CORRECTIVE MEASURES STUDY PLAN BOCA CHICA DICHLORODIPHENYLTRICHLOROETHANE MIXING AREA NAS KEY WEST FL

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CORRECTIVE MEASURES STUDY PLAN
BOCA CHICA DDT MIXING AREA
NAVAL AIR STATION - KEY WEST
KEY WEST, FLORIDA

PREPARED FOR

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA
CONTRACT NO. N62467-88-C-0196

PREPARED BY

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IT PROJECT NO. 595392
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This document was prepared on behalf of Naval Air Station-Key West by IT Corporation, Tampa, Florida.

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1.0 Introduction

This Corrective Measures Study (CMS) Work Plan is prepared by IT Corporation (IT) to identify and recommend as appropriate, specific measures to correct a release at SWMU 2, (Boca Chica DDT Mixing Area) at Naval Air Station (NAS) Key West. The plan was developed based on site visits, meetings and discussions with the Southern Division Naval Facility Engineering Command (SouthDiv), NAS-Key West personnel and information gathered from a Phase I RCRA Facility Investigation (RFI) conducted by IT at SWMU 2. Information that will be collected from the performance of a future Phase II RFI will also be used as part of the CMS.

1.1 Historical Perspective

Section II.G.1.b of the Hazardous and Solid Waste Amendments (HSWA) portion of the RCRA permit (No. H044-144053) issued to NAS-Key West on August 30, 1990 states that a CMS plan should be prepared for those SWMUs requiring a CMS. The EPA notified NAS-Key West on Sep. 27, 1991 to perform a CMS at SWMU-2, Boca Chica DDT Mixing Area.

1.2 CMS Plan Approach

Subsequent to the completion of the RFI to the point that the corrective action objectives are established and are approved by the USEPA, the CMS effort will be initiated. The following sections describe the various tasks associated with the performance of the CMS at Boca Chica DDT Mixing Area. The CMS Plan presents site background, environmental setting, existing data and scope of work for the CMS. The CMS plan will include a description of the general approach to investigating and evaluating potential remedies, a definition of the overall objectives of the study, a schedule for the study, a description of the specific remedies which will be studied and a description of how each potential remedy will be evaluated. The CMS plan will consist of the following four main sections with associated sub-sections:

Section 2.0: Regional Physical Setting

- Location
- Climate
- Biological factors
- Hydrogeology/Geology
- Surface water hydrology
- Migration potential
- Potential contaminant receiving body

Section 3.0: Identification and Development of the Corrective Measure Alternatives

- Description of current situation
- Establishment of corrective action objectives
- Screening of corrective measures technologies
- Identification of corrective measures alternatives

Section 4.0: Evaluation of the Corrective Measures Alternatives

- Technical/Environmental/Human Health/Institutional
- Cost Estimate

Section 5.0: Justification and Recommendation of the Corrective Measure or Measures

- Technical
- Environmental
- Human Health

Section 6.0: Production of Reports

- Progress
- Draft
- Final
- Public Review and Final Selection of Corrective Measure

2.0 Regional Physical Setting

This section summarizes the regional physical setting of geology, hydrogeology, and biology at Key West, Florida. Information was obtained from a review of available data, the results of the on site visits, interviews with current and retired NAS-Key West employees, military personnel, past contractors, and work IT conducted during the Phase I Remedial Investigation study.

2.1 Location

NAS-Key West is located approximately 150 miles southwest of Miami on the last two major islands of the Florida Keys that are connected to the mainland by the Overseas Highway (US Highway No. 1). A regional map showing the Florida Keys is presented in Figure 2-1. Tourism is currently the primary industry in the Key West area. Visitors are attracted by the tropical climate and island setting. Fishing is the second most important industry with shrimping accounting for half the total catch recorded.

2.2 Climate

Key West has an average annual temperature of 77°F. The temperature difference between summer and winter is 14°F. The nearness of the Gulf Stream combined with the effects of the Gulf of Mexico tend to mitigate advancing cold fronts. Easterly tradewinds and sea breezes suppress the summer heat during the months of June through September.

Hurricanes normally form in the warm moist air over the tropical sea areas around the Lesser Antilles and occasionally in the Caribbean. They tend to move in a westerly to north-westerly direction gradually turning northward and eastward. The majority of hurricanes approach Key West from the south and east with their effects being felt on the south, east and west sides of the island; however, severe hurricanes have struck Key West from all directions. It is estimated that 75 percent of all damage that occurs during a hurricane is from tidal flooding.

During the period of December through April, the Keys receive approximately 25 percent of the total annual precipitation, which, over the years, have averaged

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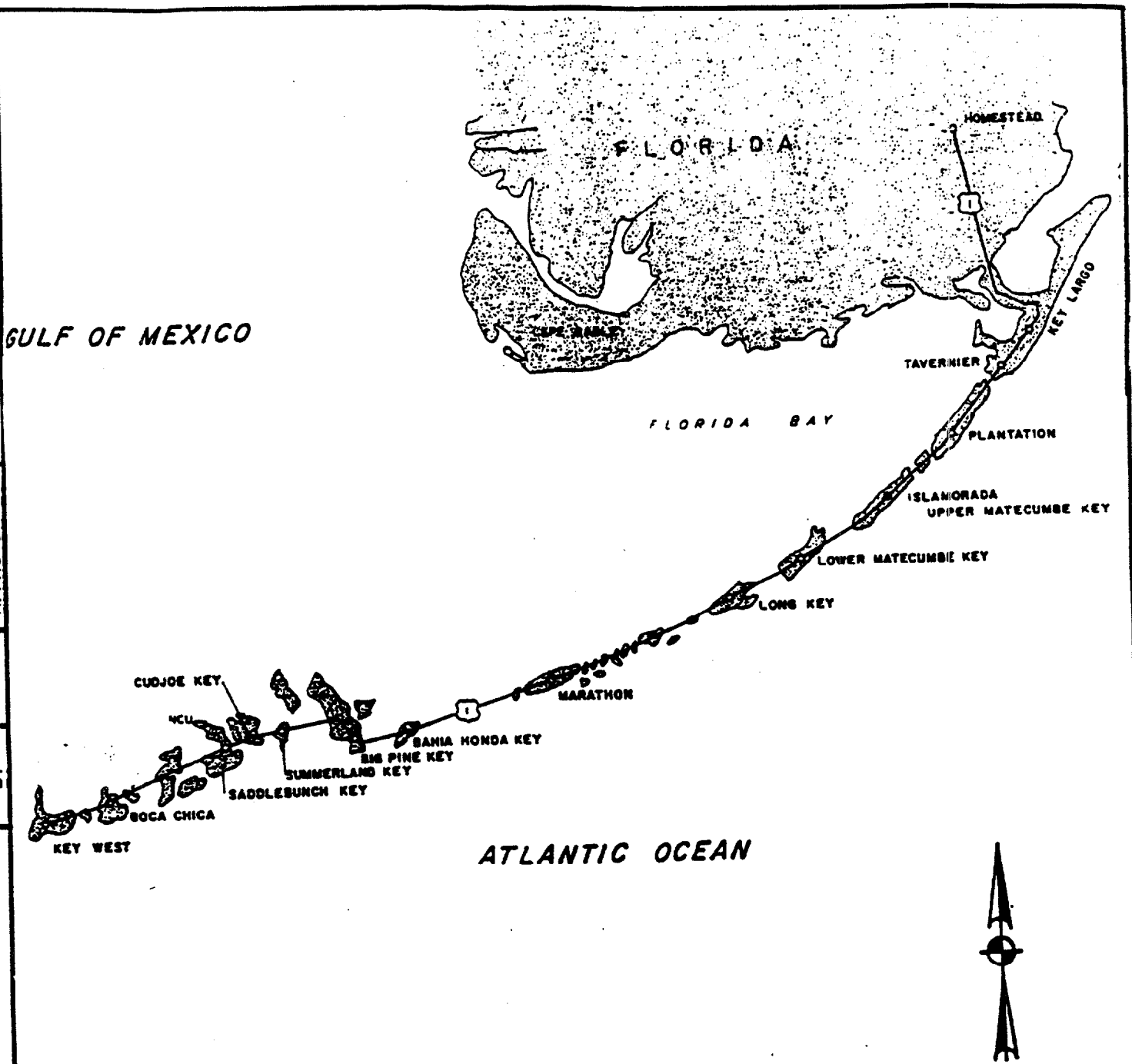

FIGURE 2-1

REGIONAL MAP
FLORIDA KEYS

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NAS-KEY WEST
KEY WEST, FL

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Do Not Scale This Drawing

approximately 40 inches. The bulk of the annual rainfall, approximately 53 percent, falls in the period of June through October.

Rainfall runoff from Key West is carried to the tidal waters by overland flow or storm drains that cover approximately 50 percent of the island; however, much of the rainfall percolates directly into the subsurface.

2.3 Biological Factors

The Key West Naval Complex includes some areas that are completely developed while other areas such as portions of Boca Chica, Saddlebunch, and Demolition Island are mostly cleared land. Around the periphery of these islands are mangrove communities and salt marshes in intertidal areas, grading into marine grass flats in sub-tidal areas. Areas cleared and left fallow have typically come back with an Australian Pine monoculture or thick cover of other early successionals (i.e., Brazilian Pepper Trees).

In Florida there are 68 animal species considered endangered or threatened by either the United States Fish and Wildlife Service (US FWS) or the Florida Game and Freshwater Fish Commission (FGFFC). Sixteen of these species have ranges that potentially overlap NAS-Key West. The list includes: the Key Silverside Fish, American Crocodile, Leatherback Turtles, Key Mud Turtles, Green Turtles, Kemp's Ridley Turtles, Hawksbill Turtles, Loggerhead Turtles, Eastern Brown Pelican, Bald Eagle, Least Tern, White-Crowned Pigeons, West Indian Manatee, Silver Rice Rat, Stock Island Tree Snail, and the Keys Rabbit.

There are approximately 325 plants listed as either endangered or threatened by the Florida Department of Agriculture. Of these, only seven now occur in the Key West area. The list includes: the Golden Leather Fern, Tree Cactus, Silver Thatch and Coconut Palms, Manchineel Tree, Florida Thatch Palm, and the Brittle Thatch Palm. The tree cactus was recently designated an endangered species by the US FWS.

2.4 Hydrogeology/Geology

The Florida Keys were created through eustatic elevation of limestone rock units. All of the Lower Keys are composed of Miami Oolite, which consists of calcium carbonate and tiny ooloids or spherical calcareous grains. Key Largo Limestone underlies the Miami Oolite on all the Lower Keys. It consists of cemented remains of ancient coral reefs, fossils, and shells. The Miami Oolite is approximately 20 feet thick at Key West. It is a porous formation of little use as a groundwater aquifer because of its poor water quality. The underlying Key Largo Limestone is also permeable and yields water but the quality is poor, being close to that of seawater. The Key Largo Limestone is approximately 180 feet thick at Key West. Slug tests conducted during the Phase I RFI yielded hydraulic conductivity values of 72 gpd/sq.ft. and 1024 gpd/sq.ft. and transmissivity values of 70,000 gpd/ft.and 12,500 gpd/ft.

Although the Keys are underlain by highly transmissive limestone aquifers, most groundwater is brackish, saline, or hypersaline. In the Key West areas, freshwater wells of consequence do not exist at the present time and potable water is obtained by rainwater catchment or imported via the Florida Keys Aqueduct Authority via a 150 mile pipeline from Miami. There are no freshwater public or domestic wells at the NAS-Key West facility. In an earlier investigation conducted by consultants Geraghty and Miller during the summer of 1986, groundwater samples were collected from the various locations at NAS-Key West and analyzed for concentrations of total dissolved solids. The samples indicate average concentrations of total dissolved solids in excess of 10,000 mg/l. The State of Florida classifies groundwater in unconfined aquifers which have a total dissolved solids content of 10,000 mg/l or greater as Class G-III which is non-potable. Therefore, the groundwater at the site is classified as Class G-III.

The elevations of Boca Chica are less than five feet MSL except for filled areas which underlie the Overseas Highway. Due to the low elevation, the lower keys are subject to major tidal effects.

Soils in Key West are primarily rockland, with some filled areas and mangroves. The soils at Boca Chica are also primarily rockland with some filled areas and mangrove swamps. Boca Chica is used mainly as a military base.

2.5 Surface Water Hydrology

The surface water regime in the Florida Keys is dominated by the surrounding saltwater bodies, the Atlantic Ocean and the Gulf of Mexico. The Florida Department of Environmental Regulation (FDER) classifies surface water in the Keys as Class 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 are classified by FDER as Outstanding Florida Waters and are afforded the highest protection by the State. These waters are considered to be of exceptional recreational and ecological significance to the residents of Florida.

2.6 Migration Potential

There is a potential for solute migration to surface waters in the Key West area due to the porous nature of Miami Oolite and the underlying Key Largo Limestone. Groundwater under tidal influence flows with relative ease in and out of the aquifer, creating a flushing action for potential solute dispersal into the large volume of tidal waters.

2.7 Potential Contaminant Receiving Body

The major potential contaminant receiving body of concern is the surface water regime. Common activities in the Key West area waters include commercial and recreational fishing, shell fishing, boating, and swimming. These waters support the richest coral reefs in the continental United States. Any pollution migrating into the surface water could potentially impact activities and marine life in the Key West area waters.

3.0 Identification and Development of the Corrective Measures Alternatives

The primary objective of this phase of the CMS is to develop an appropriate range of waste management options for detailed analysis. Combinations of technologies and the media to which they would be applied will be assembled to form alternatives that address contamination on a site wide basis. Alternatives will be initially developed and assembled to meet a set of corrective action objectives for each media i.e. soil, groundwater and surface water. The following tasks will be performed in the identification and development of the Corrective Measures Alternatives and each is discussed in detail below.

- Description of current situation
- Establishment of Corrective Action Objectives
- Screening of Corrective Measures Technologies
- Identification of Corrective Measures Alternatives

3.1 Description of the Current Situation

The following sections describe the site conditions, geology, hydrogeology, and existing analytical data at SWMU 2. Information was obtained from a review of available data, the results of the on site visits, interviews with current and retired NAS-Key West employees, military personnel, past contractors, and studies conducted during the Phase I Remedial Investigation study.

3.1.1 Site Description

The Boca Chica DDT Mixing Area is located at the central portion of the island of Boca Chica, as depicted in Figure 3-1. The site is located next to a man-made drainage ditch that is connected to a large borrow pit, along the west side of Runway 13 and is shown in detail in Figure 3-2. DDT mixing operations were conducted at the site of Building 915 (demolished in 1982) from the 1940's to the early 1970's. DDT contamination at the site reportedly occurred during the removal of a 500 gallon mixing tank and a 1,000 gallon storage tank, both of which were located to the west of Building 915. During the removal of the tanks, some spillage reportedly occurred as per NAS-Key West records. Contamination may also have occurred when pesticides

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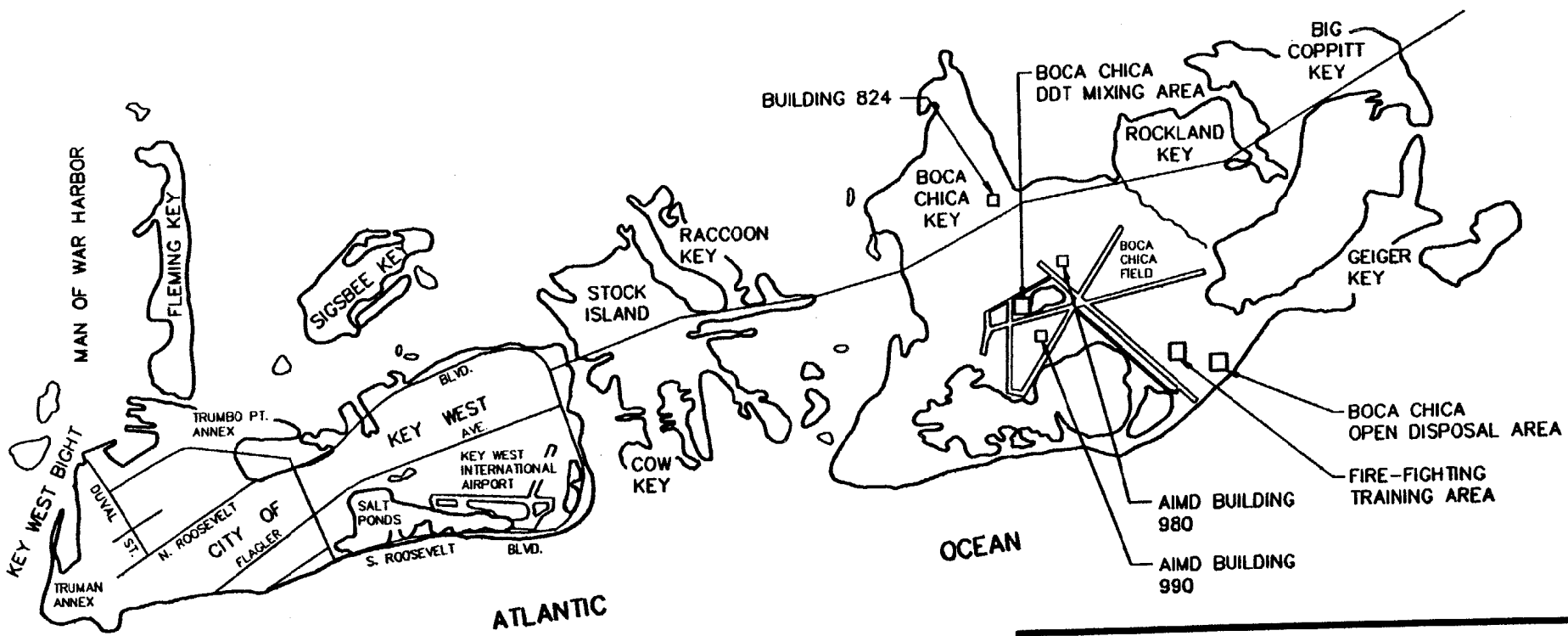

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MIAMI, FLORIDA 33157

2) GERAGHTY AND MILLER, INC.

FIGURE 3-1

LOCATION OF NAVAL ACTIVITIES
AND STUDY SITES
NAS - KEY WEST
KEY WEST, FLORIDA

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KEY WEST, FLORIDA

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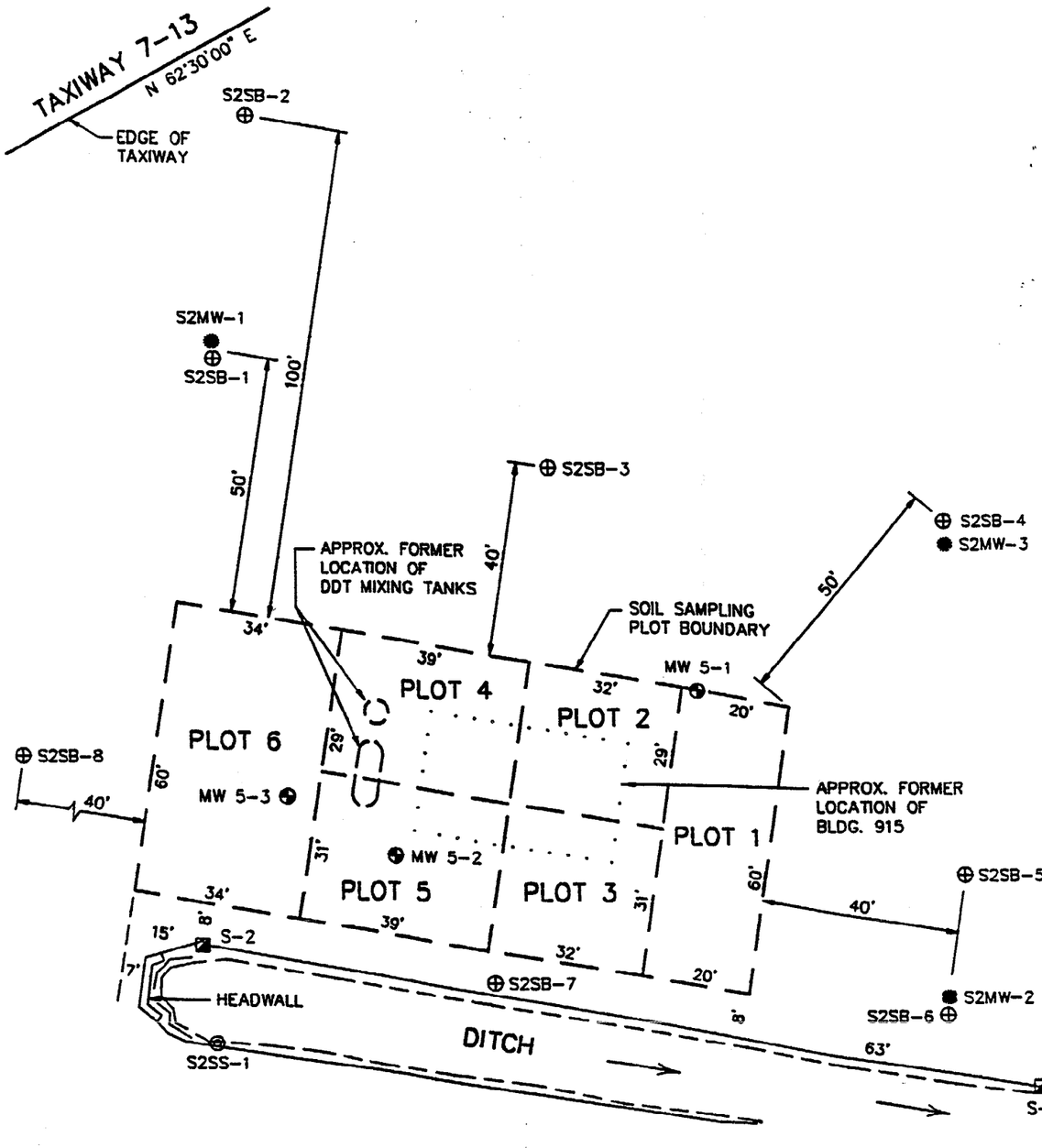

SOIL SAMPLES

COMPOUND	STANDARDS*	SAMPLE LOCATIONS							
	µg/l	PLOT 1	PLOT 2	PLOT 3	PLOT 4	PLOT 5	PLOT 6	MW5-2	MW5-1
4,4 - DDT	1000	2,800,000	42,000	160,000	210,000	470,000	25,000	8100	1000
4,4 - DDD	1500	1,800,000	620,000	840,000	49,000	580,000	23,000	37,000	-
4,4 - DDE	1000	-	-	-	-	-	-	8400	-
BETA - BHC	NE	-	-	-	-	-	1100	-	-
NAPTHALENE	NE	6000	-	-	-	-	-	-	-
2 METHYL NAPTHALENE	NE	25,000	12,000	16,000	-	-	-	-	-
PHENANTHRENE	NE	2600	-	-	-	-	-	-	-

SURFACE WATER SAMPLES

COMPOUND	STANDARDS*	SAMPLE LOCATIONS	
	µg/l	S-1	S-2
BETA - BHC	0.05	0.07	-
4,4 - DDD	0.15	-	0.24
HEPTACHLOR	0.0078	0.062	-

SEDIMENT SAMPLES

COMPOUND	STANDARDS*	SAMPLE LOCATIONS	
	µg/l	S-1	S-2
4,4 - DDT	1000	1900	2500
4,4 - DDE	1000	2800	1800
4,4 - DDD	1500	6000	13,000
DIELDRIN	NE	<3100	-

* STANDARDS REFERS TO A COMBINATION OF DRINKING WATER STANDARDS, FLORIDA GUIDANCE CONCENTRATIONS AND CORRECTIVE ACTION LIMITS.

GROUNDWATER SAMPLES

COMPOUND	STANDARDS*	SAMPLE LOCATIONS		
	µg/l	MW5-1	MW5-2	MW5-3
BENZENE	1	90	-	-
CHLOROBENZENE	10	210	57	-
1,2 DICHLOROETHENE	4.2	1800	-	-
ETHYLBENZENE	2	38	-	-
2 METHYL NAPTHALENE	NE	52	-	-
NAPTHALENE	10	46	-	-
XYLENES (TOTAL)	50	76	-	-
ALPHA - BHC	0.05	16	-	-
BETA - BHC	0.05	6.1	2.4	0.05
DELTA - BHC	0.05	15	13	0.1
4,4 - DDE	0.01	22	1.5	0.16
4,4 - DDT	0.01	34	0.72	0.16
4,4 - DDD	0.15	-	-	0.76

NE = NOT ESTABLISHED

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LEGEND

- MW 5-1 — IT CORP. MONITORING WELL
- S-1 — SURFACE WATER & SEDIMENT SAMPLE NO. 1
- PLOT A — PLOT BOUNDARY & NUMBER
- S2MW-1 — PROPOSED MONITORING WELL
- S2SB-1 — PROPOSED SOIL BORING
- S2SS-1 — PROPOSED SEDIMENT/ SURFACE WATER SAMPLE

30 20 10 0 10 20 30
GRAPHIC SCALE

FIGURE 3-2

INVESTIGATION & SAMPLING LOCATIONS
BOCA CHICA
DDT MIXING AREA

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were sometimes mixed with waste fuel oil to allow the pesticide to float on the surface of standing water in order to help destroy insect larvae.

A slight odor of pesticide was detectable at the site during the on-site survey (July 1989). A man-made drainage ditch is located just south of the site. Drainage from the ditch is to a large borrow pit to the east of the site. The area near the demolished building is now partly covered with sparse grass. The ditch has medium size mangroves around its banks. During the on site survey, numerous fish were observed in the ditch.

3.1.2 Geologic and Hydrogeologic Setting

The following discussion presents the geologic and hydrogeologic setting existing at the site.

Information derived from the borings during the Phase I RFI was used to construct a geologic framework that was utilized to assess the potential for contaminant migration, at the site. The material encountered during drilling of the monitoring well boreholes consisted of fill sands, reworked limestone, gravel and natural oolitic limestone. Specifically, the fill encountered was composed of minor amounts of sand and gravel mixtures with slight fractions of silt and reworked crushed oolitic limestone with varying amounts of shell fragments. Natural oolitic limestone and limestone/sand mixtures were encountered continuously to boring termination in all three boreholes (10 feet BLS).

Geotechnical data was obtained from a composite soil sample. Geotechnical data included grain size distribution, moisture content, soil, pH, cation exchange capacity, and total organic carbon content and permeability. Grain size analysis indicates that the soil sample was a silty medium to fine grained sand with 12 percent passing a 200 mesh sieve. The pH of the sample was 8.25 which is expected because of the abundance of carbonate soils and rocks. The ion exchange capacity was 39.37 meq/g. The TOC content of the soil was found to be 6,600 mg/kg. The permeability value was 9.05×10^{-6} centimeters per second which is representative of a sandy clay to clay material.

Groundwater was encountered at approximately 1.5 feet BLS during installation of the monitoring wells. This level is influenced by seasonal rainfall variations. The water table is higher during the rainy summer season (June through October) and lower during the drier months (January through May) with the highest levels occurring in September and the lowest in May. Water level data was obtained in August and most likely is near the seasonal high. The vadose zone occurs in soils above the water table and appears to have an average thickness of approximately 1.5 to 2 feet.

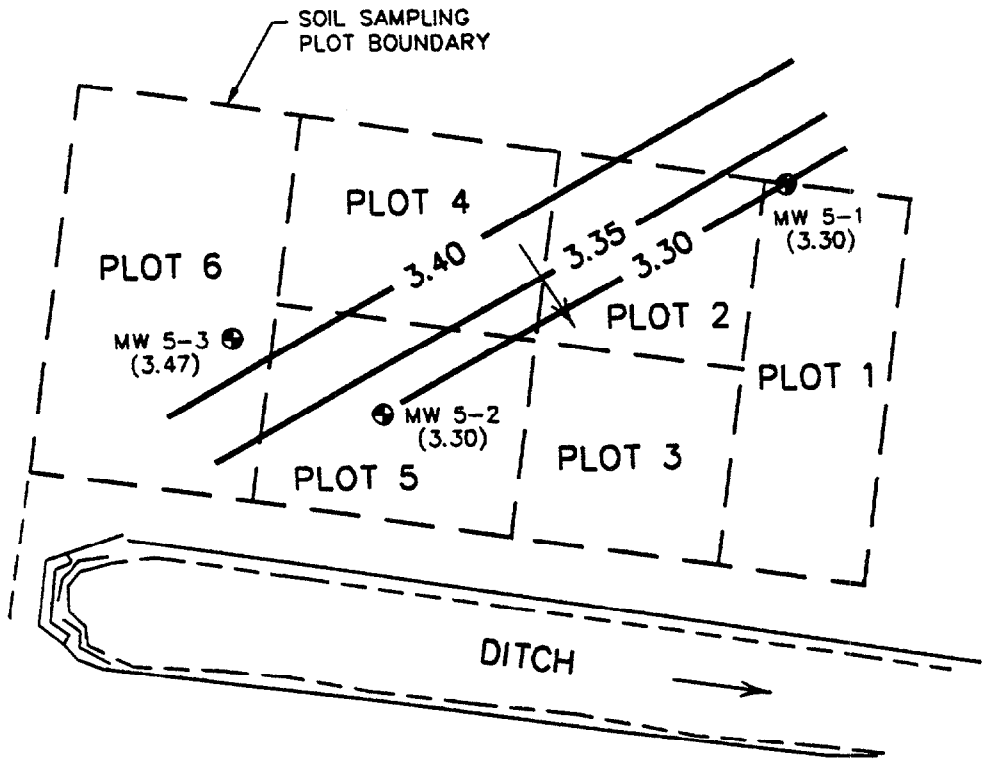
Groundwater levels collected at the site were contoured, and are depicted on Figure 3-3. Groundwater flow is towards the southeast and mainly discharges into the Atlantic Ocean. Recharge of the aquifer is through direct infiltration of precipitation.

3.1.3 Existing Data

During a previous study conducted by consultants Geraghty and Miller, the site was divided into six plots and three sample points were selected in each plot. Soil samples were collected at depths of 0 to 1 feet, 1 to 2 feet, and 2 to 3 feet BLS at each of the sampling points in the plot. The exact locations of these points are unknown. The laboratory analyses of the soil samples indicated the presence of pesticides throughout the three foot sampling range. The highest concentrations ranged from 80 to 936 ppm of DDT and its daughter products DDE and DDD. In addition, other pesticides including alpha-BHC, beta-BHC, gamma-BHC, and delta-BHC were detected.

During the Phase I RFI study IT collected and analyzed samples from all media. Figure 3-2 shows the levels and locations at which organic contaminants were detected during the Phase I RFI study. The tables in Appendix A summarize the analytical results for samples collected during the Phase I RFI. The site has high concentrations of pesticides in all media.

The pesticides DDD, DDE, DDT, and related chlorinated hydrocarbon pesticides were detected in the soil, sediment, surface water, and groundwater samples significantly above the established standards. The soil samples at this site contain the highest pesticide concentration levels. Due to significant leaching in the area, these same pesticides are found to a lesser degree in the sediment and groundwater at this site.



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30 20 10 0 10 20 30
GRAPHIC SCALE

LEGEND

MW 5-1	IT CORP. MONITORING WELL
(3.30)	GROUNDWATER ELEVATION
3.40	GROUNDWATER ELEVATION CONTOUR
→	GROUNDWATER FLOW DIRECTION ARROW

FIGURE 3-3

GROUNDWATER ELEVATION
CONTOUR MAP - AUGUST, 1990
BOCA CHICA
DDT MIXING AREA

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PLOT ● 1=1 | CAD FILE: FIG3-9.DWG | ARCHIVED:
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Most likely, the pesticide contamination is spread by soil erosion, and groundwater movement. Certain volatile substances such as benzene, 1,2-dichloroethene, chlorobenzene, and naphthalene were also present in the ground water samples in concentrations above background thus further supporting the information that the site is contaminated.

Groundwater flow (and potential pesticide migration) is in a southeasterly direction into the borrow pit. Although the groundwater at the site is not used by the human species, the aquatic life in the surface water around this site may be contaminated with pesticide compounds. Those organisms higher in the food chain, such as the human species, may ultimately become contaminated if ingestion of the lower organisms occurs. Currently, access to the site is restricted so public exposure to the pesticides is unlikely.

In order to further delineate contamination in all media and to add to the existing database, a Phase II RFI is to be carried out at the site. Additional soil borings and monitoring wells will be installed and samples from all media will be collected during the Phase II RFI. Information derived from the Phase II RFI will be used in performing the CMS. A background sampling and analyses program is also being performed during the Phase II RFI to obtain background analytical data for surface and subsurface soil, groundwater, surface water, sediment. The analysis of background samples should adequately establish background levels and offer site specific standards of comparison for media impact studies.

A quantitative baseline risk assessment will be performed as part of the Phase II RFI to evaluate the potential impacts of current and future exposure scenarios on human health and the environment. The specific tasks of a baseline risk assessment are:

- Identification of the chemicals of concern
- Exposure assessment
- Toxicity assessment
- Risk characterization

The result of the risk assessment and regulatory requirements will be used to establish corrective action objectives.

3.1.4 Additional Data To Be Obtained

The CMS investigation for Boca Chica DDT Mixing Area will require the accumulation of additional site-specific information which may restrict or influence response actions, technologies or formation of corrective measure alternatives. Included within the scope of this needed information are the following:

- A topographic and land use map of the area potentially affected by remedial activity.
- Identification of statutory or regulatory site restraints such as specific restrictions imposed by the U.S. Navy, Monroe County, or the State of Florida.
- Determination of the storm surge levels (100 year flood plain) experienced in the location.
- Hydrologic correction of site ditch surface water to outstanding waters of Florida.
- Verification that an adequate underground utility survey has been performed for the site.
- Determination as to exactly what is the regulatory status of soil that may be excavated during the course of the remediation.
- What future plans does NAS Key West command have for the site and surrounding area.
- Restrictions on contractors working in the vicinity of the site as may be required by the NAS Key West Command, including safety precautions required for air operations in the area.
- Potential off-site disposal sites and restrictions that may be applied by the Navy or Monroe County.

3.2 Establishment of Corrective Action Objectives

Corrective Action Objectives consist of medium specific or operable unit-specific goals for protecting human health and the environment. The objectives will be based on human health and environmental concerns, information from the RFI, risk assessment and the requirements of any applicable Federal and State Statutes. Corrective actions concerning groundwater releases will be consistent with those required under 40 CFR 264.100. The following standards have been tentatively identified for corrective action at SWMU 2:

- Groundwater - Since groundwater at the site is Class G-III, FAC 17-3.405 will apply.
- Surface water - Since surface water is classified as Class III, FAC 17-302.560 standards will apply.

The Corrective Action Objectives will specify the contaminant(s) of concern, exposure route(s), receptor(s) and an acceptable contaminant level or range levels for each media of concern. Although primary cleanup goals will be established on standards, the final acceptable exposure levels will be determined on the basis of the results of a baseline risk assessment and the evaluation of the expected exposures and associated risks for each corrective measures alternative. Contaminant levels in each media will be compared with final acceptable exposure levels and include an evaluation of the following factors:

- Whether the cleanup goals for all carcinogens of concern provides protection within the risk range of 10^{-4} to 10^{-6}
- Whether the cleanup goals set for all non-carcinogens of concern are sufficiently protective at the site.
- Whether environmental effects are adequately addressed.
- Whether the exposure analysis conducted as part of the risk assessment adequately addresses each significant pathway of human exposure identified in the baseline risk assessment.

3.3 Screening of Corrective Measures Technologies

The goal of the screening process will be to identify the most applicable or appropriate technologies capable of performing the response action for the media of concern. Potentially applicable technology types and process options will be reduced by evaluating the options with respect to technical implementability. Technology types and process options will be identified by drawing on a variety of sources including references developed for application to a RCRA site. The list of technology types and process options will be further refined when additional data from the Phase II RFI is obtained. Site data will be reviewed to identify conditions that will limit or promote the use of certain technologies. Technologies whose use is clearly precluded by site characteristics will be eliminated from further consideration.

Based on the Phase I RFI there are four media of potential concern that may require remediation:

- Soil
- Sediment
- Surface Water
- Ground Water

Some of these media of concern may be eliminated during the Phase II RFI and risk assessment or others may be added. Preliminary corrective measures technologies that may be applicable or appropriate for the soil media are:

- In-situ Containment
  - Cap
  - Slurry Wall
- Excavation
- Incineration
- Off-site Disposal

Preliminary corrective measures technologies that may be applicable or appropriate for the sediment media are:

- Excavation

- Incineration
- Off-site Disposal

Preliminary corrective measures technologies that may be applicable or appropriate for the surface water media are:

- Source containment or removal
- Containment and treatment

Preliminary corrective measures technologies that may be applicable or appropriate for the ground water media are:

- Source containment or removal
- Pump, treat and re-inject

The level of technology development, performance record, inherent construction, operation and maintenance problems will be identified for each technology considered. Technologies that are unreliable, perform poorly or are not fully demonstrated may be eliminated. In addition, waste characteristics that limit the effectiveness of technologies will be identified and technologies that are clearly limited by the waste characteristics will be eliminated from further consideration.

The screening of all technologies will be well documented. The technologies considered to be implementable will be evaluated in greater detail before one technology is selected. The technology will be screened using the criteria of site characteristics, waste characteristics and technology limitations. Those technologies that are applicable or appropriate to each media will be assembled into corrective measure alternatives.

3.4 Identification of the Corrective Measures Alternatives

The corrective measures alternatives will be developed based on the corrective action objectives and analysis of potential corrective measure technologies. Each alternative will consist of an individual technology or a combination of technologies. The corrective measure alternatives will be developed so that the corrective objectives are achieved for each media of concern at the site. A description of each alternative and

the logic behind the assembly of technologies into specific corrective measure alternatives will be documented and included in the CMS report.

4.0 Evaluation of the Corrective Measure Alternatives

Alternatives are initially developed and assembled to meet a set of corrective action objectives for each media of interest. During evaluation, the assembled alternatives will be evaluated to ensure that they protect human health and the environment from each potential pathway of concern at SWMU 2. If more than one pathway is present, the overall risk level to receptors will be evaluated. If it is found that an alternative is not fully protective, a reduction in exposure levels for one or more media will be made to attain an acceptable risk level.

4.1 Evaluation Considerations

Each corrective measure alternative will be evaluated based on technical, environmental, human health and institutional considerations. Each of these considerations are addressed below.

4.1.1 Technical Considerations

Each corrective measure alternative will be evaluated based on performance, reliability, implementability and safety.

Performance will be evaluated based on the effectiveness and useful life of the corrective measure. Each alternative will be evaluated as to its effectiveness in providing protection to the human health and the environment and the reductions in toxicity, mobility or volume that it will achieve. Both short and long term components of effectiveness will be evaluated; short term referring to the construction and implementation period and long term referring to the period after the corrective measure is complete. Useful life of the corrective measure is the length of time that the desired effectiveness can be maintained. Each corrective measure will be evaluated in terms of the projected useful life.

Information on the **reliability** of each corrective measure including their operation and maintenance requirements and their demonstrated ability will be included in the evaluation of each alternative. Operation and maintenance requirements include the frequency and complexity of necessary operation and maintenance. Alternatives with

technologies requiring frequent and/or complex operation and maintenance activities will be regarded as less reliable than technologies requiring little or straightforward operation and maintenance. The reliability of an alternative will be considered by evaluating whether the technologies have been used under analogous conditions and whether the combination of technologies have been used together effectively. In addition, the alternative will be evaluated to determine if the failure of any one technology has an immediate impact on receptors and whether the corrective measure has the flexibility to deal with uncontrollable changes at the site.

Implementability of an alternative is determined by the relative ease of installation (constructability) and the time required to achieve a given level of response. Constructability includes the technical and administrative feasibility of implementing each alternative. Technical feasibility includes items such as location of underground utilities, depth to water table, aquifer characteristics, and location of facility. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies, the availability of treatment, storage and disposal services and capacity and the requirements for and availability of specific equipment and technical specialists. Each alternative will be evaluated for both technical and administrative feasibility. The time required to install (construct) the alternatives and the time required to achieve the corrective action objectives will be evaluated as part of the implementability of the alternative.

Each corrective measures alternative will also be evaluated with regard to **safety**. This evaluation will include threats to the safety of nearby communities and environments as well as those to workers during implementation.

4.1.2 Environmental Considerations

The risk assessment will include an evaluation of risks to potential environmental receptors. Endangered, threatened or species at or near the site will be identified using information from federal, state and local agencies. Potential ecological receptors will be identified for the site and exposure concentrations for ecological receptors will be estimated for the site using site specific data, data from scientific literature or exposure models. Exposure pathways for ecological receptors will be identified and

exposure to ecological receptors will be quantified based on the most susceptible species identified. Toxicological information about the chemicals of concern and acceptable exposure levels will be based on information from scientific literature and from promulgated standards such as Ambient Water Quality Criteria.

Each alternative will be evaluated on the short-term and long-term beneficial and adverse effects of the corrective measures including an analysis on potential to mitigate adverse effects of the alternative.

4.1.3 Human Health Considerations

Potential chemicals of concern and their concentrations will be identified from data collected during the Phase I and Phase II RFI. The risk assessment will identify the potential receptors, exposure pathways, and estimate the levels of potential exposures. The toxicity assessment will examine the potential adverse health effects associated with exposure to the chemicals of concern. The exposure and toxicity assessments will be integrated to define the general magnitude of human health risks. The risk characterization is based upon a Reasonable Maximum Exposure Scenario as defined in USEPA Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual, (Part A) v.989. This approach is used so that risks can be both accurately estimated and protective of human health and the environment.

4.1.4 Institutional Considerations

Relevant institutional needs for each corrective measure alternative will be assessed. Specifically, the effects of federal, state and local environmental and public health standards, regulations or community relations on the design, timing and operation of each alternative will be evaluated.

4.2 Cost Estimate

An estimate of the cost of each corrective measure alternative will be developed. The estimate will include both capital costs and operation and maintenance (O&M) costs.

Capital costs includes both direct (construction) and indirect (non construction and overhead) costs. Direct costs include expenditures for the equipment, labor, and

materials necessary to install corrective actions. Indirect costs include expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of corrective measures alternatives. Costs that will be incurred in the future as part of the corrective measures alternative will be identified and noted for the year in which they will occur. The distribution of costs over time will be a critical factor in making trade offs between capital-intensive technologies and less capital intensive technologies. Direct capital costs may include the following:

- Construction costs - Cost of materials, labor and equipment required to install a corrective measure.
- Equipment costs - Cost of service equipment necessary to enact the corrective measure.
- Land and site-development costs - Expenses associated with the purchase of land and site preparation costs of existing property.
- Buildings and services cost - Costs of process and non-process buildings, utility connections, purchased services and disposal costs.
- Relocation expenses - Costs of temporary or permanent accommodations for affected nearby residents.
- Disposal costs - Costs of transporting and disposing of waste material such as drums and contaminated soils.

Indirect capital costs may include the following:

- Engineering expenses - Costs of administration, design, construction supervision, drafting and treatability testing.
- License or Permit costs - Administrative and technical costs including legal fees necessary to obtain licenses and permits necessary to obtain licenses and permits for installation and operation of offsite activities.
- Start-up and shakedown costs - Costs incurred to ensure system is operational and functional.

- Contingency allowances - Funds to cover costs resulting from unforeseen circumstances such as adverse weather conditions, strikes or inadequate facility characterization.

Annual O&M costs are post construction costs necessary to ensure the continued effectiveness of a corrective action. The following O&M costs will be considered:

- Operating labor costs - Wages, salaries, training, overhead and fringe benefits associated with the labor needed for post construction activities.
- Maintenance materials and labor costs - Costs for labor, parts and other resources required for routine maintenance of facilities and equipment.
- Auxiliary materials and energy - Costs of such items as chemicals, and electricity for treatment plant operations, water and sewer services and fuel.
- Disposal of residues - Costs to treat or dispose of residuals such as sludges from treatment processes.
- Purchased services - Sampling costs, laboratory fees and professional fees for which the need can be predicted.
- Administrative costs - Costs associated with the administration of remedial O&M not included under other categories.
- Insurance, Taxes and Licensing costs - Costs of such items as liability and sudden accidental insurance, real estate taxes on purchased land or right-of-way, licensing fees for certain technologies and permit renewal and reporting costs.
- Maintenance, Reserve and Contingency funds - Annual payments into escrow funds to cover costs of anticipated replacement or rebuilding of equipment and any large unanticipated O&M cost.
- Rehabilitation costs - Cost for maintaining equipment or structures that wear out over time.
- Costs of periodic site reviews - Costs for site reviews that are conducted at least every 5 years if wastes above health-based levels remain on the site.

A present worth analysis will be used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year. In conducting the

present worth analysis, assumptions will be made regarding the discount rate and the period of performance.

After the present worth of each remedial corrective measures alternative is calculated, individual costs may be evaluated through a sensitivity analysis if there is sufficient uncertainty concerning specific assumptions. The sensitivity analysis will assess the effect that variations in specific assumptions associated with the design, implementation, operation, discount rate, and effective life of an alternative can have on the estimated cost of an alternative.

5.0 Justification and Recommendation of the Corrective Measure

The results obtained after evaluation of the alternatives when combined with risk management decisions become the rationale for selecting a preferred alternative. Overall protection of human health and the environment and achievement of corrective action objectives will serve as threshold determinations in that they must be met by any alternative in order for it to be eligible for selection. The assessment of each alternative will be presented in summary tables. Tradeoffs among health risks, environmental effects, and other pertinent factors will be highlighted.

The following criteria will be used to justify and recommend a corrective measure alternative:

- Technical
- Human Health
- Environmental

These criteria are explained in detail in the following subsections.

5.1 Technical Criteria

The technical criteria relate to the technical difficulties and unknowns associated with a technology and can be quantified by performance, reliability, implementability and safety.

Performance - The corrective measure or measures which are most effective at performing their intended functions and maintaining the performance over extended periods of time will be given preference.

Reliability - The corrective measure or measures which do not require frequent or complex operation and maintenance activities and that have proved effective under waste and facility conditions similar to those anticipated will be given preference.

Implementability - The corrective measure or measures which can be constructed and operated to reduce levels of contamination to attain or exceed applicable standards in the shortest period of time will be preferred.

Safety - The corrective measure or measures which pose the least threat to the safety of nearby residents and environments as well as workers during implementation will be preferred.

5.2 Human Health Criteria

This evaluation criterion will provide a check to assess whether each alternative provides adequate protection of human health. The corrective measure or measures will comply with existing USEPA criteria, standards or guidelines for the protection of human health. The corrective measure which provides the minimum level of exposure to contaminants and the maximum reduction in exposure with time will be preferred.

5.3 Environmental Criteria

This evaluation criterion will provide a check to assess whether each alternative provides adequate protection of the environment. The corrective measure or measures posing the least adverse impact (or greatest improvement) over the shortest period of time on the environment will be favored.

6.0 Reports

A Corrective Measures Study Report will be prepared presenting the detailed results of the tasks identified in sections 3.0 through 5.0 and a recommendation for corrective measure alternative. The following reports will be provided to USEPA as described below:

6.1 Progress Report

The EPA will also be provided with signed monthly progress reports containing:

- A description and estimate of the percentage of CMS completed.
- Summaries of all findings.
- Summaries of all changes made in the CMS during the reporting period.
- Summaries of all contacts with representatives of the local community, public interest groups or state government during the reporting period.
- Summaries of all problems or potential problems encountered during the reporting period.
- Actions being taken to rectify problems.
- Changes in the personnel involved with the CMS during the reporting period.
- Projected work for the next reporting period.
- Copies of daily reports, inspection reports, laboratory/monitoring data, etc.

6.2 Draft Report

A draft CMS report will be prepared and presented to the EPA for review and comments. The report will include:

- A description of the facility
    - Site topographic map and preliminary layouts.

- A summary of the corrective measure or measures and rational for selection
  - Description of the corrective measure or measures and rational for selection;
  - Performance expectations;
  - Preliminary design criteria and rationale;
  - General operation and maintenance requirements; and
  - Long-term monitoring requirements.
- A summary of the RCRA Facility Investigation and impact on the selected corrective measure or measures
  - Field studies (groundwater, surface water, soil, air); and
  - Laboratory studies (bench scale, pick scale).
- Design and Implementation Precautions
  - Special technical problems;
  - Additional engineering data required;
  - Permits and regulatory requirements;
  - Access, easements, right-of-way;
  - Health and safety requirements; and
  - Community relations activities.
- Cost Estimates and Schedules
  - Capitol cost estimate;
  - Operation and maintenance cost estimate; and
  - Project schedule (design, construction, operation).

The CMS report will then be finalized by incorporating comments received from EPA in the Draft CMS report and resubmitted for final approval. The report will then be available for public review.

Appendix A

Summary
Analytical Data
Site 5, Boca Chica DDT Mixing Area

TABLE A-3

DATA SUMMARY
Boca Chica, DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392

MEDIA	CLASS	PARAMETER	CSC	MINIMUM* CONCENTRATION	MAXIMUM CONCENTRATION
Soil Samples	Pesticides/PCB	4,4-DDT	1,000	1,000	2,800,000
		4,4-DDT	1,500	23,000	1,800,000
		4,4-DDE	1,000	---	8,400
	Inorganics	Silver	51	---	386
Groundwater	Inorganics	Iron	300	465	1,700
		Sodium	160,000	1,460,000	1,620,000
	Volatiles	Chlorobenzene	10	57	210
		1,2-dichloroethene	4.2	1,500	1,800
		Ethylbenzene	2	---	38
		Naphthalene	10	40	46
		Xylenes	50	---	76
	Pesticides/PCB	Alpha-BHC	.05	14	16
		Beta-BHC	.05	0.54	6.1
		Delta-BHC	.05	0.10	15
		4,4-DDE	.01	.16	22
		4,4-DDT	.01	.16	34
		4,4-DDD	.15	---	.76
Surface Water	Inorganics	Lead	50	---	53.6
		Sodium	160,000	6,410,000	6,590,000
	Pesticides/PCB	Beta-BHC	.05	---	.066
		4,4-DDD	.15	---	.24

TABLE 3-45

DATA SUMMARY - SITE 5
Boca Chica, DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392

MEDIA	CLASS	PARAMETER	CSC	MINIMUM* CONCENTRATION	MAXIMUM CONCENTRATION
Sediment Samples	Pesticides/PCB	4,4-DDD	1,500	6,000	13,000
		4,4-DDE	1,000	1,800	2,800
		4,4-DDT	1,000	1,900	2,500

NOTE:

* Minimum values represent the smallest concentration level above CSC
--- Present when only one value above CSC exists
CSC Concentration standards for comparison

TABLE 3-33

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS FOR SURFACE/SUBSURFACE SOIL SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		Site 5, Plot 1	Site 5, Plot 2	Site 5, Plot 3	Site 5, Plot 4	Site 5, Plot 5	Site 5, Plot 6	Site 5, MW-2	Site 5, MW-3
SAMPLE TYPE:		Composite	Composite	Composite	Composite	Composite	Composite	Discrete	Discrete
FIELD SAMPLE LOCAITON:		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		16	30	30	30	30	30	25	25
COMPOUND	CSC								
4,4-DDT	1,000	2,800,000*	42,000	160,000	210,000*	470,000*	25,000*	8,100*	1,000*
4,4-DDD	1,500	1,800,000*	620,000*	840,000*	49,000*	580,000*	23,000*	37,000*	BDL
4,4-DDE	1,000	BDL	BDL	BDL	BDL	BDL	BDL	8,400*	100*
Beta-BHC	NE	ND	BDL	ND	ND	BDL	1,100	ND	ND
Alpha-BHC	NE	BDL	BDL	BDL	ND	ND	BDL	ND	ND
Delta-BHC	NE	BDL	ND	ND	ND	ND	BDL	ND	ND

NOTE:

MW = Monitoring well
BDL = Detected, but below instrument quantitation limit
ND = Not detected at the instrument quantitation limit
NE = Not established

* = Designates samples analyzed at a dilution factor according to the following:

Site 5, Plot 1: Dilution factor of 50,000. Results of this sample agree well with results from sample diluted at a factor of 5,000
Site 5, Plot 2: Dilution factor of 20,000.
Site 5, Plot 3: Dilution factor of 20,000.
Site 5, Plot 4: Dilution factor of 5,000. Value for 4,4-DDD represents an estimated value less than the detection limit at this dilution
Site 5, Plot 5: Dilution factor of 20,000.
Site 5, Plot 6: Dilution factor of 1,000.
Site 5, MW-2: Dilution factor of 1,000. Values for DDE & DDT represent an estimated value less than detection limit at this dilution
Site 5, MW-3: Dilution factor of 1,000. Values for DDE & DDT represent an estimated values less than detection limit at this dilution

TABLE 3-34

ANALYTICAL DETECTIONS FOR VOLATILE ORGANIC COMPOUNDS (VOLATILES AND SEMI-VOLATILES) IN SURFACE/SUBSURFACE SOIL SAMPLES

Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		Site 5, Plot 1	Site 5, Plot 2	Site 5, Plot 3	Site 5, Plot 4	Site 5, Plot 5	Site 5, Plot 6	Site 5, MW-2	Site 5, MW-3
SAMPLE TYPE:		Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete
FIELD SAMPLE LOCATION:		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		14, 15	27, 29	28, 29	28, 29	28, 29	28, 29	23, 24	23, 24
COMPOUND	CSC								
Chloroform	57,000	11	ND	ND	ND	BDL	ND	ND	ND
Chlorobenzene	510,000	ND	1,600	ND	ND	ND	ND	ND	ND
Ethylbenzene	1,700,000	ND	1,500	ND	ND	ND	ND	ND	ND
Total xylenes	34,000,000	BDL	8,200	7	ND	ND	ND	ND	ND
Methylene chloride	47,000	17*	BDL	BDL	BDL	7	ND	BDL*	46*
1,2,4-trichlorobenzene	340,000	3,500	ND	ND	ND	ND	ND	ND	ND
Naphthalene	NE	6,000	ND	ND	ND	ND	ND	ND	ND
2-methylnaphthalene	NE	25,000	12,000	16,000	ND	ND	ND	ND	ND
Phenanthrene	NE	2,600	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	340,000	2,100	ND	ND	1,100*	BDL	1,800*	BDL	BDL
Acetone	1,700,000	BDL	ND	BDL	ND	BDL	BDL	BDL*	BDL*
Bromodichloromethane	340,000	BDL	ND	ND	ND	ND	ND	ND	ND
1,3-dichlorobenzene	NE	BDL	ND	ND	ND	ND	ND	ND	ND
1,4-dichlorobenzene	NE	BDL	ND	ND	ND	ND	ND	ND	ND

TABLE 3-34

ANALYTICAL DETECTIONS FOR VOLATILE ORGANIC COMPOUNDS (VOLATILES AND SEMI-VOLATILES) IN SURFACE/SUBSURFACE SOIL SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		Site 5, Plot 1	Site 5, Plot 2	Site 5, Plot 3	Site 5, Plot 4	Site 5, Plot 5	Site 5, Plot 6	Site 5, MW-2	Site 5, MW-3
SAMPLE TYPE:		Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete
FIELD SAMPLE LOCATION:		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		14, 15	27, 29	28, 29	28, 29	28, 29	28, 29	23, 24	23, 24
COMPOUND	CSC								
Anthracene	NE	BDL	ND	ND	ND	ND	ND	ND	ND
Toluene	5,100,000	ND	BDL	14	BDL	15	BDL	ND	ND
1,2-dichloroethane	3,600	ND	ND	BDL	ND	ND	ND	ND	ND
Diethylphthlate	14,000,000	ND	ND	ND	BDL	ND	BDL	ND	ND
Di-n-butylphthlate	NE	ND	ND	ND	BDL	ND	BDL	ND	ND
Carbon disolfide	1,700,000	ND	ND	ND	ND	ND	ND	BDL	ND
2-hexanone	NE	ND	ND	ND	ND	ND	ND	BDL*	ND

NOTE:

* = Analyte was detected in the blank as well as the sample
ND = Not detected at the instrument detection limit
BDL = Detected, but below the instrument quantitation limit
NE = Not established

TABLE 3-35

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (INORGANICS) IN SURFACE/SUBSURFACE SOIL SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in mg/kg (ppm)

LABORATORY SAMPLE IDENTIFICATION:		Site 5, Plot 1	Site 5, Plot 2	Site 5, Plot 3	Site 5, Plot 4	Site 5, Plot 5	Site 5, Plot 6	Site 5, MW-2	Site 5, MW-3
SAMPLE TYPE:		Composite	Composite	Composite	Composite	Composite	Composite	Discrete	Discrete
FIELD SAMPLE LOCATION:		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		17	31	31	31	31	31	26	26
COMPOUND	CSC								
Aluminum	NE	882	1,000 E	1,560 E	1,560 E	3,510 E	1,170 E	2,070	119
Arsenic	NE	3.5	14.3	3.2	3.1	1.5	1.9	BDL	BDL
Barium	850	53.3 E	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	NE	3.9	ND	ND	ND	ND	ND	ND	ND
Calcium	NE	323,000	378,000	310,000	437,000	278,000	397,000	284,000	405,000
Chromium	NE	4.3	4.8	5.6	4.6	8.50	4.4	4.8	2.2
Copper	NE	10.7	5.8	3.7	BDL	13.1	5.3	ND	ND
Iron	NE	1,480 E	819 E	1,230 E	814 E	2,100 E	737 E	1,160	133
Lead	NE	57.1	34.7	82.1	5.7	102	4.9	5.5	0.4
Magnesium	NE	8,900 E	2,690 E	2,920 E	3,740 E	6,230 E	3,040 E	7,530	1,110
Manganese	NE	14.7 E	7.5	10.3	15.5	17.30	9.2	10	2.0
Mercury	NE	ND	ND	ND	ND	0.03	ND	ND	ND
Silver	51	ND	9.8	ND	ND	ND	ND	ND	386
Sodium	NE	735	909	1,050	1,600	1,770	1,130	1,660	1,230

TABLE 3-35

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (INORGANICS) IN SURFACE/SUBSURFACE SOIL SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in mg/kg (ppm)

LABORATORY SAMPLE IDENTIFICATION:		Site 5, Plot 1	Site 5, Plot 2	Site 5, Plot 3	Site 5, Plot 4	Site 5, Plot 5	Site 5, Plot 6	Site 5, MW-2	Site 5, MW-3
SAMPLE TYPE:		Composite	Composite	Composite	Composite	Composite	Composite	Discrete	Discrete
FIELD SAMPLE LOCATION:		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		17	31	31	31	31	31	26	26
COMPOUND	CSC								
Vanadium	NE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	ND
Zinc	NE	50.9 E	30.7	30.7	20.3	38.8	11.5	11.9	9.9

NOTE:

BDL = Detected but below the instrument quantitation limit
NE = Not established
ND = Not detected to the instrument detection limit
E = The reported value is estimated because of the presence of interference
MW = Monitoring well

TABLE 3-36

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (INORGANICS)
FOR GROUNDWATER SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-01-GWD	05-01-GWO	05-02-GW	05-03-GW
FIELD SAMPLE LOCATION:		MW 5-1 duplicate	MW 5-1	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		47	47	54	54
COMPOUND	CSC				
Aluminum	NE	682	717	3,000	1,010
Barium	1,000	BDL	BDL	BDL	BDL
Calcium	NE	94,000	1,210,000	1,460,000	1,410,000
Chromium	50	ND	ND	33.7	ND
Copper	1,000	BDL	ND	ND	ND
Iron	300	465	497	1,700	524
Lead	50	ND	ND	ND	ND
Magnesium	NE	163,000	163,000	159,000	190,000
Manganese	50	BDL	BDL	18.8	BDL
Potassium	NE	60,500	60,500	51,500	63,900
Sodium	160,000	1,570,000	1,570,000	1,460,000	1,620,000
Zinc	5,000	27.9	26.8	49	ND

NOTE:

ND = Not detected at instrument detection limit
NE = Not established
BDL = Detected, but below instrument quantitation limit
MW = Monitoring well

TABLE 3-37

ANALYTICAL DETECTIONS FOR VOLATILE ORGANIC ANALYSIS (VOLATILES AND SEMI-VOLATILES) FOR GROUNDWATER SAMPLES

Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-01-GWO	05-01-GWD	05-02-GW	05-03-GW	Boca Chica DDT
FIELD SAMPLE LOCATION:		MW 5-1	MW 5-1 duplicate	MW 5-2	MW 5-3	MW 5-3
ASSOCIATED METHOD BLANKS:		43, 45	43, 45	49	49	95
COMPOUND	CSC					
Acetone	700	BDL	16	ND	BDL	NA
Benzene	1	ND	90	ND	BDL	NA
Carbon disulfide	3,500	BDL+	10+	BDL	BDL	NA
Chlorobenzene	10	ND	210	57	BDL	NA
1,2-dichloroethene (total)	4.2	1,500	1,800	ND	BDL	NA
Ethylbenzene	2	ND	38	ND	BDL	NA
2-methylnaphthalene	NE	54	52	ND	NA	ND
Naphthalene	10	46	40	ND	NA	ND
Toluene	24	ND	16	ND	BDL	NA
1,2,4-trichlorobenzene	700	15	16	ND	NA	ND
Xylenes (total)	50	BDL	76	BDL	BDL	NA
1,1-dichloroethene	NE	ND	BDL	ND	ND	NA
Methylene chloride	4.7	BDL+	BDL+	BDL	ND	NA
Trichloroethene	3	ND	BDL	ND	ND	NA
1,3-dichlorobenzene	10	BDL	BDL	BDL	ND	NA

TABLE 3-37

ANALYTICAL DETECTIONS FOR VOLATILE ORGANIC ANALYSIS (VOLATILES AND SEMI-VOLATILES) FOR GROUNDWATER SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-01-GWO	05-01-GWD	05-02-GW	05-03-GW	Boca Chica DDT
FIELD SAMPLE LOCATION:		MW 5-1	MW 5-1 duplicate	MW 5-2	MW 5-3	MW 5-3
ASSOCIATED METHOD BLANKS:		43, 45	43, 45	49	49	95
COMPOUND	CSC					
1,4-dichlorobenzene	75	BDL	BDL	ND	ND	NA
1,2-dichlorobenzene	10	BDL	BDL	ND	ND	NA
Benzoic acid	NE	BDL	BDL	ND	NA	ND
Bis(2-ethylhexyl)phthlate	700	ND	BDL	ND	NA	ND
4-methylphenol	NE	ND	ND	BDL	NA	ND

NOTE:

+ = Analyte was found in blank as well as sample
NA = Not analyzed
ND = Not detected at instrument detection limit
BDL = Detected, but below instrument quantitation limit
NE = Not established
MW = Montioring well

TABLE 3-38

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS FOR GROUNDWATER SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-01-GWD	05-01-GWO	05-02-GW	05-03-GW
FIELD SAMPLE LOCATION:		MW 5-1 duplicate	MW 5-1	MW 5-2	MW 5-3
ASSOCIATED METHOD BLANKS:		46	46	53	53
COMPOUND	CSC				
Alpha-BHC	0.05	16*	14*	BDL	BDL
Beta-BHC	0.05	6.1	5.0	2.4*	0.05
Delta-BHC	0.05	15*	13*	0.10	BDL
Gamma-BHC (lindane)	4.0	1.1	BDL	BDL	BDL
4,4-DDE	0.01	2.6	22	1.5*	0.16
4,4-DDT	0.01	34*	30*	0.72	0.16
Heptachlor epoxide	0.0039	BDL	BDL	BDL	BDL
4,4-DDD	0.15	BDL	BDL	BDL	0.76

NOTE:

* - Compound analyzed at a secondary dilution factor according to the followign:

05-01-GWD: Dilution factor of 200
05-01-GWO: Dilution factor of 200
05-02-GW: Diltution factor of 20. Value for DDE represents an estimated concentration below the detection limit at this dilution

BDL = Detected, but below instrument quantitation limit
MW = Monitoring well

TABLE 3-39

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (METALS)
FOR SURFACE WATER SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-SW-D	05-SW-U
FIELD SAMPLE LOCATION:		S-1	S-2
ASSOCIATED METHOD BLANKS:		65	65
COMPOUND	CSC		
Aluminum	NE	BDL	1,510
Barium	1,000	BDL	BDL
Calcium	NE	246,000	242,000
Iron	300	112*	236*
Lead	50	53.6	ND
Magnesium	NE	819,000	792,000
Potassium	NE	232,000	220,000
Silver	50	BDL	BDL
Sodium	160,000	6,590,000	6,410,000
Zinc	5,000	22.4	36.6

NOTE:

NE = Not established
* = Reported value estimated due to the presence of an interference
BDL = Detected, but below the instrument quantitation limit
ND = Not detected to the instrument detection limit
S = Sediment/Surface Water location

TABLE 3-40

VOLATILE ORGANIC ANALYSIS (VOLATILES AND SEMI-VOLATILES)
FOR SURFACE WATER SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-SW-D	05-SW-U
FIELD SAMPLE LOCATION:		S-1	S-2
ASSOCIATED METHOD BLANKS:		56, 59	57, 59
COMPOUND	CSC		
Acetone	700	ND	13
Methylene chloride	4.7	BDL	BDL
Benzyl alcohol	NE	ND	BDL

NOTE:

ND = Not detected at instrument detection limit
BDL = Dectected, but below instrument quantitation limit
NE = Not established
S = Sediment/Surface Water sample

TABLE 3-41

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS IN SURFACE WATER SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-SW-D	05-SW-U
FIELD SAMPLE LOCATION:		S-1	S-2
ASSOCIATED METHOD BLANKS:		62	62
COMPOUND	CSC		
Aldrin	0.0021	ND*	ND
Beta-BHC	0.05	0.07	ND
4,4-DDD	0.15	ND	0.24
Heptachlor	0.0078	0.0620	ND

NOTE:

* = Elevated detection limit due to interference
ND = Not detected below instrument detection limit
S = Sediment/Surface Water location

TABLE 3-42

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS IN SEDIMENT SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-SED-U	05-SED-D
FIELD SAMPLE LOCATION:		S-2	S-1
ASSOCIATED METHOD BLANKS:		64	64
COMPOUND	CSC		
4,4-DDD	1,500	13,000*	6,000*
4,4-DDE	1,000	1,800	2,800*
4,4-DDT	1,000	2,500	1,900*
Dieldrin	NE	BDL	<3,100*

NOTE:

* = Designates samples analyzed at a dilution factor according to the following:

05-SED-U: Dilution factor of 200. Value for DDD represents a concentration below the detection limit at this dilution
05-SEd-D: Dilution factor of 100. Values for DDE and DDT represent concentrations below the detection limit at this dilution. Value for dieldrin is below the detection limit at this dilution.

NE = Not established
BDL = Detected, but below instrument quantitation limit
S = Sediment/Surface Water location

TABLE 3-43

VOLATILE ORGANIC ANALYSIS (VOLATILES AND SEMI-VOLATILES) FOR SEDIMENT SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		05-SED-U	05-SED-D
FIELD SAMPLE LOCATION:		S-2	S-1
ASSOCIATED METHOD BLANKS:		58, 61	58, 61
COMPOUND	CSC		
Methylene chloride	47,000	53	10
Acetone	1,700,000	BDL	ND
Butylbenzylphthlate	NE	BDL	BDL
Di-n-butylphthlate	NE	BDL	BDL
Bis(2-ethylhexyl)phthlate	14,000,000	BDL	BDL

NOTE:

ND = Not detected to the instrument detection limit
BDL = Detected, but below instrument quantitation limit
NE = Not established
S = Sediment/Surface Water Location

TABLE 3-44

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (INORGANICS)
FOR SEDIMENT SAMPLES
Site 5 - Boca Chica DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in mg/kg (ppm)

LABORATORY SAMPLE IDENTIFICATION:		05-SED-U	05-SED-D
FIELD SAMPLE LOCATION:		S-2	S-1
ASSOCIATED METHOD BLANKS:		66	66
COMPOUND	CSC		
Aluminum	NE	928	459
Barium	850	BDL	BDL
Cadmium	NE	1.8	1.9
Calcium	NE	317,000	325,000
Chromium	85*	5.6	5.3
Copper	NE	18.6	11
Iron	NE	1,230	1,140
Lead	NE	23.3	29.9
Magnesium	NE	3,100	1,970
Manganese	NE	10	7.3
Sodium	NE	7,310	7,580
Vanadium	NE	BDL	BDL
Zinc	NE	46.5 E	58.6

NOTE:

NE = Not established
BDL = Detected, but below instrument quantitation limit
E = The reported value is estimated due to an interference
* = CSC is for Chromium VI
S = Sediment/Surface Water location