposal area that contained discarded truck and car body parts. In 1996, BEI conducted an IRA that removed most of discarded debris and 993 cubic yards of surface soil. Metals and pesticides were the most frequently detected contaminants at AOC B. In general, the number of metals detected and the concentrations of these metals were highest at the edge of the excavated area and decreased with distance into the surrounding mangrove swamp. PCBs

were detected in isolated surface water and sediment samples. VOCs and SVOCs were rarely detected in any medium, while pesticides were detected in groundwater and sediment at low levels.

The human health risk assessment indicates that contaminants are not present at sufficient concentrations to cause possible adverse noncarcinogenic health effects to current potential receptors. The cancer risks estimated for the current potential receptors and the future resident were also within EPA's target risk range of 1E-04 to 1E-06; however, the risk exceeds the FDEP cancer risk of 1E-06. Contaminants are present at sufficient levels to cause possible adverse noncarcinogenic health effects to future residential receptors. Arsenic in sediment and antimony in surface water are the main contributors to noncarcinogenic risks. However, uncertainty exists because antimony is in the range of background concentrations, and arsenic was detected only at levels slightly above background. In addition, arsenic and antimony may not be associated with past activities at the site, which consist of disposal of car and truck frames. Since arsenic and antimony are major contributors to risk, risks may be overstated. The cancer risk to future residents remains in the 1E-04 to 1E-06 range.

The ecological risk assessment indicates low potential risk to most ecological receptors at AOC B. Some contaminants may pose potential risks to benthic organisms. However, conditions at the site probably preclude the existence of diverse and abundant benthic communities regardless of the presence of contaminants. Results of the foodchain modeling indicate low potential risks to mammals and piscivorous birds from AOC B-related contaminants. In addition, contaminants present in surface water and sediments have not accumulated in fish and crabs. This suggests that the contaminants may not be in bioavailable form. Therefore, although remediation of sediments at AOC B may remove contaminants, it would not improve the quality of the benthic habitat and may resuspend contaminants in water, potentially increasing their bioavailability.

Although inorganic contaminants (i.e., antimony and arsenic) are present at concentrations that might contribute to the risk for the hypothetical future resident, these metals may not be associated with past site-related activity. Antimony and arsenic appear to be present at concentrations within or slightly above background. Based on the minimal human health and ecological risks posed by the site, it is recommended that an NFA decision document be prepared for AOC B with the provision that a future residential scenario is prevented by institutional controls.



PARAMETER	SCREENING VALUE +
INORGANIC	
Arsenic	5.2
Barium	40
Beryllium	0.15
Cadmium	0.676
Chromium	52.3
Copper	18.7
Iron	23,000
Lead	35
Mercury	0.13
Nickel	15.9
Zinc	124
ORGANIC	
4,4'-DDD	8.7
4,4'-DDE	8.9
Aroclor-1254	22.7
Aroclor-1260	22.7
Dieldrin	0.715
Endosulfan I	4.9
Endrin	8.3
gamma-BHC (lindane)	5
Heptachlor	4.9

+ THE SELECTION OF THE NATURE AND EXTENT SCREENING VALUES IS DISCUSSED IN APPENDIX C.

NOTE: ALL ORGANIC CONCENTRATIONS ARE IN µg/kg

NOTE: ALL INORGANIC CONCENTRATIONS ARE IN mg/kg

NOTE: A FEW SUBSURFACE SEDIMENT SAMPLES WERE COLLECTED. FOR THESE SAMPLES, THE TOP OF THE SAMPLING INTERVAL IS INDICATED IN THE RESULTS BOX.

LEGEND

ABSB-2(II) ◐ SEDIMENT SAMPLE LOCATION IT CORPORATION (1993)

ABD18 ● SEDIMENT SAMPLE LOCATION BEI (1995)

ABF15(C) ✦ SEDIMENT SAMPLE LOCATION BEI (1995, 1996)

ABSS-9 ✦ SEDIMENT SAMPLE LOCATION B&R ENVIRONMENTAL (1996)

SITE MANAGER: RCD	CHECKED BY: CB
DRAWN BY: LRH	DRAWING DATE: 4/21/97
SURVEYED BY: TCB	SURVEY DATE: 9/24/96
SCALE: AS SHOWN	
CAD DWG. NO.:7046AOC912	PROJ. NO.: 7046

Brown & Root Environmental

AOC B

SEDIMENT CHEMICAL CONCENTRATIONS

NAVAL AIR STATION
KEY WEST, FLORIDA

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